North America's Wars

New analyses suggest that prehistoric North America, once considered peaceful, was instead a bitter battlefield where tribes fought over land and water

Most archaeologists have long viewed war as a disease of civilization. Only kingdoms and states with great armies, the theory goes, slaughtered opponents for economic ends and left battlefields littered with corpses. Tribal societies, such as those that flourished across prehistoric North America, were thought to have fought mainly for sport and to have halted hostilities after only a few deaths because they lacked resources for extensive battles. Political correctness, too, has favored the idea that native peoples lived in harmony. But new studies of prominent Southwestern cultures clash with this vision of a peaceful past.

Clever new ways to read the subtle marks of periodic warfare in such features as the arrangement of villages and the placement of wells, plus direct evidence of massacres (see sidebar), are persuading archaeologists that ancient North American societies made war as fiercely as any nation states. In order to acquire scarce resources, particularly when the climate turned harsh, combatants slaughtered women and children, razed settlements, and inflicted stunningly high casualty rates. The turnaround in thinking is most dramatic in the Southwest. There, cultures once idealized as peaceful, such as the Hohokam of southern Arizona and the Anasazi of the Colorado Plateau, now seem to have been shaped by warfare, researchers argued this week at a special symposium at the Society for American Archaeology (SAA) meetings in Seattle.

"There's been more and more evidence coming forward that the levels of violence in prehistoric times were quite high," says Jon Driver, an archaeologist at Simon Fraser University in Vancouver and SAA program chair. Such studies are changing many anthropologists' minds about war in tribal societies, he says. "Now that we're seeing different types of warfare around the world, I think people are opening up more to warfare" as an explanation for prehistoric events.

Not everyone, though. Skeptics such as Linda Cordell, director of the University of Colorado Museum in Boulder, argue that particularly in the Southwest, warfare advocates have yet to present convincing proof that ancient hostilities claimed many lives. "I'm looking for good syntheses and good reports with lots of bodies," she says. Much of the new evidence for war is open to less sensational interpretations, agrees Charles Adams, an archaeologist at the University of Arizona, Tucson. Warfare proponents, he notes, have "taken a body of information and mixed all sorts of stuff in there. It could be the result of warfare, but they haven't demonstrated it."

Even those arguing for tribal warfare, such as Hohokam expert Glen Rice, director of Cultural Resource Management at Arizona State University in Tempe, admit that their ideas are "still controversial." But for a growing number of scientists, the evidence can no longer be ignored. Says Rice, one of the new converts, "I've flopped recently from being very unconcerned about warfare to being very concerned that it is an important factor."

G. RICE/ASU

Defensive buildup. A massive wall, now highlighted by green growth, protects a Hohokam platform mound east of Phoenix.

From farmers to warriors

Although there are new signs of prehistoric warfare across North America, some of the newest and most controversial data come from the river valleys of Arizona. The Hohokam, who flourished there from A.D. 300 to 1450, have long been idealized as peaceful maize farmers who cooperated to build canals. But now Rice argues that not only did the Hohokam fight, conflicts over water actually defined their society.

The Hohokam cremated their dead, so Rice can't rely on broken bodies to make his claim. Rather, he makes a more inferential argument based on what seems to be the Hohokam social system. From architecture and other clues, Rice argues that Hohokam society was organized to require constant readiness for battle, in an arrangement also seen in highly warlike societies like Sudan's Nuer and Central America's Quiche Maya. This structure, known to social scientists as "segmentary organization with complementary opposition," is more simply described as "me against my brother, me and my brother against my father, and me and my brother and my father against my uncles," says Neal Ackerly, an archaeologist with Dos Rios Consultants in Silver City, New Mexico. He and other experts agree: If the Hohokam had this structure, then they must have been warriors.

Rice's ideas are based on his studies of major Hohokam irrigation canals east of Phoenix, some of which stretch as long as 15 kilometers along valley floors and sustained as many as seven separate Hohokam communities each. He and others wondered how water was parceled out among the communities during droughts, when canal water levels dropped.

