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RESEARCH ARTICLE

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Lascaux Adhesives in Objects Conservation: Three Practical Case Studies on Leather, Skin, and Entomological Specimens

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ABSTRACT

Although BEVA 371 film is almost synonymous with leather and skin repairs because of its flexibility and ease of use, Lascaux adhesives 498HV, 303HV (formerly 360HV), and 498 20-X have also been used for years on these types of object treatments with successful results. Not only do they adhere well to leather and skin, but also to entomological specimens and other related organics. Lascaux adhesives are easy to handle, remain flexible when set, and adapt to different situations. This article explains multiple application methods: direct wet-application, as a heat-activated and solvent-activated coated lining, pressure-sensitive tape, and as a bulked adhesive shapeable fill material. Because original substrates are often thin or associated with areas of loss, suitable lining materials and bulking agents are also reviewed. Three case studies – a vegetable tanned leather doctor's bag, pinned butterflies, and a taxidermy golden eagle – demonstrate how the materials can be used in multiple treatment steps.

RÉSUMÉ

Bien que la flexibilité et la facilité d'utilisation du film BEVA 371 en fassent un adhésif incontournable pour la réparation de cuir et de peau, les adhésifs Lascaux 498HV, 303HV (précédemment 360HV) et 498 20-X ont aussi été utilisés avec succès sur ces types d'objets depuis plusieurs années. Non seulement adhèrent-ils bien au cuir et à la peau, mais aussi aux spécimens entomologiques et autres matériaux organiques assimilés. Les adhésifs Lascaux sont faciles à manipuler, gardent leur flexibilité après le séchage et s'adaptent à une variété de situations. Cet article décrit plusieurs méthodes d'application : application directe de l'adhésif liquide, réactivation à la chaleur et aux solvants d'un doublage précédemment enduit d'adhésif et séché avant utilisation, ruban autoadhésif, et adhésif mélangé à une charge pour former un comblement de lacune malléable. Étant donné que les substrats originaux sont souvent amincis et emplis de pertes, des matériaux de doublage et des agents structurants adaptés sont aussi présentés. Trois études de cas — une trousse de médecin tannée de manière végétale, des papillons épinglés, et un aigle royal en taxidermie — démontrent comment les matériaux peuvent être utilisés en plusieurs étapes de traitement. Traduit par Anne-Marie Guérin.

RESUMO

Embora o filme BEVA 371 seja quase sinônimo de reparos de couro e pele devido à sua flexibilidade e facilidade de uso, os adesivos Lascaux 498HV, 303HV (anteriormente 360HV) e 498 20-X também têm sido usados há anos nesses tipos de tratamentos de objetos com resultados satisfatórios. Não apenas aderem bem ao couro e à pele, mas também a espécimes entomológicos e outros orgânicos relacionados. Os adesivos Lascaux são fáceis de manusear, permanecem flexíveis quando fixados e se adaptam a diferentes situações. Este artigo explica vários métodos de aplicação: Aplicação direta úmida, como forro de revestimento ativado por calor e por solvente, filme sensível à pressão e como um material adesivo de preenchimento volumoso moldável. Como os substratos originais são frequentemente finos ou associados a áreas de perda, materiais de revestimento adequados e agentes de volume também são revisados. Três estudos de caso – uma bolsa de uso médico de couro vegetal curtido, borboletas presas e uma águia-real taxidermizada – demonstram como os materiais podem ser usados em várias etapas de tratamento. Traduzido por Andreh Maragno.

