

Fossils on File

Computerized preservation may give reburied bones back to science

By BRUCE BOWER

A human skull sits on a turntable, its eye sockets staring ahead impassively. Suddenly, the circular platform rotates slightly and stops, guided by a computer system set up on an adjacent desk. A laser beam strikes a point on the skull's temple, then jumps horizontally to a spot 1 millimeter away. The turntable shifts again and the thin shaft of laser light continues its millimeter-by-millimeter journey around the skull. Upon completing this circuit, the laser beam drops 1 millimeter and sets out over new terrain. No bony crevice or bump escapes its inquisitive ray.

Three hours and innumerable rotations of the turntable later, the laser has transferred exhaustive information on the skull's three-dimensional properties into the computer system. A highly accurate computerized tomography (CT) scanner fleshes out the specimen's interior features. Scientists then examine images of the skull and its various parts on the computer screen, print out detailed illustrations, and store precise measurements of the disembodied specimen for a comparative study of related finds.

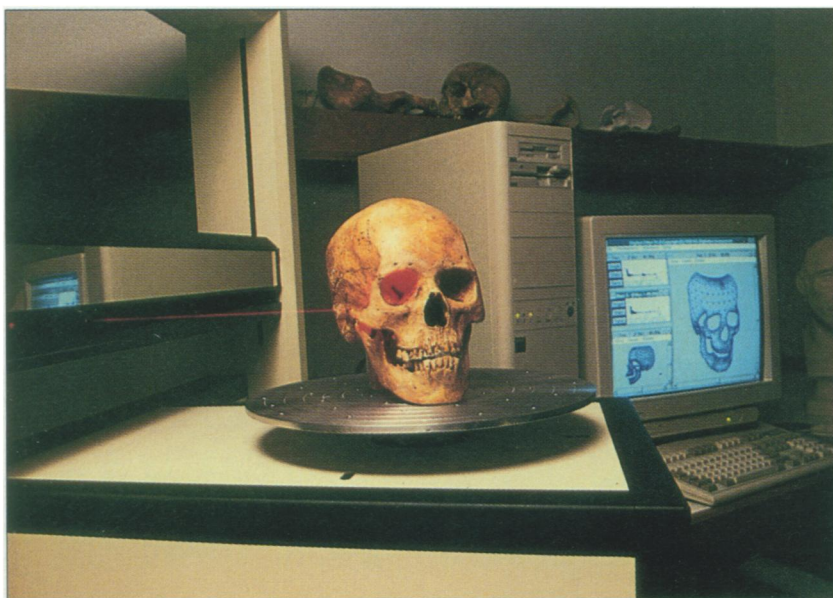
Another computer-controlled laser then takes the anatomical data, capable of being stored on either a floppy disk or CD-ROM, and sculpts a precise nylon replica of the skull.

This unusual union of anthropology and advanced technology — presided over by three researchers at the University of Texas at Austin — may either invigorate the study of bones and cultural artifacts or prove too expensive to make a major impact. But its emergence within the past year suggests that scientific innovation sometimes feeds off anxiety, in this case sparked by new laws that allow Native American tribes to reclaim their ancestors' remains from museum collections.

"Our scanning and replication project may represent a compromise for what has become an almost intractable political problem," asserts John Kappelman, a Texas anthropologist who directs the project. "In many cases, we can noninvasively store data on bones and artifacts in the computer for generations to come and still honor the wishes and rights of Native American tribes."

technology companies to participate in a project aimed at scanning and replicating a University of Texas collection of nearly 60 pieces of human bone, numerous pottery fragments, and assorted artifacts slated for eventual return to a Native American tribe.

Tribal leaders granted the scientists permission to study the 8,000-year-old remains.



Kappelman's team hit on the idea after experimenting with the technology in an analysis of several fossil knee joints that belonged to members of the earliest known species in the human evolutionary family, which lived in Africa more than 3 million years ago.

Austin firms dealing in cutting-edge computer applications gave the Native American project critical support. Digi-botics allowed free access to its three-dimensional laser scanner, a technology already employed in the design, inspection, and animation of a variety of industrial products; Scientific Measurement Systems furnished its high-resolution CT scanner; and DTM Corp. made available its "Sinterstation 2000 System," which directs a laser to produce nylon and polycarbonate replicas of objects based on data in computer files.

