Smithsonian
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Kenneth E. Behring Center

News

Media only: Valeska Hilbig (202) 633-3129

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Fact Sheet

The Star-Spangled Banner Conservation Treatment

Overview

The 200-year-old Star-Spangled Banner has been in the care of the Smithsonian Institution since 1907. Since then, it has undergone three major conservation treatments. The first was in 1914, when the Smithsonian hired flag restorer Amelia Fowler and a team of seamstresses to sew on a supportive linen backing. The second treatment occurred in 1982, when a major surface cleaning was undertaken while the flag was on display at the National Museum of American History. The third—and most extensive—conservation effort began in 1998.

Already damaged when it arrived at the Smithsonian, the increasingly fragile flag had to be treated and stabilized in order to preserve it for future generations. The flag had sustained mechanical damage (frayed edges, splits, tears and losses) from its use at Fort McHenry. In general, all textiles undergo deterioration as they age when exposed for years to ultraviolet light, pollution and changes in humidity and temperature. In this recent conservation work, the museum's goal was to clean and stabilize this flag while preserving its history. It was never intended that the flag would be restored to look like new.

The museum took extreme care in the planning and execution of the conservation of the Star-Spangled Banner—any mistakes would be irreversible. Evaluating treatment beforehand is always difficult with historic materials. The museum's extensive flag collection allowed conservators opportunities to investigate newer conservation practices on flags that were similar in age to the Star-Spangled Banner. The generous support of donors allowed the museum to engage in extensive research and testing of the proposed treatment options at each step of the process and permitted consultation with independent researchers, scientists and conservators, who worked as a technical advisory group to inform the decision making.

The museum took the time necessary to perform exacting scientific research to test the actual outcomes and the impact of the work on the artifact. This allowed the museum full confidence to move forward and to avoid unintended consequences.

Planning for the current conservation project—the most comprehensive to date—began in 1996, when the museum convened a conference to discuss the preservation of the flag. A group of 50 international experts, including conservators, historians, curators, engineers and organic scientists, provided suggestions for the best possible treatment and display options.

SMITHSONIAN INSTITUTION MRC 623 PO Box 37012 Washington DC 20013-7012 Telephone 202.633.3129 Fax 202.633.8053

The treatment work was recently completed. The Star-Spangled Banner is now displayed in a specially constructed, climate-controlled gallery at the heart of the museum. Visitors can view a side of the flag that was previously obscured by a linen backing. The flag is displayed according to U.S. flag code, at a horizontal orientation and an angle not to exceed 10 degrees of elevation. Light levels are low to protect the flag, but dramatic to evoke an atmosphere of the "dawn's early light," similar to what Francis Scott Key experienced on the morning of Sept. 14, 1814, when he was inspired to pen his famous poem. Temperature and relative humidity are kept constant at 68 to 72 degrees Fahrenheit and relative humidity of 50 percent.

The conservation of the Star-Spangled Banner has provided the museum and the conservators with many research opportunities that have informed and advanced museum and conservation practices. All phases of the conservation have been carefully documented and photographed. Scientific research, along with before-and-after-treatment photographs, provide critical information about the condition of the banner and inform future preservation decisions. Conservators project that with the benefits of the recent conservation treatment and future display under optimum conditions, the flag will survive for many generations.

Description of the Star-Spangled Banner

Mary Pickersgill used wool bunting and cotton fabric to make the Star-Spangled Banner in August 1813. While the original size of the flag was 30 by 42 feet, it now measures only 30 by 34 feet.

Approximately eight feet, much of it from the fly end, and a total of 240 square feet, were lost due to wear and tear during its use at Fort McHenry and from pieces that previous owners had cut off as mementos for war veterans and other patriots. The original size of the banner, while it seems massive today, was customary for 19th-century garrison flags designed to fly from 90-foot flagpoles. Without its heavy linen backing, the flag weighs less than 50 pounds. It had 15 stars and stripes originally, one for each state as mandated by the Congress of 1794. The stripes are about two feet wide and each star has a diameter of approximately 24 inches. The 15th star has been missing since before 1873.