RESUMEN

Aunque la película BEVA 371 es casi sinónimo de reparaciones de cuero y piel debido a su flexibilidad y facilidad de uso, los adhesivos Lascaux 498HV, 303HV (anteriormente 360HV) y 498 20-X también se han utilizado durante años en este tipo de tratamientos de objetos con resultados exitosos. No solo se adhieren bien al cuero y la piel, sino también a especímenes entomológicos y otros compuestos orgánicos relacionados. Los adhesivos Lascaux son fáciles de manejar, se mantienen flexibles cuando se fraguan y se adaptan a diferentes situaciones. Este

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Lascaux adhesive 498HV 303HV 498 20-X; BEVA 371 film; leather and skin; taxidermy; vegetable tanned leather; pinned insect; entomology; butterflies

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artículo explica varios métodos de aplicación: aplicación húmeda directa, como una película sobre papel activada por medio de solvente o activada por calor, en cinta sensible a la presión y como material de relleno moldeable, tridimensional. Debido a que los sustratos originales a menudo son delgados o están asociados con áreas de pérdida, también se hace una revisión de los materiales utilizados para forrar y los agentes para hacer rellenos adecuados. Tres estudios de casos (un maletín de médico de cuero de curtición vegetal, mariposa atravesada por alfiler y un águila real disecada) demuestran cómo se pueden usar los materiales en múltiples pasos de tratamiento. Traducción: Amparo Rueda.

1. Introduction

Objects containing leather, skin, and other preserved animal parts demand a lot from repair materials. Successfully adhering tears can be difficult due to the fact that the hydrophilic materials will continue to fluctuate as they respond to environmental changes, and due to skin surfaces that are oily from preservation processes or spalling from red rot. Adhesives must have tack and remain flexible after setting, but should not penetrate far into the organic substrate to prevent staining and to aid in re-treatability. Even when utilizing "good" adhesives, tears are difficult to repair because of the small amount of original surface present on damaged edges. To combat this challenge, conservators have relied on flexible synthetic adhesives in conjunction with various linings placed behind joins to provide adequate surface areas/adhesive amounts (Kronthal et al. 2003; Horelick, McHugh, and Madden 2011; Holdcraft et al. 2020).

BEVA 371 film is a thermoplastic film often associated with leather repairs due to its flexibility and ease of application onto lining substrates (Nieuwenhuizen 1998; Kronthal et al. 2003). While BEVA remains a viable option, Lascaux adhesives have increasingly been utilized in object conservation, often in conjunction with lining materials such as Japanese tissue paper, spun-bond polyester, and goldbeater's skin (Kite and Thomson 2006; Holdcraft et al. 2020). These water-based acrylic emulsions are not harmful for humans, are easy to apply either wet or reactivated with heat, and remain flexible once set, providing a reliable alternative to BEVA 371 film. As an added bonus, Lascaux adhesives can be bulked with Japanese tissue fragments, glass microballoons, and other agents to create a lightweight spackle or paste fill that is easily applied and shaped.

This article aims to contribute to the body of knowledge for leather, skin, and preserved animal conservation, focusing on the use of Lascaux adhesives to repair tears and fill losses. This article will explore the properties that make them suitable for objects and provide recommendations for successful application. Three conservation treatment case studies will demonstrate the range of the Lascaux adhesives – focusing on an early twentieth-century vegetable tanned leather doctor's bag, two pinned butterflies, and one taxidermy specimen.

2. Materials

2.1. Adhesives for leather and skin

Although this paper focuses on the attributes of Lascaux adhesives, it does not negate other flexible conservation adhesives that could also be employed when repairing leather, skins, and other animal-based organic materials. BEVA 371 film, BEVA D8 dispersion, Jade R, and Paraloid F-10 have their place in the conservator's toolbox and brief pros and cons are listed for each. The authors hope that describing the adaptable uses of Lascaux adhesives in the subsequent sections will demonstrate their wider range of possibilities, making them more of a "Swiss knife" adhesive than those listed below.

