A Closer Look at *Santos*

Objects tell us about ourselves. As we look at their style and symbolism, we can tell a great deal about the artists who made them and about the societies in which artists lived and worked. When we extend our observations by means of techniques that "see" more than the naked eye, we also expand what we can learn. Creative processes - the materials and techniques that artists chose, cultural and traditional influences - become apparent, along with physical evidence of an object's particular history. What has happened to an object may tell us about shifts in its place in society and thus about a society itself.

In ***A Closer Look at Santos***, we address other ways of looking at *santos*, intended for anyone interested in a long and still lively cultural tradition. *Santos* have been made for centuries, since the early Spanish Colonial era. In the Americas, three main traditions of artisanship - Flemish, Italian, and Spanish - contributed to a distinctly New World style, which blended local expressions and native materials with older imported styles.

Today, dedicated artists in Hispanic-American communities are still creating *santos*, working within an evolving tradition steeped in a rich history but adapting to modern society. *Santos*, as objects of veneration that play an important role in religious life, lie at the very heart of the Latino cultural tradition. Specialized scientific techniques offer new ways to appreciate them and thus to celebrate some of the many threads that weave the tapestry of contemporary American culture.

Seeing with Scientific Techniques

In examining *santos*, archives of historical and anthropological literature are important sources, as are comparative studies of imagery - iconography and iconology. However, when the origin of a *santo* is uncertain, or the *santo* has been altered or repainted several times, studying its material structure is necessary to acquire a thorough understanding of the sculpture.

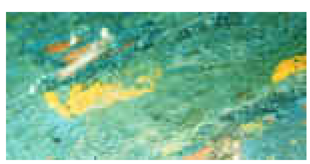
When we examine artifacts, assumptions or previous knowledge about them can lead us to interpret, enhance, and sometimes overlook what our senses tell us. By focusing just on using all of our senses, "looking" can be systematic, through, and objective. in technical studies of artifacts, the goal is to use not only all of our senses but also techniques and tools that are extensions of them.

Using visible light, our eyes can determine general form and appearance - colors, surface texture, sheen, and so forth - while microscopes can reveal minute details such as layers of paint and pigments that affect color and provide decoration. Imaging techniques that rely on infrared and ultraviolet light and x-rays can reveal otherwise invisible details. Other instruments and techniques literally extend our other senses.

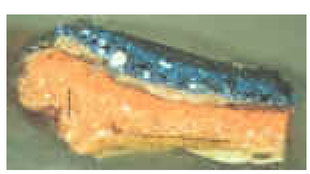
Modern scientific tools provide information that suggests the age, origin, composition, and function of artifacts. Many museums have conservation laboratories with modern scientific equipment. The conservation laboratory shares a common interest with the forensic laboratory in trying to learn as much as possible by examining small, sometimes minuscule samples removed from their context. Often, the task facing the conservation laboratory is more challenging because sampling a "treasure" may not be an option. Growing public interest in the interrelation of science and art has promoted closer looks at cultural artifacts and fine and decorative arts.

A wooden sculpture like a *santo* ages and eventually deteriorates. Internal factors, the wear and tear of normal use, and deliberate actions to restore or "refresh" it can affect its life. A closer look at the materials and techniques used to make a *santo* is indispensable in order to define the best conditions for keeping and displaying it and developing viable treatment to preserve it, if needed.

To examine art works, conservators use many approaches, which are separated into "non-destructive" and "destructive" methods. Non-destructive methods involve "looking" with x-rays, ultraviolet light, infrared light, and magnifying devices. Destructive methods require taking small samples from unobtrusive areas. The samples collected can be used to identify pigments, binders, wood types, metals, and other materials. For *santos*, studies often focus on paint layers to see how many times an original has been repainted, as scholars, conservators, *santeros*, and the Church debate whether to remove newer paint. Analytical technology can contribute to this decision making.



Conservators and other scholars look closely at paint layers to understand the history and condition of a *santo*. The many layers in the paint cross section below indicates that the *santo* from which it was taken had been repainted frequently.



Santos: Materials and Techniques

In general, *santos* made for private devotion are smaller and not as elaborate as *santos* commissioned for the Church. However, *santeros* used the same materials and techniques regardless of a sculpture's purpose.

Grounds and Paints

Santos makers worked in the European tradition of polychrome (painted wooden) sculpture. Typically, a *santero* carved and sanded a locally available wood to achieve the desired contour and expression. Then he applied size (animal glue) and gesso (chalk in animal glue) or gesso-soaked clothe to prepare the surface. He might have further sanded the gesso to achieve a smoother surface for painting. Gesso provides an ideal ground to receive paint. Without gesso, paint would sink into the wood, yielding less color. Sometimes, an artist applied colored bole (fine clay and glue) on top of gesso as special preparation for gold leaf. To decorate more elaborate polychromes, he could also use gesso to build three-dimensional designs and then apply paint or gold leaf. And, to create the illusion of richly embroidered cloth, he could selectively scratch through paint applied over gold leaf.

