

PHYSICAL

Most of the ancient Greek and Roman statues shown in museums and textbooks are white—the color of the marble they were carved from. But the ancient Greeks and Romans wanted their statues to look alive. So they painted them in ways you might find surprising.

Nature has since washed and worn away most of the vibrant, original colors. Vinzenz Brinkmann, a German archaeologist, has made it his life work to bring back the colors. He creates full-scale replicas of ancient statues, then has them painted with the same ground-up minerals and organic matter used by the ancients. (For black, the ancients used charred bone.) His reconstructions have been exhibited around the world.

Some of the scientific equipment that Brinkmann uses was originally



Painting one of Brinkmann's replicas of an ancient statue

Vinzenz Brinkmann and Ulrike Koch-Brinkmann

designed to inspect aircraft for fatal hairline cracks or test models of new Formula 1 race cars for wind resistance. But the instrument he started with and always comes back to is the naked eye.

NEWFOUND CURIOSITY

In the 1400s, the Italians developed a new curiosity about their Roman past. The period historians call the *Renaissance* began. A century later, when the Italians began digging up ancient statues buried in the rubble of time, they found bare marble and tiny traces of paint. One of the most important early finds was a statue showing the high priest Laocoön

and his sons being devoured by a sea serpent.

"Five centuries after the *Laocoön* was rediscovered, we can still see some color in his eyes," says Brinkmann. "But for people in the Renaissance, the pure form of the white marble was a symbol of a new, modern way of thinking. The color was there for them to see. They chose not to."

When Brinkmann started working on ancient statues, he examined them with *extreme raking light*—narrow beams of visible light directed over the surface at a very low angle. The process reveals chiseled outlines of details and patterns that were once filled in with color.

Different techniques reveal different features of the statues. Now Brinkmann also views statues under *ultraviolet (UV) light*. UV is a form of electromagnetic radiation that is invisible to the eyes. For reasons that are not entirely understood, faded color patterns that are

no longer visible in normal light do show up under UV light.

To determine what *pigments* (coloring agents) were used to paint a statue, it used to be necessary to scrape tiny samples from the colored surface and subject them to analysis. But to sample paint one must sacrifice bits of precious traces—the very things one wants to preserve. Happily, that's no longer necessary.

"For the last three years, we've been working a lot with *UV-Vis absorbance spectroscopy* machines," Brinkmann says. "Here, we are working with light that combines both visible and UV frequencies. Basically, you shine a beam on the pigment you want to identify. Then you catch the beam that is reflected back. Every material absorbs different light frequencies. The computer analyzes the reflected beam to determine what frequencies have been absorbed. From these calculations, we obtain a profile as unique as a human fingerprint."

With that technique, Brinkmann can collect data on hundreds of points on the surface of a statue in just a few days. "That would have been unthinkable in the days of sampling," he says. "Back then, it took hours or days to analyze a single sample, and you could never have gotten permission to take samples by the hundreds. They would have chopped your head off!"

VIRTUAL COPIES

In the past, the only way to copy a statue was to pack the original in plaster to create a *cast* (mold)—another process that endangers the



Brinkmann made a synthetic replica (bottom) of a battle scene carved on the marble *Alexander Sarcophagus* (top), then painted the replica in its original colors.

From top: Erich Lessing/Art Resource, NY; Vinzenz Brinkmann/Stiftung Archäologie, München; Shutterstock

object. Now, with the help of *three-dimensional scanners*, it's possible to create accurate reproductions without touching or otherwise harming the original. Three-dimensional scanners are the machines that can find the hairline cracks in an airplane. A 3-D scanner examines an object and produces a digital model of it in a computer. Because the machine scans from more than one angle, it can capture the exact shape of a solid object.

From the computer data, a replica is built, one ultrathin layer at a time. That process, called *stereolithography*, is the one used to test models of Formula 1 race cars. At no point does the archaeologist need to touch or damage the statue in any way. "Noninvasive, nondestructive,

nonimpact—those are the buzz-words," Brinkmann says. "The new technology has expanded the scope of our work exponentially."

Two of Brinkmann's most recent pieces are color reconstructions of the so-called *Alexander Sarcophagus* in Istanbul, Turkey, and the *Persian Rider* from the Acropolis in Athens, Greece. Often, the color traces on ancient statues have been corroded by time, oxidized, or damaged by bacteria or fungi. But those two works of art are especially rich in color traces that are preserved perfectly.

"We know what color the horse is in the *Persian Rider*, for instance, but we're not sure how it was applied," says Brinkmann. "The virtual image in the computer allows us to experiment. Where we're not sure what to do, we leave the reproduction white. But the statues were never white." **CS**

By Matthew Gurewitsch

Color
statues in their original hues.



Vinzenz Brinkmann's painted replica of an ancient Greek statue of an archer, set up by the Parthenon in Athens

Dieter Rehm/2005-2006 Vinzenz Brinkmann and Ulrike Koch-Brinkmann, Hermann Pflug

IN LIVING

A German archaeologist reproduces ancient