- BEVA 371 film: A propriety mixture of thermoplastic elastomeric polymers with paraffin wax that has been formed into a film that can be applied to a wide range of lining materials using heat. It is transparent and glossy once set and remains flexible. Although the film can be melted and reformed with the addition of pigment and bulking agents, creating alternative forms is difficult and they are cumbersome to use. The film is not tacky and although it is available in two thicknesses, the commercially available amount can be difficult to activate if there is limited access to apply heat to a repair, which is often the case for taxidermy mounts and 3D objects. The film can be heat set on itself to create a thicker layer of adhesive.
- BEVA D8 dispersion: A ethylene-vinyl acetate dispersion that applies white and dries clear. The very low viscosity liquid adhesive can be painted onto a variety of materials and used as a heat-set coated lining or used wet (Bloser, Sybalsky, and Ritchie 2018). Although it has low viscosity and no initial tack, requiring brief clamping or holding into place, it does provide a working time of a few minutes and can be manipulated after setting using heat. It

adheres to wax and other smooth surfaces but may yellow with age.

- Jade R: An aqueous emulsion of polyvinyl acetate and ethylene vinyl acetate mix that is reversible in water after setting, unlike its predecessor Jade 403. This liquid adhesive has low viscosity and although there is some tack when wet, it dries smooth. It is not thermoplastic and can only be applied wet and reversed with water, which may cause shrinkage or tidelines on leather and skin. There have been anecdotal discussions on art conservation forums regarding its use and reversibility, but thus far no articles have been published on its use in object conservation.
- Paraloid F-10: A viscous thermoplastic butyl methacrylate adhesive purchased as 40% solids in mineral spirits and trace amounts of toluene, naphtha, and other solvents. Paraloid F-10, formerly Acryloid F-10, was manufactured by Dow and has been discontinued, but backstock is available by some conservation material suppliers. It can be painted onto linings and heat-set or wet-applied and can be bulked with glass microballoons and other agents (Nieuwenhuizen 1998; AMNH 2017). Although F-10 can adhere to many types of surfaces, including wax taxidermy manikins and finishing materials, the slow evaporation rate of the solvents can be frustrating under some circumstances and a bulked solution will slump while setting.

2.1.2. Lascaux adhesives 498HV, 303HV and 498 20-X

Lascaux 498HV and 303HV (formerly 360HV) are both aqueous acrylic emulsions of butyl acrylate thickened with methacrylic acid, manufactured by Suisse company Lascaux Colours & Restauro. Lascaux 498 20-X is chemically identical to 498HV however contains 15–20% xylene thinner which provides a longer setting time. The adhesives are stabilized against mold growth with an added biocide and pH range 8–9. Although slightly higher than neutral pH7, this range is still considered "conservation-grade" (Kilby 1995). Lascaux adhesives in liquid form can be diluted with water. However, once set they are insoluble in water, white spirits, naphtha, etc., but remain soluble in acetone, toluene, and xylene. As thermoplastic adhesives, they can be applied wet or as film reactivated with solvent or heat – approximately 154.4–168.8°F (68–76°C) for Lascaux 498HV/498 20-X, and approximately 122°F (50°C) for 303HV. Both 498HV/498 20-X and 303HV are slightly viscous and easy to control when wet, flexible and clear once dry. The most notable difference between the adhesives is that the 303HV remains tacky once set.

2.1.3. Adhesive mix of Lascaux 498HV and 303HV

While 498HV is a strong and flexible adhesive on its own, adding 303HV provides a tacky quality during both heat-set and wet applications. The tack from the 303HV acts as a natural clamp to "grab" components of the repair – the original leather or skin substrate and the lining material. This tacky quality also helps in situations when the original substrate is slightly oily and does not take adhesive well. Adding any amount of 303HV can be beneficial to the adhesive mix, based on the type and condition of the leather and the type of repair. A 3:1 ratio of 489HV:303HV is a good starting point, and more 303HV may be added if increased tack is required. Lascaux 498 20-X mixed with the other Lascaux adhesives has not been explored by the authors but has great potential for future study.

2.2. Types of lining materials

Common conservation lining materials are Japanese tissue paper, spun-bond polyesters (such as Reemay and Hollytex), and gutskins (such as Goldbeater's skin and natural sausage casings) (Anderson and Puglia 2003; Horelick, McHugh, and Madden 2011; Mahony 2013; Holdcraft et al. 2020). The conservator's personal preference on the working properties may be the ultimate factor when deciding which lining to use.