Oil paints or egg tempera (paints in egg yolk) were traditional for polychromes. The particles of pigments ground by hand are larger and less uniform that those of modern commercial machine-ground pigments.

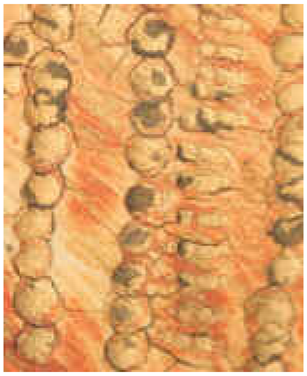
Analyzing Pigments and Paint

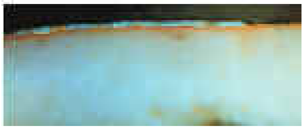
Analyzing pigment types and particle size is useful for describing and even dating polychromes, especially when no other information is available. For example, consider a *santo* with ultramarine in the blue paints. In medieval times, ultramarine was costly. Like gold, it symbolized luxury, and rich patrons frequently specified its use in commissioned works. Other traditional pigments like lead white, ground chalk, vermillion, and red lake occur on many *santos*. Conservation scientists have been able to identify nearly all the pigments used during the history of painting. Because different pigments were used at different times, identifying pigments can contribute to determining the date and origin of a particular paint layer.

During its lifetime, a *santo* may be repainted repeatedly during worship and normal use. Visual examination and optical and scanning electron microscopy of paint layers make it apparent that many *santos* have been painted several times. Modern commercial pigments may lie on top of traditional pigments. This information is useful in deciding how to interpret, care for, and preserve *santos*.

Conservation scientists evaluate a cross section of paint layers by means of a color photograph taken through an optical microscope. A tiny sample of paint nearly as small as the period [·] shown in this text is embedded in epoxy and polished to reveal the layers, which appear like the edge of a stack of paper, or in this case paint and varnish layers. The same cross section can be examined by SEM-EDS (scanning electron microscopy - energy dispersive x-ray fluorescence spectroscopy). Each corresponding paint layer is cross-referenced and double-checked by optical microscopy.

Using various ways of "looking" with the naked eye (above left), with x-rays (above right), with magnification (lower left) or microscopes (lower right) yield different and useful information about the making of objects.





Analyzing Structure

Xeroradiographs can answer many questions about the structure of *santos*. How were faces or heads attached? Were wooded elements of the sculpture carved as integral parts of the figure? Were some parts glued or nailed together? Sometimes, figures were nailed to stands after they had left the workshop. It is safe to assume that some of the stands are not original.

Wood

Historically, *santeros* who had access to imported materials, used a range of woods including Spanish cedar (*Cedrela odorata* L.), Cuban mahogany (*Swietenia mahogani* Jacu), or Honduras mahogany (*Sweitenia macrophylla* King), in addition to local woods, including a variety of pines. Carvers preferred relatively soft woods with fine texture and straight grain, and they also looked for durability and resistance to insects. If they could not obtain imported tropical woods, artists chose local materials, based on many of the same physical characteristics, cost, and availability.

Analyzing Wood

To identify wood, a conservation scientist removes a small sample from the exposed wood surface of the object. In most cases the samples taken are extremely small to disrupt the artifact as little as possible. Sometimes only a tentative identification is possible, based on a few macroscopic and microscopic characteristics.

Molded Wax

Another traditional material, observed in some *santos*, was molded wax. Artists formed the faces or heads of saints by mixing wax with rosin and chalk, shaping it to the desired contour, roughing up the flat surface of the wood so that the wax would stick, and fixing the wax to the figure's body or head.

Through techniques such as microscopic wood identification (above) and x-ray fluorescence (xrf - below) the materials of an object can be identified.

Preserving *Santos*

All finished art works are vulnerable to gradual decay, even those made skillfully and properly, using high quality materials. Recognizing the causes and consequences of deterioration for the materials in *santos* allows us to follow an informed strategy of use, care, and preservation.

Wood

Wood is a food source for insects such as termites or beetles. The tunnels they make through wood can be seen in xeroradiographs of *santos*. If an infestation is not remedied, eventually a *santo* will be damaged and ultimately destroyed. Since insect infestation can spread throughout an entire collection, close initial inspection and constant vigilance are important. Display and storage areas should be kept clean and free of dust. Fresh wood powder, called frass, coming out of exit holes is a good indication that there is an active infestation. The first thing to do is to isolate the object. Consult a professional conservator for advice or a professional fumigation service if the damage is extensive and ongoing.

