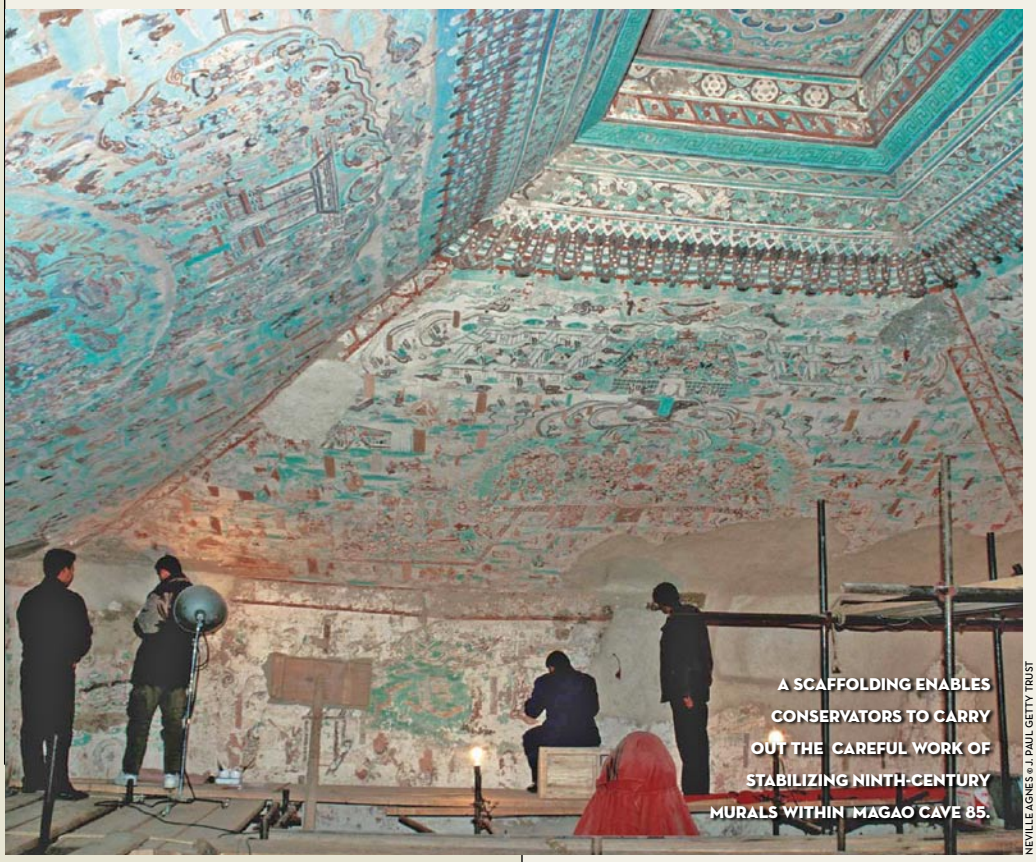
Mural Masters

by Eve M. Kahn



A SCAFFOLDING ENABLES CONSERVATORS TO CARRY OUT THE CAREFUL WORK OF STABILIZING NINTH-CENTURY MURALS WITHIN MAGAO CAVE 85.

NEVILLE AGNES © J. PAUL GETTY TRUST

Fresco and mural conservation specialists are a brave, frighteningly knowledgeable, and slightly geeky elite, traveling the world studying painted walls and trying to keep maximum amounts of original pigment adhering. Over the past decade, the arsenal of high-tech tools and chemicals for analysis and repair has expanded greatly. But this roving band and the institutions they work for must still rely on venerable scientific methods: they hypothesize, get second and third opinions, and test in labs again and again before selecting treatment protocols. And the experts must sometimes concoct gentle restoration potions with ingredients as primeval as egg whites. Here are three pioneers who are working to advance the state of the art, whether in Chinese mud-walled caves, Italian cathedrals' groin vaults, or Brooklyn laboratories.

NEVILLE AGNEW

Principal project specialist, Getty Conservation Institute, Los Angeles, California. ***Mural territory: Buddhist cave temples cut into rock cliffs at Mogao, in northwest China***

For two decades Neville Agnew has visited China at least annually, orchestrating conservation of cave murals up to 1,600 years old. Buddhist monks and their wealthy patrons commissioned the paintings from master craftsmen; the dried-mud walls in some 490 grottoes depict scenes from the Buddhist canon and Chinese daily life, and often portray the benefactors themselves. Agnew and his international colleagues have collaborated with scholars at Dunhuang Academy, which oversees the site as a research center and increasingly popular tourist attraction. The teams just finished a showpiece project, Cave 85, which was painted in the 860s with mineral pigments that retain their bold green and brick-red palette. Parts of the murals have separated from the rock, eroded, flaked, or fallen due to salt infiltration, sandstorms, floods, and earthquakes.

To stabilize what remains and simulate original plaster, the Getty cohort and fellow scientists tested 80 grout formulas. "We were looking for the optimal combination of fluidity, quick set time, light weight, durability, adhesion, and water resistance," Agnew explains. The winner? A mixture of Scotchlite K1 glass microspheres, pumice, and whipped egg whites. "We moved very slowly before we agreed on a treatment approach," Agnew adds. "We hear all the time, 'what's the newest material, where's the magic bullet?' But hastening to intervene can be a catastrophe, and sometimes doing nothing is best—although that wasn't the case at all, as it turned out, for Cave 85."

In collaboration with the Chinese government, he has helped draw up formal national guidelines called "Principles for the Conservation of Heritage Sites in China." The thick document, he says, "will have bite and impact and wide dissemination." The Getty is meanwhile studying how many tourists Mogao can handle: "It's a complicated matter, involving studies of microclimates and visitor routing and quality of experience," Agnew reports. The research will shape a management plan that could prove a role model for other Chinese sites.

