Preventative Conservation of Military Artifacts at the Frontier Army Museum

Megan Hunter

We have nothing that is really our own; we hold everything as a loan.

—Nicolas Poussin

This statement rings true for all things in life, and as a museum specialist at the Frontier Army Museum, I see this first-hand. As part of the Army Museum Enterprise, my roles and responsibilities range from creating and designing exhibits, teaching soldiers and Department of Defense civilians, creating public education programming, and caring for the museum's collection. The Frontier Army Museum at Fort Leavenworth, Kansas, holds almost 6,500 objects in the public trust. These objects represent the story of the United States Army on the frontier from the Corps of Discovery Expedition of Capt. Meriwether Lewis and 2nd Lt. William Clark (1804) through the Pancho Villa Expedition (1917). The museum also holds artifacts related to the history of Fort Leavenworth from its establishment in 1827 to modern day.

One of the core staff duties at the museum is to care and account for the artifacts in the collection. When I say care, I specifically mean a term we use in the museum field called "preventative conservation." This consists of taking measures that prevent damage or reduce the potential for damage. Critical elements in preventive conservation include handling, storage, and management of collections.[1]

Most of the time, damage occurs to objects when they are improperly handled. One of the first rules in handling artifacts is to always wear gloves. Gloves are important because they protect both the artifact and the handler. Human skin is naturally covered in oils, dirt, salts, and moisture that causes etching, staining, and abrasions to artifact surfaces. Additionally, the artifact may be composed of or treated with toxic materials, so gloves protect the wearer as well. There are two acceptable types of gloves in the field: cotton and nitrile. Cotton gloves can be used for delicate items such as books and paper.[2] However, cotton gloves have fallen out of favor because of several issues including snagging on documents, loss of tactile feeling, and the fact they are absorbent and collect oils inside and outside of the glove. For most paper-based materials, clean dry hands are used while handling those media types. Nitrile gloves are preferred while handling all material types because they provide protection against dirt and oil from human hands and gives the wearer a more dexterous grip.

Picking up and moving artifacts is another aspect that must be done carefully and mindfully. Ideally, not handling an artifact is best, but sometimes a situation calls for it. When handling an object, staff consider what they are handling and the best method to move it. In general, lifting an artifact from the base with two hands supporting is best practice. We must also consider if the artifact has multiple parts or has had previous

repairs that may have weakened the artifact's structure. Moving artifacts should also be carefully planned with a destination prepared to receive the artifact. Long distance movements usually require the use of equipment such as trays or carts.

Another consideration for museum professionals in terms of object care is long-term storage. Currently at the Frontier Army Museum, only 6 percent of the collection is on display, which calculates to approximately 6,114 objects in long-term storage. Although this seems like a low percentage, it is the norm for many museums. Lack of physical space is one reason for displaying a low number of artifacts. Another reason is to protect artifacts. Certain artifacts should be rotated off display frequently. For example, rare or fragile textiles should only be on exhibit for a period of three to six months.[3] This assists in prevention of future issues and damages caused by exposure to various elements such as temperature changes and light.

How an object is stored is something museum professionals must consider. For many textiles, flat storage is best as it limits stress points versus hanging or rolling. The Frontier Army Museum's storage area is fortunate to be able to accommodate flat storage for most of its textile and uniform collections. In addition to storing textiles flat, military coats and other similar garments have custom inserts placed inside the body cavity. The inserts consist of Tyvek filled with polyester batting. The insert serves to keep the garment inflated and prevents the textile from folding on itself. The arms are filled with another Tyvek insert or with rolled acid-free tissue paper. A polyester film is placed between metal components and the fabric surface to act as a barrier. This will protect the fabric from any metal corrosion from transferring onto the fabric.

Perhaps the most important aspect of preventative conservation is the physical environment, which houses the collection and exhibits. Today the Frontier Army Museum is in what was known as Andrews Hall, Building 801. Constructed in 1941, Andrews Hall was modeled after a large temporary recreation building. After completion in 1942, the building was soon converted for classroom space to accommodate the increased student load at the Command and General Staff School during World War II. Academic use of the building continued until 1959, when the college was moved into the newly built J. Franklin Bell Hall. That same year the museum moved into Andrews Hall and is currently there today. Over the years, the building has been retrofitted to properly display and house the collection to maintain an overall physical environment in accordance with guidelines for temperature, light, and relative humidity (RH).

