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Old Blocks,
New
Pyramids
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PLEASE RECYCLE



BY STEVE MURRAY

'INDIANA JONES' IS GOING DIGITAL.

* **JOSEPH GREENE** and **ADAM AJA** are staff members at the Harvard University Semitic Museum. They want to rebuild a **RARE CERAMIC LION** from the Mesopotamian city of Nuzi. The statue was broken when Assyrians attacked Nuzi 3,000 years ago, however, and pieces are missing. How can they make sure that their reconstruction will be accurate?

* **JILL WEBER** is a zooarchaeologist with the University of Pennsylvania. She wants to study 5,000-year-old **BONES OF A RARE ANIMAL**—a donkey-ass hybrid—from the Syrian city of Umm el-Marra. Syrian law, however, prevents her from taking the bones out of the country. How can she study these specimens in her home laboratory?

* **KEN LACOVARA** is a paleontologist at Drexel University who studies how dinosaurs walked and needs to build a **DINOSAUR ROBOT** to help with his research. Some dinosaurs weighed about 75 tons—15 times heavier than a modern elephant. A robot like that would be far too heavy to build. What can he do to continue his experiments?



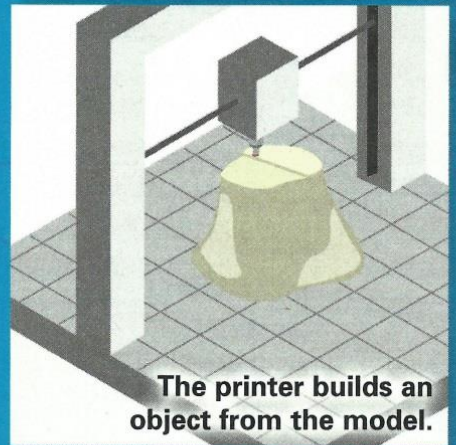
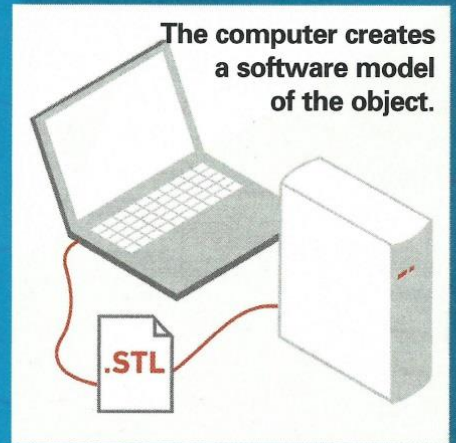
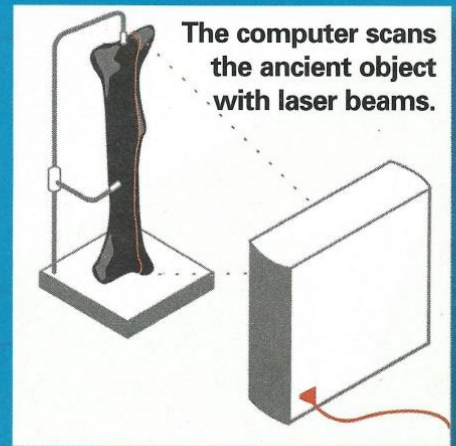
Scanning and modeling a dinosaur bone

DIGITAL

The problems facing the researchers at left are just some of the many problems scientists face when studying the past. Now, a new generation of explorers is solving some of these problems with technology. They are using computer scanning and 3D printing to preserve and examine rare artifacts and fossils. Along the way, they are developing new approaches to how archaeology and paleontology are done.

How It Works

First, scientists build computer models and physical models of the objects they want to study. Computer models are software programs that contain detailed information



DIGGERS

about the size and shape of an object. Scientists make a computer model of an ancient object by scanning it with laser beams that measure the exact location of every point on its surface. Scanning like this is safer than making plaster molds because the object does not have to be handled or moved as much.

Scientists can fix any problem with these models by viewing them on a computer display. If an object has been crushed, for example, or if pieces are missing, scientists can make changes in the software program so that it is accurate and complete.

Physical models are real, of course, but they require computer models to guide the construction process. In many cases, a computer model is useful enough for scientific study, and a physical model is not needed at all. If a real model is needed, however, the computer program is sent to a 3D printer for construction.