The Getty is also involved in another temple project at Mogao, Cave 260, which will serve as a training ground for master's-degree candidates studying wall-painting conservation at Chinese universities and London's Courtauld Institute. "Cave 260 has different problems from Cave 85," Agnew says. "It's two or three hundred years older, and it burned at some point, so there's a great deal of soot to deal with. And we don't know yet if the pigments and binding media there are the same as the ones at Cave 85. There'll be generations of arduous work to be done at Mogao."

MARINE COTTE

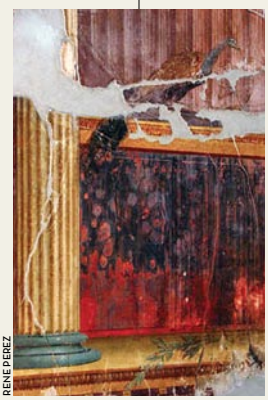
Post-doctoral researcher, European Synchrotron Radiation Facility, Grenoble, France. ***Mural territory: Pompeii and environs, Bamiyan caves in central Afghanistan***

Paint flecks with the circumference of a hair shaft are Marine Cotte's stock in trade. She works at the European Synchrotron Radiation Facility, a donut-shaped airport-size lab in Grenoble, which can shoot high-intensity x-ray beamlines at microscopic samples. The resulting data indicates not only all the piece's ingredients but also how those compounds are molecularly bonded. Physicians, physicists, chemists, biologists, and forensic scientists, among other professions, reserve time for studies at the ESRF. Cotte specializes in assisting archaeologists.

In 2005, she collaborated with an Italian team to train ESRF machines on fragments of frescoes from the Villa Sora, a ruined first-century home near Pompeii. Cinnabar red pigments there have blackened, and conservators long believed that sunlight was causing the sulfide to morph into a crystal called metacinnabar. But Cotte's discoveries defied that common wisdom. The ESRF, she explains, "found no metacinnabar at all. Instead there was chlorine. It was difficult to detect in the mixture of many compounds, but it was definitely there. We found it in the blackened degradation layer, which is about 10% as thick as a strand of hair." (For details of the results, see an article in the journal *Analytical Chemistry,* downloadable at http://pubs.acs.org/cgi-bin/sample.cgi/ancham/2006/78/i21/pdf/ac0612224.pdf.)

She's now examining cinnabar-dyed fresco flecks from various Roman archaeological sites and from museum collections of wall fragments. "I want to see if the proximity of the Mediterranean brought in the chlorine to the Villa Sora, or if chlorine is found in samples exposed to various atmospheric conditions," she notes. "I'm looking for general tendencies, to see if we need to adapt treatments to the presence of chlorine."

Scrapings of mural paint from the Bamiyan Buddhist temple caves in Afghanistan are also piled on her desk lately, for studies led by a Japanese team and partly funded by UNESCO. "We're trying to understand the painting techniques and some degradation problems there," she says. "We don't know yet which pigments were used, and how they were mixed." That is, x-rays from a state-of-the-art accelerator in France will help unravel the mysteries of domed grottoes full of seventh-century Buddha portraits, just spared from the Taliban.



RENÉ PEREZ

COURTESY ELEONORA DEL FEDERICO

RED PIGMENTS HAVE TURNED BLACK IN A DEGRADED WALL PAINTING, LEFT, IN THE VILLA DI POPPEA, OPLONTIS, ITALY. ELEONORA DEL FEDERICO AND ALEXEJ JERSCHOW AND THEIR STUDENTS, BELOW, USE A RECENTLY ACQUIRED NMR TO ANALYZE ULTRAMARINE PIGMENTS.

ELEONORA DEL FEDERICO

Associate professor of chemistry at Pratt Institute, Brooklyn, NY, and Andrew W. Mellon Conservation Fellow at the Metropolitan Museum of Art, New York, NY ***Mural territory: Anywhere in Europe with murals painted blue in the Middle Ages or Renaissance***

Eleonora Del Federico cooks up blue fresco pigments based on centuries-old recipes, laced with powdered lapis (for ultramarine tones), azurite, or copper. She paints some samples on plaster, sprinkles salt here and there, and then stores the swatches in sealed, humidified lab chambers. After a week or two, the ultramarine tends to fade to yellowish gray, and the azurite and copper turn green. With teams co-led by Alexej Jerschow, a chemistry professor at New York University, Del Federico and Pratt fine arts professor Licio Isolani are figuring out why the paints fail and how to arrest or undo the damage.

In the conservation trade, the lapis decay is called "ultramarine sickness." With nuclear magnetic resonance (NMR) analysis, Del Federico explains, "we discovered that in ultramarine, there are cages of aluminum and silicon atoms that hold sulfur molecules. Humidity and the alkalinity in plaster combine to break down those cages, and the sulfur molecules aren't stable once they're loose." Ultramarine losses are particularly devastating in religious murals: the color was popular for robes worn by Jesus and the Virgin Mary (it also appears in the Sistine Chapel's sky). "We're looking into how to protect the sulfur cages," Del Federico says. "There's also a remote chance we'll find ways to regenerate the cages and trap the sulfur back inside."

With funds from the Alfred P. Sloan Foundation, her lab has just acquired a portable NMR machine, which fits into a carry-on-size suitcase. "We're figuring out which would be the best sites to try it out," she says. "It's all nondestructive testing, and it'll be able to tell us about the walls' pore size and salt and water content. My students can't wait to give it a field test." And they won't just train it on blue sections, she adds. At the Basilica of Assisi, where murals were executed by artists as prominent as Giotto and Cimabue, "we're also seeing the lead-white pigment turning black. No one knows yet what the chemical mechanisms are. In five or ten years, I'm hoping we can at least slow down these processes if not reverse them, before these images disappear."