Preparation

As much information as possible about the flag was gathered before its removal from the museum's Flag Hall in 1998, using techniques such as near-infrared spectral imaging, photography, stress/strain analysis and micro sampling. At that time, the Star-Spangled Banner was lowered from the wall where it had been hanging for 34 years, since the museum opened in 1964. It was laid flat on a platform. During the next few months, the conservation team carefully examined the textile and prepared to move it into the new conservation laboratory, while they developed a detailed treatment plan. Next, the banner was carefully rolled onto a 450-pound, 32-foot tube, crated and moved into a specially designed climate-controlled laboratory.

Phase I

The laboratory, with a 50-foot floor-to-ceiling glass wall, allowed museum visitors to see the Star-Spangled Banner and learn about the conservation treatment.

The lab was operated to maintain a clean environment and low light levels, and less than one foot-candle of light illuminated the surface of the flag, whereas three foot-candles of light shined on the perimeters that allowed visitors a better view of the lab. (Foot-candles is a professional measurement of light levels, no actual candles are used in the lab.) Conservators used task lights to direct higher levels of light to limited areas. The room was kept at 68-70 degrees Fahrenheit with a steady humidity

level of 50 percent. Slightly positive pressure prevented infiltration of dirt, and an exhaust system, commonly called "elephant trunks," removed chemical vapors directly above specific work spaces.

On close examination, it became evident that the linen backing, dating from 1914, was soiled and worn and no longer provided the appropriate support. Conservators slowly unrolled the 1,020-square-foot banner while they carefully clipped approximately 1.7 million stitches that attached the linen to the flag. The conservators, wearing surgical scrubs and using special tools, worked from the edge of the roller tube or, for hard-to-reach areas, from a 32-foot-wide movable gantry, or platform, suspended four inches above the flag.

By March 31, 2000, the monumental task of removing the stitches was completed and the banner lay stretched out fully across the immense table. Next, the team prepared the flag for removal of the linen backing. The face of the flag was covered with "marquisette," a gauze-like open-weave polyester fabric that is nonabrasive and provides lightweight support.

Phase II

In mid-July 2000, the flag was rolled onto the tube again and unrolled with the linen side up. Then conservators carefully separated the linen from the flag throughout the next several months. The linen remnants were saved for later study. The removal of the backing revealed a side of the Star-Spangled Banner not seen by the public since 1873.

Phase III

Conservators used nonabrasive cosmetic sponges to lift harmful materials off the surface of the flag (completed in August 2003). Then they brushed an acetone-water mixture, at a ratio of 90/10, on the wool, and an 80/20 mixture on the cotton stars and followed it with a rinse of deionized water to remove the soils that were embedded in the fibers. The solvent treatment also restored the acidic pH levels to a more neutral range (between 5.5-6.0) preventing further damage to the cotton (completed late January 2004).

Testing identified the soiling as urban pollution, including carbons, soot, salts and oils. These soils are not unique to this museum but are common to urban industrial areas. Some of these materials date back to the time when the flag was used at Fort McHenry and when the Armistead family used it for special events. Some were deposited on the flag while it was on display at the Smithsonian.

Phase IV

Finally, to stabilize the flag for future display, conservators realigned it and sewed on a lightweight sheer backing for support. Stabiltex is a "synthetic silk" mesh fabric that is made of multifilament polyester yarns and is as transparent as nylon stockings. This phase of the conservation treatment was completed in late 2005. In an ongoing effort, conservation staff consulted with the gallery designers to refine the technical requirements for the new home of the Star-Spangled Banner to ensure its optimal preservation.

Conclusions: New Insights and Innovations

- The method of attaching a linen backing with a web of stitches to damaged historic flags, patented by Amelia Fowler, was used extensively toward the beginning of the 20th century. It allowed long-term display of the treated flags and saved them from disintegration. Research on the Star-Spangled Banner showed that the Fowler treatment had now become a detriment to the flag and needed to be removed. Before undertaking this step, the museum debated it with the

advisory committee to ensure high professional standards. The chief conservator of the project tested her theories by removing the Fowler treatment from another flag in the collections with satisfactory results.

- Conventional textile conservation has experimented with chemically treated sponges soaked to remove greasy soils. The museum's conservation team advanced this method by using nonabrasive cosmetic sponges without the use of any chemicals or water. This made for a benign transfer of materials.

- Using a mixture of acetone and water to clean the fabric was more effective than traditional solvents and exposed the staff and the flag to less harm. This acetone mixture is less toxic, evaporates faster and does not need mechanical action or heat to be effective.

Conservation staff, at the museum and at other organizations, have begun to adopt these innovations or are investigating new applications of these methods.

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