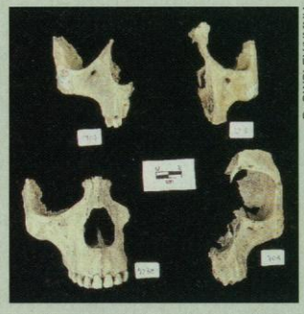
Some researchers theorized that a powerful centralized authority lived in the village nearest the canal head gate on the river and peacefully controlled water and economic life along the canal. But in Hohokam settlements east of Phoenix, Rice found no trace of centralized wealth and authority. Instead, in the architecture atop large earthen mounds at the center of Hohokam communities, he found public council rooms that were in paired and opposing arrangements. This, plus traces of distinct ceremonial regalia, indicated the presence of two or more opposing elites, he says. And some communities contained two or more of these mounds, each with their own sets of elites. That implies that there were modular segments of society that could be organized into bigger units—a hallmark of segmentary organization, explains Jeffrey Dean, a Southwest specialist at the University of Arizona, Tucson.

With no controlling central authority, reasoned Rice, canal-end communities could only obtain water by resorting to occasional force and constant threats against upstream communities. Yet they cooperated with those same communities during times of canal maintenance. "It doesn't have to be a con-

Crow Creek's Revenge

In A.D. 1325, prehistoric warriors stormed a palisaded village in South Dakota along the Missouri River, razed its earth lodges, and slaughtered many of its estimated 800 inhabitants. The 550 dead, mainly men and children, were later tossed into a mass grave. Nearly 95% of the intact skulls bore cut marks from scalping.

Now known as Crow Creek, the village and its grave were discovered in the 1970s; the unfortunate villagers have been identified as the ancestors of a historic tribe called the Arikara. But for years, with prehistoric America seen as a peaceful place (see main text), Crow Creek was generally thought to be an extreme and isolated case of violence. Now, new analyses suggest that this massacre was merely one act in a long-running life-and-death struggle between Crow Creek and the ancestors of two neighboring tribes: the historic Mandan and Hidatsa.



D. OWSLEY/NMNH

Battle scars. A broken skull at Tony Glas shows intent to kill.

In research still in progress, Douglas Owsley, a physical anthropologist at the National Museum of Natural History (NMNH) in Washington, D.C., has found clear traces of massacres at two 14th century villages within striking range of Crow Creek. In a village known today as Tony Glas, built by the ancestors of the Mandan and Hidatsa, he found the remains of at least 50 people in one earth lodge. Most died between the ages of 15 and 25, and most were women. There were fractures caused by blows to the head and mouth and breakage of skulls after death, including "cut marks and intentional fragmentation of bone, intentional mutilation," says Owsley.

A nearby village called Helb, also inhabited by ancestors of the Mandan and Hidatsa, shows signs of a similar disaster—burned houses, an unfinished palisade, and a scattering of human remains, says Marvin Kay, an archaeologist at the University of Arkansas, Fayetteville, who excavated the site. "Those [remains] have cut marks from being scalped," notes Owsley. "The evidence is consistent with a massacre."

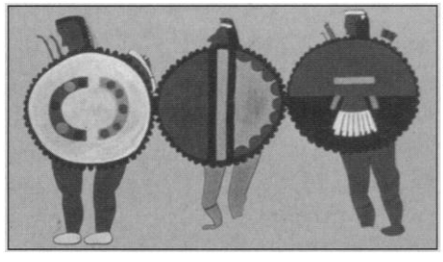
To both Owsley and Kay, the evidence points to a desperate struggle between the two groups of farmers. Kay thinks the climate cooling of the 14th century led to crop failures, sparking battles over the narrow zone of arable land in the Missouri River Trench, which was "on the fringe or northern limits for prehistoric agriculture," he says. Like many bitter wars before and since, it seems that the Crow Creek massacre and its companion slaughters were fought for land. –H.P.

stant state of war, just a constant preparedness to go to war," he explains. If so, each end settlement should be more populous—thereby ensuring greater military strength—than its neighbors upstream. In this way a fragile balance of power could be struck.

Using the size and number of platform mounds as indicators of community size, Rice tested this theory on data from five canal systems, gathered by his own group and others. Just as predicted, the biggest settlement on each canal was the one farthest from the head gate. Moreover, in four of the canal systems, the end community was as large as all the others combined, giving it clear military superiority. And one canal-end community yielded many potsherds in a foreign style characteristic of the Lower Colorado Plateau. This suggested that people from as far as 260 kilometers away had joined the canal-end community, reinforcing its fighting forces, says Rice.