Repaint

As a part of religious practice, it is common to have a *santo* "repainted." Layers of repaint were found on most of the *santos* that we studied. Repaint layers represent the object's history.

There is a trend in some quarters to have the repaint removed to reveal the "original" layers. This practice of "chipping away" the repaint has caused concern and started vigorous debates among collectors, restorers, cultural institutions, and religious institutions. From our technical study, it is apparent that layers of repaint are not always evenly applied to the whole sculpture. For example, on a typical *santo* the face tends to get "cleaned" or "repainted" more often than areas such as the back of the sculpture or the feet. Cloaks may be painted in entirely different colors, and sometimes paint covers gilding. Various materials are used for the repaint. There is evidence of casein, water-soluble matte paint, and sometimes oil paint used in the repainting. It is difficult to remove the repaint evenly without inflicting some damage to the original. In addition, it requires substantial "personal opinion" and many subjective judgments on the part of the restorer in removing repaint. It also raises the issue of who is most qualified to decide which layer of the history of the *santo* should be removed.

Being able to observe the multiple painting campaigns tells us about the history of the object, the veneration in which it has been held, and changes in iconographic expression. Removal of repaint results in a loss of material information and could imply disrespect for both the object and its history.

Cleaning

Cleaning is a delicate, irreversible procedure using abrasives, water and detergents, organic solvents, and other chemicals to remove unwanted accretions such as grime or discolored varnish from the surface. Chemicals, such as acids or bases often used by restorers, can destroy the color of the paint. Ultramarine can be decomposed by dilute acid; even a weak acid such as acetic acid (vinegar) will cause the loss of blue color ("ultramarine sickness"). Azurite, another common traditional blue pigment, is soluble in acid and can be blackened by heat and warm bases. Traditional red lake is sensitive to solvents such as alcohol. Obviously, the risk of cleaning is higher when information on the materials and techniques of the *santo* is not available.

Temperature and Relative Humidity

The rule of thumb is that the speed of a chemical reaction doubles when the temperature increases about 20°F. In great part, deterioration is a chemical process.

Humidity refers to the water vapor content in air; relative humidity refers to the amount of water vapor content in air relative to the maximum water vapor content possible for the air at a given temperature. High relative humidity encourages insects and growth of microorganisms such as mold and fungi.

In addition, humidity and temperature have other effects on wood. Wood swells and shrinks when it absorbs and releases water as relative humidity rises and falls. Making matters worse, wood expands and contracts unequally along different grain directions. As humidity changes, the components of wooden objects are continually pushing and pulling against each other. This pressure often results in parts no longer fitting together closely or becoming distorted or breaking from their own internal stresses. This general characteristic is true for all wood, whether it is new or old.

The interrelationship between temperature and relative humidity is roughly inverse. As the temperature goes up, the relative humidity goes down, and vice versa. Large fluctuations in temperature (30-60°F/16-33°C) will affect the dimensions of *santos* and possibly cause the wood to split due to expansion or contraction as the wood's moisture content changes. When a wooden object is moved from high relative humidity to low relative humidity, contraction in wood can cause the surface paint to flake off.

The key to avoiding this type of damage is slowing down the changes and gradually lowering the relative humidity. Sudden and drastic changes in temperature and relative humidity pose a serious problem to wooden *santos*.

X-ray images called xeroradiographs are particularly important for examining the structure of artifacts. Notice the three grain directions in the *Piedad* above, and the differences in the arms on *Angelito* below.

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Exhibition Collaborators

The de Saisset Museum is Santa Clara University's museum of art and history. Since its founding in 1955 through a bequest from Isabel de Saisset, collections have expanded to include nearly 6,000 prints, photographs, and other art media. The museum, which was accredited by the American Association for Museums in 1979, is also the caretaker of the University's California History Collection. The museum presents temporary exhibitions, often focusing on social or ethical issues, as well as lectures, concerts, and film series, for the educational and cultural benefit of the University and local communities and other visitors. The de Saisset Museum welcomes thousands of grade school children, seniors, special education groups, and other visitors each year for free, docent-led tours.

The Smithsonian Center for Materials Research and Education (SCMRE) is the Smithsonian Institution's specialized research facility dedicated to the technical study and conservation of museum artifacts and their component materials. SCMRE advises and assists Smithsonian and other museums in the study, preservation and conservation of artistic and historic objects. Research is performed in the areas of material technology, chemistry, art and cultural history, and development of treatment procedures. SCMRE conducts programs for the dissemination of knowledge about collections, their properties and preservation, to museums and associated professionals throughout the United States and the world.