Automotive and manufacturing companies create prototypes of new products with DTM's system, which has also aided in the development of custom prosthetic devices and artificial knee joints.

For now, Kappelman and his coworkers travel a few miles to each firm in order to use the various pieces of equipment. The Texas researchers have a grant to buy a laser scanner, which costs around \$100,000. A CT scanner and a Sinterstation 2000 will cost at least an additional \$600,000.

The researchers hope eventually to assemble enough equipment to start a regional center where anthropologists can bring bones and artifacts for analysis.

The dilemma cited by Kappelman stems from a 1990 federal law, the Native American Graves Protection and Repatriation Act (NAGPRA). It requires federal agencies and museums that receive federal funds to inventory skeletal and cultural remains and return them to Native American groups that demonstrate a claim to the material. A number of tribes, both before and after passage of the legislation, have secured the return of museum-held bones belonging to their ancestors and cultural objects deemed sacred by their religious leaders. The skeletal material has invariably been reburied.

Many anthropologists and archaeologists rely on museum collections for research and regard the 1990 law as a potentially catastrophic blow to science, even if they accept it on moral grounds.

Enter Kappelman and his Texas coworkers, archaeologists Samuel Wilson and Thomas R. Hester. In March 1993, Kappelman convinced three Austin high-

"Approaches such as this allow for the archiving of information from museum collections, many of which are in the process of being returned for reburial," says Charles Hildebolt, an anthropologist at Washington University in St. Louis who participates in CT studies of fossils. "The only problem is the expense of the equipment."

Nevertheless, Kappelman views scanning and replication technology as a potential boon to the teaching of anthropology. He hopes students 20 years from now can study long-since-reburied skeletons on computer screens and compare sets of bones from different museums.

In the future, bones and artifacts on loan to the University of Texas may also receive laser and CT analysis so that detailed investigations can continue after the material has been returned, Hester adds.

Even if the scanning and copying of museum collections flourish, museum and tribal officials will still face tough decisions in carrying out the letter and spirit of federal repatriation laws.

A phase of negotiations recently completed between the Smithsonian Institution in Washington, D.C., and the Zuni of western New Mexico highlights the importance of patiently establishing common goals without resorting to threats or angry exchanges, according to researchers who took part in the 9-year process.

The result: In 1987, the Smithsonian returned two sculpted wooden war gods to the Zuni. The museum's chief negotiator, ethnologist William L. Merrill, concluded after extensive research that the entire Zuni community owned these artifacts, which had been taken from shrines about 100 years earlier without the authorization of the pueblo as a whole.

Edmund J. Ladd, an anthropologist at the Museum of New Mexico in Santa Fe and a Zuni himself, helped Zuni leaders formulate requests and official statements submitted to the Smithsonian. Both sides consulted with T.J. Ferguson, an archaeologist at the Institute of the North American West in Tucson, to determine the ways in which the Zuni lost possession of various war-god artifacts.

Merrill, Ladd, and Ferguson describe in the December 1993 *CURRENT ANTHROPOLOGY* the considerable effort that led to repatriation of the artifacts. These negotiations preceded the NAGPRA legislation and a similar 1989 federal repatriation law that applies only to the Smithsonian.

The entire episode demonstrates that successful repatriation "is complex, lengthy, and expensive," holds Charlotte J. Frisbie, an anthropologist at Southern Illinois University at Edwardsville. However, she notes, Congress has yet to approve funds for conducting inventories

of museum collections and other phases of repatriation required under the law.

Some NAGPRA terminology proves ambiguous, such as the injunction to return "sacred objects" and "communally owned cultural patrimony," Frisbie asserts. The law's ultimate meaning may have to be decided in court cases after particular museums and tribes fail to work out agreements, in her view.

In fact, despite their achievements, conflict still exists between the Smithsonian and the Zuni. The tribe argues that all objects made on the basis of Zuni knowledge, such as cardboard copies of Zuni ceremonial masks, belong to the Zuni people; Smithsonian officials disagree. A new round of negotiations will address this fundamental difference in perspective.

