

Penn Museum uses the latest in science to conserve the most ancient of artifacts

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The graceful ceramic pedestal was coated with a thin layer of dirt, some of it perhaps lodged in the artifact's clay pores for thousands of years.

Wielding a soft brush, Marci Burton applied a blob of clear gel to the object's surface, then removed it moments later, taking a bit of grime with it. Bit by bit, the pedestal's grayish hue gave way to a milky beige.

Burton is part of a massive conservation effort at the University of Pennsylvania Museum of Archaeology and Anthropology, which is preparing a new exhibit of nearly 1,200 finds from ancient sites in the Middle East that opens April 21.

To prepare these works of art and history for display, the conservators apply the tools of science. A laser was used to lift centuries of grit from limestone carvings. A 3-D printer produced a new head for the statue of a bull. A technique called X-ray fluorescence revealed the type of metal alloys used to make certain relics, guiding the choice of treatment.

And for delicate cleaning, the preferred option is gel. The viscous substance that Burton dabbed on the pedestal did not look like much, but it represented some sophisticated chemistry.

Depending on the composition of dirt to be removed, Penn Museum's conservators use one of six gel formulations that gently clean without harming the surface beneath—chemically binding, dissolving, or simply lifting off unwanted residue. The staff was trained last fall by the man

who pioneered the concept: Richard C. Wolbers, an associate professor of art conservation at the University of Delaware.

"It's a meditatively slow process," Burton said, working the gel in a circular motion on the surface of the 4,400-year-old relic. The pedestal, unearthed in 1927 on a joint expedition by the Penn Museum and the British Museum, is thought to have been a stand for holding a ceremonial vessel of some sort.

Wolbers started using gels in the 1980s to treat paintings, and they also have been used to clean historic papers. Their use on ancient ceramics is a relatively recent development. The last time someone treated the pedestal that Burton was working on, in 2012, dust was removed with a soft brush, a vacuum, and swabs moistened with de-ionized water.

That procedure was only partly effective, said Lynn A. Grant, Penn Museum's head conservator. And the goal is to avoid using water where possible, lest it carry dirt into the object's pores.

The gels contain water, too, but it is mixed with food-grade xanthan gum—a substance used in some ice creams, salad dressings, and sauces. The resulting jellylike texture allows the conservator to control how much of the cleaning agent touches an object's surface, with no unnecessary wetting, spreading, and dripping, Wolbers said.

In addition to water, the gels contain small amounts of acids, enzymes, or other chemical agents suited for each task. With each object to be cleaned, Penn conservators start by applying a small dab from each of six standard gel recipes that Wolbers has perfected over the years.

For Burton's pedestal, the gel that seemed to work best contained a chelator—a substance that binds with metals. That suggests there were metal ions on the object's surface, forming some sort of chemical bond

with the soil that Burton wanted to remove. So she proceeded to use that gel to clean the rest of the pedestal, a process that took a couple of days.

Another tool used to prep objects for the exhibit is a hand-held laser. The museum's staff got a hands-on lesson in that technique, too—this time from Adam Jenkins, a Philadelphia-based conservator who once used lasers to clean the decorative terracotta cornices on the Philadelphia Museum of Art.

At the Penn Museum, conservator Madeleine Neiman used a laser to lift layers of gray grime from the surface of three limestone birds, excavated in the early 1920s at Al-Ubaid, in what is now Iraq. The brief bursts of infrared energy were enough to heat the dirt—expanding it so rapidly that it lifted off the surface—but not enough to heat the stone beneath, Jenkins said.

Neiman's treatment transformed one bird from dismal gray to an ivory white in a matter of seconds.

In a video of the cleaning (at vimeo.com/234378683), the crackling sound may seem a bit alarming, but Jenkins said the stone birds were unharmed. When the laser's energy hit the dirt on the birds, it generated what he called a "plasma plume—a flash of light coupled with a brief, audible shock wave.

Some of the items to be shown in the Penn Museum's Middle East Galleries have been part of past displays, but the new exhibit is unprecedented in its scope, representing the fruits of expeditions going back more than a century. Visitors will see such diverse finds as the jewelry of a Sumerian queen from 4,500 years ago and clay tablets with cuneiform writing, including one that records an ancient prediction of a solar eclipse.

When cleaning objects, the conservators take pains to remove dirt only from the surface, aiming primarily to remove the dust that has accumulated during decades of museum storage. With vessels, they avoid cleaning the insides, in case there is organic residue that may someday yield clues to what the object was used for—such as cooking, processing wool, or perhaps a religious ceremony. Depending on the condition of any residues, identifying them may lie beyond the laboratory methods of today, but conservators preserve them just in case.

"You never know what technique is going to come up two decades from now," said Grant, the head conservator.

Burton, a graduate student at the UCLA/Getty [art conservation](#) program who is doing a nine-month stint at the Penn Museum, found time to admire the pedestal as she worked on it.

The artifact is decorated with three bulls around its neck, and also features geometric designs. In several spots, the unidentified artisan from long ago went too far when making diagonal incisions, leaving little notches in the base of the object.

"We see these little clues," Burton said. "I love that. It's like connecting to a person or a culture that lived thousands of years ago."

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