Environmental variables such as RH, temperature, light exposure, pests, and air pollution can harm artifacts if not monitored. Changes in relative humidity and temperature can have detrimental effects by causing thermal and moisture content expansion and contraction of materials. High temperatures promote faster chemical reactions and degrade organic material quickly. High temperatures also lead to loss of flexibility and cracking due to accelerated dehydration. On the other hand, extreme cold can cause brittleness and cracks. High relative humidity can cause a variety of problems, like mold growth on organic collection materials like paper, leather, textiles, and wooden artifacts. Irregular or fluctuating relative humidity is damaging on a microscopic level, causing the porous fibers of plant and animal-based artifacts shrink and swell as they increase and decrease their moisture content. Prolonged cycling of shrinking and swelling weakens fibers over time resulting in bond cleavage and ultimately a weakened substrate and tears or breaks.[4]

Many museums have artifacts that are considered mixed media, which means they are made up of various materials such as leather and metal. Various materials components react differently based on various levels of RH and temperature. Artifacts with metal components benefit from lower RH levels while organic materials benefit from more moderate RH. In a mixed media collection, the recommendation is to have RH levels at 50 percent while minimizing huge swings to between

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Table. Lux levels to Avoid Light Damage

Light Level	Material
200 lux (20 footcandles)	most ceramics, glass, and metals
150–200 lux (15–20 footcandles)	oil and tempera paintings, undyed leather, lacquer, wood, horn, bone, ivory, stone
50 lux (5 footcandles) or less	watercolor paintings, dyes, manuscripts, prints and drawings, vulnerable textiles, photograph

(Table by the Philadelphia Museum of Art)

40 and 60 percent. Fluctuating RH is one of the most damaging aspects of the environment and is a key element that museums work to control through management and maintenance of their facilities' heating, ventilation, and air condition systems.

To combat the changes in the environment, we utilize various environmental control strategies. At the Frontier Army Museum, we control the ambient air temperature and pollution within the building in both the exhibit galleries and collection storage. The collection storage runs on its own heating, ventilation, and air conditioning (HVAC) system that has back-up in case of power outages. The dedicated HVAC in collection storage allows staff to keep the temperature around 65–70°F and 45–50 percent RH. In the exhibits area, guest comfort is considered, and the range is set between 65–72° and 50 percent humidity.

To alleviate air pollution, the museum HVAC is equipped with a filtration system that cleans the air of impurities. Microscopic dust and debris can settle on artifacts and cause damage. High-efficiency particulate arrestance (HEPA) filters helps to limit corrosive dust and debris from settling onto the artifacts. Within collections storage, the cabinets have door seals and vents to help regulate the airflow. In certain cabinets, silica gel is placed inside trays to help absorb excess moisture.

Hygrothermographs regularly monitor the relative humidity and temperature within the galleries and collection storage. This allows staff to notice and record any major changes in the environment and act accordingly such as removing an object from exhibit or getting the HVAC system repaired.

Light exposure can also cause damage to artifacts. Some materials, especially photographs, books, and paper, are highly susceptible to damage from light. The amount of damage occurs from light wavelength intensity, exposure time, and the material's natural resistance. Light damage can cause fading, weakening, discoloration, and brittleness.[5] The museum mitigates light damage by monitoring light exposure, utilizing film filters, installing light emitting diodes, adjusting light levels to conservation levels, and placing facsimiles on exhibit when appropriate. Light meters are a tool that reads light intensity in units known as "lux" or footcandles. One footcandle is equal to ten lux units (see table).[6]

Another important, but usually overlooked aspect of collection care is integrated pest management. Insects, mice, snakes, and other critters tend to find their way into the museum. Most of the time, pests do not pose a risk to artifacts. However, there are some that can cause a lot of damage. The "dirty dozen" as they are known in the museum field consists of specific

Circa 1895, Fort Leavenworth, two hunters wearing buffalo hide coats, photographer unknown. (Photo courtesy of the Frontier Army Museum Collections [LEAV 96.340.1])

pests that can cause damage to artifacts. Mice, carpet beetles, booklouse, and webbing cloth moths are just a few of the pests that staff is always monitoring. How can these tiny pests cause harm? Very easily. Silverfish, for example, are very tiny wingless, carrot-shaped insects that are only 10–15 mm in length. What they lack in size they make up for in appetite. These omnivores eat cellulose and protein materials. They tend to eat paper items, especially bookbinding because of the glue. Silverfish will also eat materials that have been treated with organic dyes, gelatin, or starch, which can include textiles like silk and cotton. They thrive in cool, damp environments so a presence of one indicates a moisture issue.[7] Controlling relative humidity is an important step in deterring pests. The museum works closely with the post's entomology department to conduct quarterly exterior treatments of the building, monitor pests, and react to current infestations.

