An Artist's Tools

by Kirstie Hansen & Linda Lodding

Using XRF, art restorers see beyond surface beauty

Boldly stolen and then buried deep in an Austrian forest, the 16th century golden masterpiece called the *Saliera* has found its way into the hands of nuclear detectives and 21st century technology. Vienna's curators, historians, and art lovers could not be happier.

"The relief, indeed the joy, can scarcely be imagined that we can welcome the return of the *Saliera* into the rooms of our museum," says Prof. Wilfried Seipel, General Director of Vienna's Kunsthistorisches (Art History) Museum from where the sculpture was stolen in May 2003 and now once more resides. "It is the *Mona Lisa* of sculptures."

Just under 30 centimeters high, the *Saliera* — sculpted during the Renaissance to hold salt for royal feasts — shows the graceful bodies of a man and woman symbolizing the god of the sea and goddess of earth. Its value exceeds US $60 million. After its highly publicized theft in 2003, Austrian police spent nearly three years tracking thieves, before receiving a tip in early 2006 that the artistic treasure was buried in a bag in Austria's northwest woods.

Sometimes it is even possible to learn about the authenticity of works of art," says Dr. Uhlir. Its best feature is that the invisible rays do not destroy or harm the treasured art. Another is its portability. Since any movement to a work of art is potentially catastrophic, the goal of art restorers is to minimize any disturbance. And XRF — about the size of an overhead projector mounted on a moveable chassis — can be brought right to the source. A perfect device to unlock the secrets of *Saliera*.

Dr. Uhlir says the initial findings show that the gold in the *Saliera* is very pure, about 90%. The composition of the sensitive, partly flaking enamel that covers the masterpiece is still being examined.

Dr. Martina Griesser, who heads the museum's conservation science department, said that the enamel has been degrading over time but "the theft certainly did not help things." The thief hid *Saliera* under his bed for several years before burying it in a bag in the ground for some months.

The new and improved XRF was the brainchild of a PhD student and others working at the Seibersdorf laboratory. Following a request from the Austria Government, the IAEA is offering the machine to the museum for a limited time, free-of-charge.

Today inside Vienna's Museum, the detective work is taking a scientific twist, as art conservators seek to assess any damage to the retrieved Renaissance masterpiece, and to identify ways to preserve it. Prof. Seipel and museum curators are getting help from nuclear science and atomic analysts at the IAEA's Laboratories in Seibersdorf, Austria.

Art restorers are using a specialized instrument to examine and uncover hidden truths about Benvenuto Cellini's sculpture. Known as X-ray fluorescence spectroscopy (or XRF), the IAEA has loaned a portable version of the instrument to the museum. Conservation scientist Dr. Katharina Uhlir is using it to shoot precise X-ray beams at the sculpture. The data helps her discover the exact elements Cellini used to fashion his master work.

"The XRF is a powerful tool to determine the chemical composition of works of art in a non-destructive way.

Having the sculpture exposed to harsh elements is a "horrifying scenario" for the museums' conservators. They handle the piece with deft reverence and extraordinary care. In fact only specially trained personnel are authorised to touch the piece. "The theft damaged the *Saliera* but fortunately not so much as we were expecting," Dr. Griesser says.

Most obvious is a deep scratch at the breast of the female figure "Earth" probably caused by the crowbar the thief used to smash the showcase it was stored in. The information obtained from the XRF gives conservators like Ms. Helene Hanzer the best chance to restore the piece and protect it for the future.

With the help of XRF, and the loving care of many, the work to protect a masterpiece goes on. It's hoped that *Saliera* will be fully restored and back on public display in 2008.

the science behind the XRF

Not many people know that nuclear-based techniques like XRF (X-ray fluorescence spectroscopy) are used for studying works of art — from Cellini's *Saliera* to Michelangelo's *David*. But they have been used for many decades, in fields ranging from art restoration to archaeology and the preservation of cultural artifacts.

In the art world, the technique has been used to examine the tip of *David's* nose, analyzing dust and dirt before Michelango's masterpiece could be safely restored. Restoration work on Cellini's bronze statue of *Perseus* at the Uffizi Museum in Florence also benefitted from insights gained using XRF. Examinations of *Perseus'* right knee showed that the bronze alloy was composed of varying percentages of copper, tin, lead, antimony, iron and silver.

Clues from XRF results also can aid forensic scientists in solving crimes; for example, by determining if a paint pigment matches the artist's original palette. Discovering the presence of a modern replacement for an old traditional pigment known to be used by a particular artist can provide evidence that a painting is a forgery.

XRF has become a powerful and portable analytical tool. The technology works by irradiating samples of materials using X-rays without destroying the analyzed material. At the same time, it can identify a vast number of elements simultaneously, making it an excellent way to "fingerprint" all kinds of materials.

In XRF applications, analysts are provided printouts of peaks—much like a heart patient's electrocardiogram—that tell the story of the composition of material under examination. The horizontal axis reveals the object's elements—be it copper, silver, or traces of zinc—and the height of the peaks provides the percentage of the material present. Recent improvements at the IAEA Seibersdorf Laboratories, done in cooperation with the Atomic Institute of the Austrian University, Vienna University of Technology, have enhanced the XRF instrument's portability and potency. The transportable XRF was the brainchild of a PhD student and others working at the Seibersdorf laboratory. The IAEA is offering the instrument to Vienna's Kunsthistorisches Museum for a limited time, free-of-charge.

The *Saliera* is now in the hands of nuclear detectives and 21st century technology to help restore the once-stolen masterpiece.

(Photo: D. Calma/IAEA)

"It's hoped that the machine will also be made available to other IAEA Member States for the purpose of their cultural heritage exploration," says Darek Wegrzynek who heads the Seibersdorf project. Right now, about a dozen countries are working together through an IAEA-supported research project on the applications of XRF and other nuclear analytical techniques to investigate the authenticity of art objects.

Recommended viewing: Unlocking Secrets Within: Nuclear Technology and Artistic Treasures, a photo essay, www.iaea.org/NewsCenter/Multimedia/PhotoEssays/

Nexus
where Science meets Society

by Shirley Ann Jackson

In an age of discovery and innovation, how can benefits be passed along?

Science and scientists play a vital role in society. The degree of influence wielded by scientific opinion, the reputation of scientific bodies for impartially rendered insight, the priority accorded to scientific research and education all have contributed to the success of nations.

The frontiers of science have never looked more promising than they do today. Opportunities abound. From nanotechnology, to bioengineering, to terahertz imaging, to string theory, to space science, we are in an Age of Discovery and Innovation. The challenge is how to mine these opportunities for all they are worth to impact human health and welfare and security, and to have greater public understanding of, and respect and appreciation for, science.

To frame these ideas, I would like to introduce the simple metaphor of what the ancient Greeks would have called the "agora". This represents the place where, historically, interactions occur among societal sectors and the "public at large". The government occupies a quadrant — the decision-makers, the legislators, the bureaucrats, the regulators, the courts, and the body of law, itself. Industry and the private economic sector — from merchants to corporations — hold their share of real estate. The religious sector — church, mosque, synagogue, and temple — has its place in the agora. And, last but not least, academia — the educators and students who shape the future. The agora is the societal nexus.

This agora is where the public selects its "truth" — or, put differently, what society will accept as "fact." This is where leaders make public policy decisions. But what is the role played by science? Where does the scientist stand in this arena? And how does the role of the scientist shape the formation of public policy — the real nexus of science and society?