Elsewhere, in the Hohokam hinterlands away from the largest canal systems, the evidence also suggests a volatile social system capable of exploding into hostility at the first sign of threat. At the SAA meetings, David Wilcox, an archaeologist at the Museum of Northern Arizona in Flagstaff, and Jerry Robertson, a former U.S. infantry rifle company commander, reported that Hohokam sites on a high mesa north of Phoenix have previously unnoticed defensive features such as lookouts. And Theodore Oliver, one of Rice's graduate students, found that sites in the Tonto Basin area east of Phoenix show signs of intentional destruction and catastrophic abandonment in the late 1300s. In one site, archaeologists sampled 32 of 80 rooms and found that 84% of them had been set ablaze—probably not accidentally, for adobe and cobble walls are difficult to burn. And 63% of the excavated rooms still contained a complete inventory of household objects.

Oliver also sees a trend in Hohokam village size that he interprets as an effect of endemic warfare. About A.D. 1250, Hohokam farmers in the Tonto Basin area lived scattered in 98 settlements, averaging less than 10 rooms each. But soon after, they started clustering into larger enclaves. By the 1400s, just 13 Hohokam settlements remained, averaging 43 rooms each. It seems that the Hohokam gathered into larger and more defensible settlements as the threat of war increased. "Eventually what happens," says Rice, "is that the system seems to destroy itself through warfare."



HIBBEN, 1975

Kiva warriors. Anasazi artists painted warriors with shields on kiva walls.

But the evidence of burnt houses does not persuade critics such as Adams. Razed homes need not mean fighting, he says: Historic groups in the Southwest often burned dwellings when a resident died of natural causes. So far, Dean adds, Rice's evidence falls short of traditional anthropological definitions of warfare. "I don't really think that there were armies wandering around out there, nor is there any evidence for what you'd call conquest." Yet he and others agree that Rice's work is the first to make sense of the sometimes conflicting evidence seen in Hohokam sites. It's "a brilliant stroke ... a major breakthrough," says Dean. It's "the type of work that needs to be done" to eventually settle the question of war, says Adams.

War among the pueblos

The case for war doesn't stand or fall on the Hohokam, however. Clearer signs of battle come from the Anasazi of the Four Corners region. These prehistoric pueblo people were envisioned as peaceful farmers for years, but recently controversial evidence pointing to conflict has turned up, including human bones that bear traces of apparent cannibalism (*Science*, 1 August 1997, p. 635).

In fact, warfare was not only an integral part of life in the Four Corners for centuries, but it decimated Anasazi and Mogollon corn farmers during the late 13th and early 14th centuries, argues archaeologist Stephen LeBlanc, of the University of Southern California in Los Angeles, in a major study to be published this fall. In stark contrast to popular perceptions of modern Pueblo peoples, he con-

cludes that of the 27 pueblo groups that flourished along the Colorado Plateau at the beginning of this period, just three—the Zuni, the Hopi, and the Acoma—survived intense warfare among themselves. "The pueblo people you see today are basically the victors."

Some of LeBlanc's most compelling evidence is osteological—the remains of massacres found at five major Anasazi sites. In the early 1990s, for example, Bruce Bradley and other archaeologists at Crow Canyon Archaeological Center in Cortez, Colorado, found human skeletons, primarily men and children, abandoned with no funerary ceremony at two southern Colorado pueblos dating to between A.D. 1250 and 1285. Many bore smashed skulls and other signs of violence. When LeBlanc extrapolated the numbers of dead from the sampled locations to the sites as a whole, he concluded that 50% of the 500 inhabitants of Sand Castle Pueblo and 62% of 80 inhabitants of Castle Rock Pueblo were slaughtered in vicious massacres.

At the same time, the design and location of Anasazi and Mogollon dwellings changed dramatically. In the early 1200s, Anasazi farmers lived in small, single-story room blocks arranged in an L or straight line and situated as much as 0.4 kilometers from the community well. But by about 1300, at every Anasazi site, they had moved into large, two-story pueblos built around central plazas. They also constructed wells on the plaza or within 4 meters of the outer walls. The higher roofs made better fighting platforms for residents warding off an attack, says LeBlanc. "And my suspicion is that this massive desire to have the drinking water very, very close to the pueblo is a way of protecting the women," who would otherwise risk attack while getting daily water.

The murals found in some pueblos of this time also reflect a preoccupation with warfare. Along the walls of a kiva at Pottery Mound near Albuquerque, New Mexico, for example, researchers have found paintings of what appear to be warriors armed with shields to deflect enemy arrows (see illustration on p. 2039).

No one knows just what ignited such an intense war on the Colorado Plateau, but LeBlanc notes that the 500-year-long global cold spell popularly known as the Little Ice Age began about 1300 and may have caused crop failures, famine, and hostilities. High-altitude pollen studies, he notes, revealed that tree lines in southern Colorado dropped in the 1300s as the climate turned colder and wetter. Whatever the cause, however, he argues that the evidence is overwhelming that warfare was an integral part of Anasazi life, shaping the very structure of their settlements. "The idea that you can understand Southwestern prehistory and pretend there was no warfare is just silly," he concludes.