Even with precautions, pest infestation can occur. Evidence of infestation includes insect excrement known as frass, webbing, larvae skins, and cases. Potentially infested artifacts are bagged in polyethylene bags and placed in isolation for several weeks. This allows staff to monitor for active infestation and place treatment accordingly. There are different treatment methods depending on the artifact. Freezing is one method that includes sealing an artifact in a container or bag and placing in a freezer capable of -20°F for at least seventy-two hours. This method is not recommended for paintings and audio visual materials.[8]

On the less fabulous side of museum work is the very important component of emergency planning. Although no one expects anything to go wrong, we must be prepared. The museum must be prepared for any type of large or small emergency. Whether it is a fire or a leaky pipe, the staff must be ready to act. In preparation for emergency events, staff created an emergency preparedness plan that lays out how to respond to emergencies and recover artifacts. Physical preparations include emergency response boxes that contain materials needed to aid in an emergency. The boxes include flashlights, batteries, nitrile gloves, pencils, aprons, sponges, goggles,

Left: 2018, Ford Conservation Center, Omaha, Nebraska, P1872 buffalo coat after conservation treatment. (Photo by Ford Conservation Center, Frontier Army Museum Collections [LEAV 88.7.25]). *Right:* 2018, Ford Conservation Center, Omaha, Nebraska, P1872 buffalo coat sleeve before and after conservation treatment (Photo by Ford Conservation Center, Frontier Army Museum Collections [LEAV 88.7.25])

2018, Ford Conservation Center, Omaha, Nebraska, before and after treatments of 2nd Field Artillery oil painting. (Photo by Fort Conservation Center, Frontier Army Museum Collections [LEAV 8.8.1])

tarps, and trash bags. These items are useful during an emergency and recovery operation.

Conservation of Artifacts: 1872 Buffalo Hide Coat

Staff strive to implement preventative conservation to help slow the deterioration of artifacts; however, sometimes it is not enough, and a professional conservator is needed to clean, stabilize, or conserve an artifact. Conservation professionals are experts on the conservation of material types that are trained to treat historic materials.

The Frontier Army Museum has a vast nineteenth-century collection consisting of wagons, uniforms, weapons, medical tools, musical instruments, and more. Due to age, wear, and material components, some artifacts need a little more care than others. One piece that has been professionally conserved is a pattern 1872 buffalo hide coat. This coat is 47 inches long, weighs 13 pounds, and made from buffalo hide.

In the 1870s, the Army's Clothing Bureau experimented with various types of winter clothing. Instances of lost limbs during severe winters made these changes necessary. The Army tested various types of animal skins, with buffalo proving to be the most effective and gaining high approval with soldiers. Although considered bulky and heavy, buffalo hides provided protection from the freezing temperatures.[9] After 1880, the buffalo population dwindled significantly and made the coats expensive. The Army replaced buffalo coats with blanket-lined canvas overcoats in 1883.

This buffalo hide coat has been a part of the collection since 1988, and in April 2018, it was conserved professionally. Conservators from the Gerald R. Ford Conservation Center in Omaha, Nebraska, thoroughly cleaned the coat, stabilized buttons, repaired pockets and splits in the lining, and created long-term storage. Long-term storage consisted of an acid-free custom box and archival inserts to keep the coat from folding on itself from its own weight. Additionally, conservators tested the coat for arsenic. Yes, you read that correctly, arsenic. Interesting fact: it was common practice from eighteenth century to the late twentieth century to use arsenic as preservative for biological, ethnographic, and taxidermy objects. Arsenic served as an insecticide, herbicide, rodenticide, and antibiotic.[10] To the relief of staff, the coat tested negative. After months of treatment, the coat returned to the museum better than ever. The buffalo coat can be seen on exhibit at the museum for brief periods. When not on exhibit, you may visit the coat virtually on the museum's online audio tour.

Conservation of Artwork: 1912 "Battery C, 2nd Field Artillery" Painting

When it comes to conservation treatments, experts consider every artifact on an individual basis. Conservators consider the material composition, the issues present, and the best course of action to conserve the piece. Treating a textile will be very different from treating artwork. Within the museum's collection is an oil painting by Edwin John Prittie depicting two mounted officers of Battery C, 2nd Field Artillery in a 1902 dress uniform.