Some Native American tribes cherish confrontation as a tactic to achieve consensus, notes Larry J. Zimmerman, an archaeologist at the University of South Dakota in Vermillion. The Lakota, for example, typically forge compromises on important decisions from the impassioned position statements of various concerned individuals, Zimmerman says.

Rhetorical clashes of this type might produce fairly rapid repatriation agreements with some tribes, although academics and administrators generally avoid open confrontation, he argues.

Similar repatriation concerns now extend far beyond the United States. Australian Aborigines, for example, gained the return of an extensive collection of their ancestors' bones held in that country — some of which date to 15,000 years ago — in 1989. They promptly

reburied the remains.

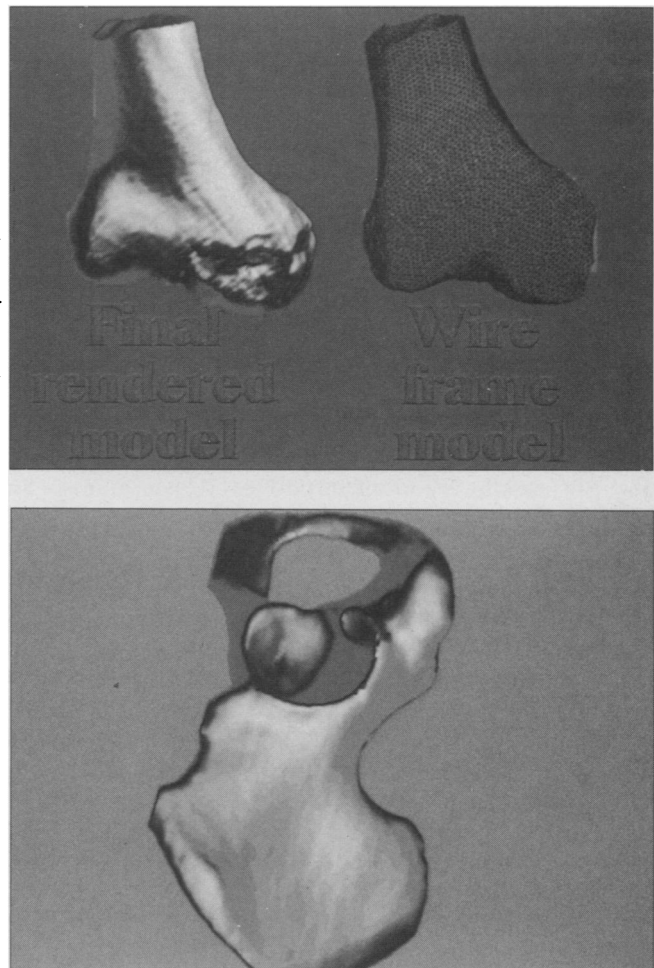
The Aborigines succeeded thanks in large part to a 1987 law passed by the Australian legislature deeming them "rightful owners of their heritage [who] should be given responsibility for its future control and management."

British museums have received an increasing number of requests from Australian Aborigines for the return of their ancestors' bones. "Some museums have cooperated, others have not," says Schuyler Jones, curator of the Pitt Rivers Museum in Oxford, England.

No repatriation laws exist in England. Museums there lie far from the groups whose bones and artifacts they hold, further encouraging an unwillingness to entertain repatriation requests, Jones maintains.

It remains unclear whether recalcitrant museums will loosen their hold on tribal remains if given access to the type of computer archiving system envisioned by John Kappelman and his Texas colleagues. Neither law nor technology can seamlessly interweave the Western scientific tradition with the cultural traditions of non-Western peoples, maintain Merrill, Ladd, and Ferguson in their article.

Still, they add, "By continuing to work together, Indian tribes and anthropologists can forge a new, more collaborative anthropology that will benefit both." □



Top, digitized images show initial and final stages in laser production of a model of an ancient hominid thigh bone at the knee. Below, digitized image shows one-half of a modern human hip bone.

Photos: Kappelman/Alexander Durcan