Most 3D printers work very much like the inkjet printers found in homes and offices. A computer program guides the inkjet cartridge to locations on a sheet of paper where the nozzle leaves a drop of ink.

3D printer cartridges contain plastics or other

material in place of ink. The material is softened by heating. The computer program then guides the cartridge to a location on a flat platform where it leaves some of the material, which quickly cools and hardens. A key difference is that 3D printers go over the surface again and again, leaving extra layers of material each time. This builds the material higher and higher, until a solid shape is left.

AND THE IMPORTANCE IS...

Digital scanning and printing help many scientists to create and share the objects that they study. Greene and Aja repaired the Nuzi lion by scanning the existing pieces and checking for missing parts on a computer display. They then used the computer program to build the missing pieces and complete their artifact.

Weber made computer scans of her bone specimens before leaving Syria and then printed models once she was back home in her lab. Now, her copies will always be available for study by scientists, even if the original bones are ever lost or damaged.

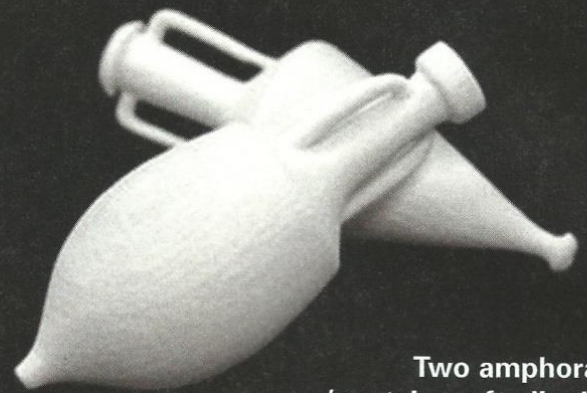
Lacovara scanned his dinosaur bones but then made computer models that were smaller in size with 3D printing. His dinosaur models will still be accurate in every important way for his robot research. They will, however, be much easier to handle.

THE FUTURE OF STUDYING THE PAST

Most ancient artifacts belong to the countries where they are found and only are loaned to scientists for research. It is difficult to keep these objects long enough to study them completely, and many scientists compete for access to rare specimens. Digital scanning and 3D printing can make accurate models in large numbers and send them almost anywhere in the world, so scientists can work together on the same materials. Sharing computer models is as easy as sending an e-mail file.

These technologies are changing the way we study the past, and young scientists are learning how to use these new capabilities. Lacovara sees a coming transformation. "For my students," he says, "this is going to be second nature in their careers...of

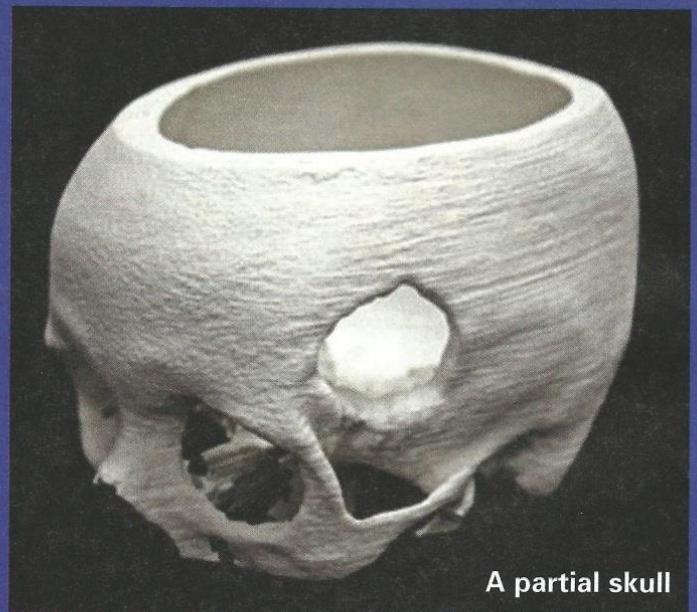
3D PRINTING AT WORK



Two amphorae
(containers for liquid)



Two ship anchors



A partial skull

course they're going to laser scan everything... of course they're going to use 3D printing."

For the past, the future is digital.

Steve Murray is a freelance science and technology writer, and former research engineer.