The painting's issues consisted of active paint/media loss (flaking) and discoloration from aged varnish. A painting conservator form the Gerald R. Ford Center Conservation Center consolidated the flaking with a thermoplastic acrylic polymer. Solvents of acetone and isopropyl removed grime and the deteriorated varnish

on the surface. The conservator lined the painting to a polyester support canvas and attached it to a new custom stretcher. The surface received a thin layer of damar resin varnish to seal the painting. Areas of loss were filled with gesso materials and retouched with matching pigments.

Images of the painting before and after treatment show a huge improvement in the visual quality of the artwork. Removing years of discolored varnish from the surface revealed rich coloring that brought out details not visible before. On the collections side, the padded support and custom stretcher stabilized the artwork for display and long-term storage.

In 1912, the artist Edwin John Prittie created the painting for an advertising illustration that featured two mounted officers. Prittie modeled the physical attributes of the officers after himself. He later exhibited this oil painting at the Philadelphia Society of Allied Arts in May 1925. Prittie's father was a Civil War veteran and raised him in a military-minded household. In 1902, Prittie enlisted with the Old Guard State Fencibles, a military organization raised in Philadelphia as part of the Pennsylvania militia. He attained the rank of colonel in 1918. Throughout his career, he painted and illustrated in various mediums and for a variety of projects including bubble gum cards. During the 1920s and 1930s, Prittie contributed covers, interior plates, and ink drawings for the John C. Winston Publishing Company. The company published a "Classic Series" that consisted of many literature classics such as *Alice in Wonderland*, *Robin Hood*, *Grimm's Fairy Tales*, *Black Beauty*, and more.[11]

Stabilization of Artifacts: c1884 10th Cavalry Regimental Standard

In some instances, although treated by a conservator, an artifact continues to deteriorate rapidly. Within the museum's collection is a beautiful circa 1884 10th Cavalry regimental standard. It is a silk flag, edged with gold fringes, and a hand-painted national eagle with two red banners. The banners read "E PLURIBUS UNUM" and "10TH U.S. CAVALRY." The silk components of the standard show wear and in some places, material is missing. The painted portions show breaking and cracking.

In 2006, Leila Harritt, a local textile conservator, treated this flag and stabilized it. The treatment included a gentle cleaning with a HEPA filter vacuum through a nylon screen. Silk components were treated with gentle humidification that reduced the number of creases. Edge fringes were detangled and humidified to reduce distortion. The standard was mounted on an archival mount covered with a layer of polyester batting to provide cushioning. The amazing conservation work completed by Harritt allows the museum to display this piece safely. Due to its fragile nature, this artifact is exhibited at the museum for limited periods of time.

Although stabilized, the standard is still deteriorating. Silk is an organic material that contains mainly fibroin and sericin proteins.[12] Due to its intrinsic properties, silk is more sensitive to the environment and tends to break down more quickly than many other types of materials. By monitoring the environment for RH and temperatures levels, limiting light exposure, and limiting display time, staff can help to slow the rate of decomposition. Unfortunately, like all

Left: 2006, Frontier Army Museum, c1884, 10th Cavalry regimental standard before treatment. 2006, Frontier Army Museum. *Right*: c1884, 10th Cavalry regimental standard after treatment. (Photos by Frontier Army Museum Staff, Frontier Army Museum Collections [LEAV 91.20.1])

2007, Frontier Army Museum, M1878 four-mule escort wagon before restoration. (Photo by Frontier Army Museum Staff, Frontier Army Museum Collections [LEAV 91.30.1])

organic materials, the silk components will continue to degrade over time.