But the Anasazi work too has its critics. "I can construct a model, based on ethnographic evidence, that takes into account virtually all of the warfare data and explains them in terms of ritual behavior," says Adams. Prehistoric pueblo peoples in the Four Corners region, for example, once killed, then burned and mutilated the bodies of people they suspected to be witches. And the Anasazi may have built pueblos on seemingly defensive hilltops simply because they, like many modern tribal groups, viewed high places as sacred. Even depictions of violent acts don't necessarily mean that war was common: Artists often portray mythical battles fought by deities or shamans. "I just don't think we can explain a lot of the archaeological record in terms of conflict," says Adams.

Warfare researchers counter that their opponents are demanding unreasonable standards of proof. "If your only evidence of warfare is going to be bodies all over the place," says Oliver, "then you're not going to be able to find it. Even in modern warfare, only a small percentage of the people involved in a conflict die." These researchers think it's high time that anthropologists accept that life in the ancient Southwest could be very nasty, brutish, and short. "War is something like trade or exchange," says Lawrence Keeley, head of the Department of Anthropology at the University of Illinois, Chicago. "It is something that all humans do."

–Heather Pringle

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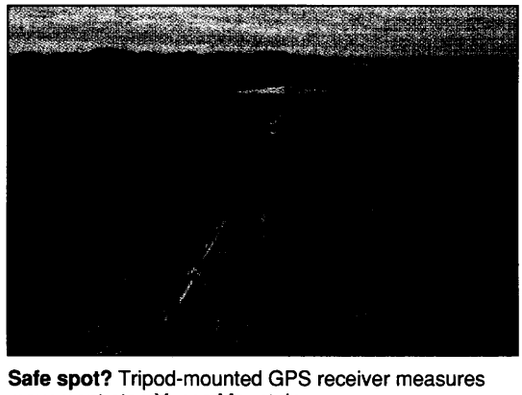
RADIOACTIVE WASTE DISPOSAL

A Hint of Unrest at Yucca Mountain

Geologists studying southern Nevada's Yucca Mountain have always looked to the past to see what the future might hold for the mountain, which is the leading candidate to become the long-term U.S. repository for highly radioactive wastes from nuclear power plants. Because the mountain has been so quiet for millennia, researchers concluded that the risks of earthquakes and volcanoes striking it are low. But on page 2096 of this issue of *Science*, a team of geologists and geophysicists reports that the crust at Yucca Mountain is stretching at least 10 times faster today than it has on average over geologic time.

If so, the area could be suffering a bout of rapid crustal deformation that would boost the chances of a disaster such as a volcanic eruption during the 10,000-year life of the repository. In fact, the authors, led by Brian Wernicke of the California Institute of Technology in Pasadena and James Davis of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Massachusetts, suggest that geologists have underestimated the hazards at Yucca Mountain by a factor of 10.

For now, other researchers are intrigued but not yet alarmed by the new findings, which stem from a satellite-based Global Positioning System (GPS) survey. "It's an interesting and provocative idea," says geologist Bruce Crowe, of Los Alamos National Laboratory in New Mexico, who has long worked on volcanic risks at Yucca Mountain. "It has to be looked at carefully."



B. WERNICKE

Safe spot? Tripod-mounted GPS receiver measures movement atop Yucca Mountain.

But he and others caution that Wernicke's group has actually measured only a few millimeters of stretching in 6 years, which is near the limit of what GPS can reliably detect. "This is testing GPS," says geophysicist Robert Smith of the University of Utah. "I don't think the answer is in."

Geologists agree that the best way to get that answer is to continue the GPS survey, which Wernicke and his colleagues have been conducting since 1991. As they report in *Science*, the team measured the positions of five benchmarks set along a 34-kilometer line stretching roughly east-west across Yucca Mountain. By comparing radio signals from several GPS satellites overhead, the researchers could determine the position of a benchmark with millimeter accuracy.

Wernicke's team checked the benchmark positions seven times between 1991 and 1997. They found that their survey line was lengthening at a rate of 1.7 ± 0.3 millimeters per year, giving a total stretching of about a centimeter over the 6 years of the study. Although that's only one-quarter the rate of crustal deformation seen in active areas like the San Andreas fault, it's about 10 times faster than geologists