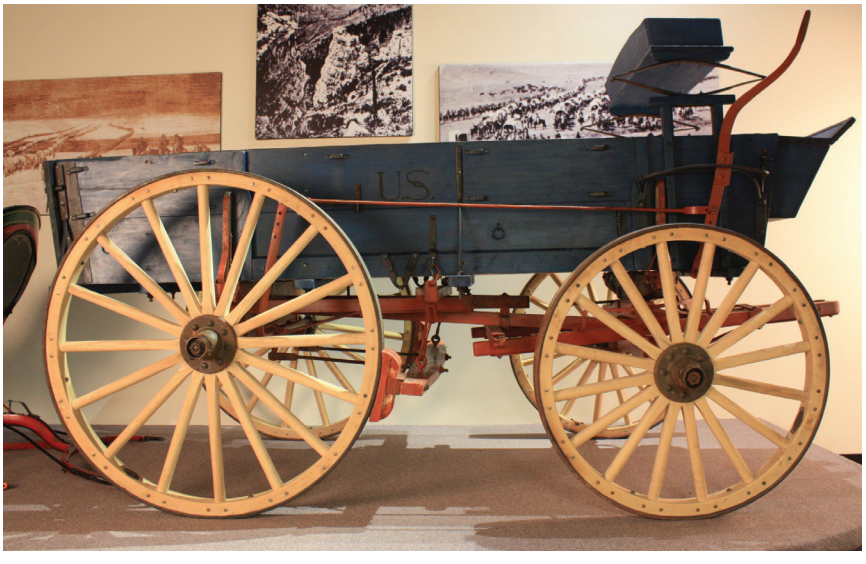
Staff follow the Army Regulation 870-20, *Army Museums, Historical Artifacts, and Art*, which sets exhibition limits for sensitive historic materials. When not on display, the standard is placed in a climate-controlled storage room where there is limited exposure to light and air pollutants. These practices help to slow the rate of decay. However, another part of the museum staff's responsibility is to tell history through objects, which means displaying these objects for public viewing. As professionals, we must balance the delicate relationship between preventative conservation and serving the public trust by displaying significant historic artifacts.

Restorations versus Conservation: M1878 Four-Mule Escort Wagon

Restoration is another avenue that can be used on historic artifacts. To be clear, there is a difference between conservation and restoration. Although they both deal with improving the structure and the look of an artifact, they have different approaches to treatment. Conservation focuses on preserving the original artwork or artifact through cleaning and repairs. Restoration involves restoring the artifact to its original appearance or function.[13] Both options have their pros and cons, and every artifact should be considered on an individual basis.

An example of restoration within our collection is our M1878 four-mule escort wagon. This macro, or large, artifact was recovered in 1991 from a field in Lawrence, Kansas, by the Frontier Army Museum. This artifact originally consisted of only wooden and metal scraps. In late 2010, the museum sent the wagon pieces to Mark Minor, conservator of wooden artifacts, in Denver where he combined original metal components and modern wood pieces to restore the wagon. Two original wooden pieces, the rub-bar of the front running gear and the front bolster, were in good enough condition to be used in the restoration. However, most of the wood is modern.

The wagon was restored based on the specifications and dimensions of the 1878 Quartermaster's Office. This included using white pine and tulip poplar wood



2012, Frontier Army Museum, M1878 four-mule escort wagon after restoration. (Photo by Frontier Army Museum Staff, Frontier Army Museum Collections [LEAV 91.30.1])

for the body. The running gear was specified as white oak or hickory; however, white ash was used as it is visually similar and easier to find in the sizes needed.

Although the quartermaster report provided specifications, some aspects had to be interpreted from existing photos. The axle wood was very degraded, and the shape could not be definitively known. In this case, the conservator had to make a best educated guess on how to shape the area. If something was unknown, it was left out. The chain arrangement at the rear tailgate was unknown and rather than guessing incorrectly, the chain was left off. The chain can be reattached if further research is found on its arrangement.

Per the Quartermaster's specifications, the wagon box was painted "leaden blue" on the outside. This was consistent with what the conservator found on the iron reinforcement. Inside the box and the running gear was painted "venetian red."[14] The wheels were not painted because they did not travel with the wagon parts. Staff decided to leave the wheels unpainted as an educational tool to discuss artifact restoration. Each side of the wagon was lettered "U.S."

The original iron pieces of the wagon were treated with tannic acid. Pieces with existing paint were cleaned with air-blasted walnut hulls. This removed dirt and loose paint. The iron was coated multiple times with a 5 percent tannic acid solution. Numerous ironwork pieces needed to be reproduced such as the chain stay hook. Bent metal pieces were heated with a torch and straightened.

To complete the look, the conservator created manual abrasions on the inside floor and wagon box. This gave the wagon a worn look, rather than a brand-new finish. Without the restoration treatment, the pile of wood and metal would have stayed in that field in Lawrence. With the process of restoration, that pile of scrap is now used to help tell the story of U.S. Army transportation in the late nineteenth century.

The Army designed the wagon to be pulled by four mules. Mules were the preferred beast of burden over horses due to lower cost, better endurance, and smaller forage equipment. In the late nineteenth century, the main logistical problem for the Army was supporting small detachments and isolated posts scattered over thousands of miles of frontier wilderness. The total strength of the Army in 1889 consisted of twenty-five thousand officers and men across 134 posts. The end of the Indian Wars allowed the Army to cut back on field transportation. Army wagon trains were retired in 1895.[15]

The four-mule escort wagon became the standard wagon through the mid-1890s and utilized through the 1930s.[16] During World War I, horses performed cavalry roles as well as vital transportation roles. Horses moved supplies, guns, ammunition, and wounded soldiers. The use of horses in the U.S. Army continued through World War I. Tanks proved to be a sufficient transportation; however, at the time they were too slow and subject to mechanical failure. During World War II, horsepower transitioned to gas power as quickly as vehicles could be rolled out.[17]

Preserving History through Conservation of Material Culture

Preventative conservation is a continuous battle. Constant monitoring of the environment and artifacts is an important step to prevent major issues in the future. Staff at the museum inventory 5 percent of the collection each month; this comes out to approximately 350 artifacts. During the inventory we check that the object is in the correct location, and we look for any issues such as pest infestation, flaking, breakage, discoloration, and other damages. Staff record the changes in the object's file. Staff can also recommend conservation treatment to an artifact if the damage is severe or if the artifact appears to need stabilization. Currently, the museum has plans for several pieces to be professionally conserved.

A unique piece in the collection that has been determined to need conservation treatment is a pair of circa 1880 women's wedding slippers. Future treatment for the artifact will include stabilizing the weakened leather with appropriate materials and adhesives, cleaning and stabilizing the delicate beadwork, reattaching beadwork where possible, cleaning the surface using gentle archival methods, and creating internal supports for display and storage.

Susan Bonapart Palmer wore these slippers at her wedding to Lt. Ethen Smith of the 5th Cavalry on 17 May 1880. Smith went on in his career to become a major general. Artifacts like these slippers help to shed a unique perspective into the culture and lifestyles of frontier army wives during westward expansion.

Wives of enlisted soldiers who wanted to accompany their husbands in the West typically had to serve in manual labor positions such as Army laundresses,

2019, circa 1880 women's wedding slippers. Worn by Susan Bonapart Palmer on 17 May 1880. (Photo by Megan Hunter, Frontier Army Museum Collections [LEAV 91.30.1])

as servants in officers' homes, and as midwives. Army laundresses were the only women recognized by the Army and given legal status. This status afforded a few minor comforts such as a quarters and rations, which during the 1870s included bacon, beans, hardtack, and beef three times a week. Those who did not fall into this category were considered "camp followers."

Although accommodations and other considerations have vastly improved, Army spouses today still share similarities with spouses on the frontier. Frontier army wives that chose to accompany their husbands spent most of the time either travelling to a new assignment or alone waiting for weeks or months at a time for their husbands to return.

In 1868, Frances Mullen Boyd, wife of a second lieutenant, traveled from New York to Camp Halleck, Nevada. The trip took three steamers, two trains, a sled, stagecoach, and an ambulance wagon to reach her destination. After spending only a year at Camp Halleck, the couple traveled to San Francisco. Frances gave birth to a daughter and three weeks later traveled with her husband to a new assignment in the Arizona Territory. Frances and her children followed her husband to several more isolated posts throughout his military career until she returned to New York for the children's health.[18]

Hearing firsthand accounts like those of the Boyd family help us to feel connected to the past and better understand what life was like at that time. If you were to share this story with military families today, they would probably be able to see several similarities of the Boyd family with their own. Connections we make with artifacts and the stories they tell help us gain a deeper understanding of its history and significance in our world.

The Power of Storytelling

The care and storage of museum artifacts take a lot of time, effort, and funding. Is it worth it? What is the point of saving old stuff if it is going to eventually fall apart? Artifacts hold a certain power, the power of storytelling. Artifacts create an emotional connection with the viewer by bringing stories to life. Museums utilize these physical representations of history to allow visitors to experience a historic event in a more intimate way. Part of the Frontier Army Museum's mission is to educate soldiers, Department of the Army civilians, and civilians through material culture. Staff utilize artifacts in exhibits, in-person programming, and virtual education to help soldiers

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Frontier Army Museum: https://history.army.mil/museums/TRADOC/frontier-army-museum/index.html

Frontier Army Museum Facebook: https://www.facebook.com/FrontierArmyMuseum

Museum Online Audio Tour: https://frontierarmymuseum.oncell.com/en/24-buffalo-coats-80744.html

Center of Military History: https://history.army.mil/

and guests make a stronger connection with history. Artifacts help people relate to large historic events on a personal level. It is one thing to read about history in a book and another to experience and see firsthand history in a three-dimensional form. As a DOD civilian in the Army, I am proud to play an integral part in protecting and sharing the Army's historical story through artifacts. ■

Notes

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