Japanese tissue paper is a versatile lining that also can be shaped to mimic a variety of forms and surfaces. It is available in different thicknesses and finishes, from thin, translucent, and soft, to thick and glossy. The cellulose fibers are thin, but the handmade interwoven structure of the paper makes it strong. Made from organic material, Japanese tissue paper responds well to the water component of the Lascaux adhesive, which can be advantageous when applying the lining because it will contour to the object. This quality can also be tricky, however, since it is difficult to handle when damp. Japanese tissue is soft enough that it can also be used as a fill material, when mixed with Lascaux adhesive to form a paste. Japanese tissue paper can be dyed or colored with all types of colorants (paints, watercolor pencils, "restoration paints," etc.).

Spun-bond polyester "fabrics," such as those under the trade names Reemay and Hollytex, are created by "bonding together extruded spun filaments of polyester to create a consistent web of material" ("What is Spun Bond Polyester?" www.nolarindustries.com). The process creates a lining material that is durable, stable, flexible, and available in a variety of weights. The thicker weight absorbs more heat when using this application method, which in turn may make this method more difficult to apply. However, it does not curl when

applying Lascaux adhesives, making it easier to handle them wet when compared to Japanese tissue. Although its non-absorbent property may be desirable in some situations, it limits the types of colorants that one can use when toning.

Goldbeater's skin and natural sausage casings are made from mammal intestine. Goldbeater's skin was traditionally made from the outer membrane of ox intestine and was used as the interleaving when pounding gold into sheet for gold leaf. Today the material is made from ox or other cattle, and is processed into 1- or 2-ply sheets of translucent tawny-color, or alum-tawed translucent white color. They are available through art conservation supply companies. Natural sausage casings are made from hog intestine membrane that has been cleaned and processed to be food-grade quality. The casings are sold by online distributors and arrive in packages of salt, requiring a thorough water rinse before using for conservation treatments. Goldbeater's skin and natural sausage casings are very strong, require low heat to activate when used in that application method, and can conform to surfaces easily. However, the organic material curls easily when applying the aqueous Lascaux adhesives, and it cannot be toned with as many types of media as Japanese tissue paper.

When selecting lining material for leather and skin repair, consider strength, thickness, and in some cases, ability to take colorants and blend with original substrate.

2.3. Types of bulking materials for fills

As with lining materials, the choice of which bulking agent to use for a bulked adhesive fill ultimately rests with the conservator's personal preference for working qualities. The case studies presented in the following sections utilized glass microballoons and Japanese tissue fibers.

Glass microballoons or glass microspheres look like a fine powder but are tiny hollow glass spheres made of soda-lime-borosilicate glass. The bulking agent is chemically stable, does not absorb water or shrink, and does not alter the color of the adhesive. Although available in different sizes and grades, the most common available through conservation supply companies is K25, manufactured by 3M. The K series has a high strength-to-weight ratio and is thermally stable. Wear a particle mask and nitrile gloves when handling and mixing in microballoons to prevent inhalation and skin irritation.

Fibers of Japanese tissue paper described in the lining materials section can also bulk Lascaux adhesives to form a paste. Although any weight of paper can be used, it may be most efficient to tease fibers from a lightweight grade of tissue using tweezers. Slightly dampening the tissue with water first will also aid in teasing individual or clumps fibers. Although cellulose powder could also be used (as described in a cellulosic basket treatment by Ledoux 2012), the teased tissue fibers are longer and create a paste matrix that may be easier to work with for some conservators. Larger fragments may also be used in a papier mache manner, as described in the techniques section. Commercially available paper pulp made from 100% cotton rag fibers do provide varying lengths of fibers and are useful for bulking larger areas. These pulps are produced for handmade papermaking and are available at art supply stores and specialty shops. Additionally, pulp of specific length and color may be produced in a conservation lab by blending or beating fibers, traditional techniques in filling losses in paper conservation ("BPG Filling of Losses" 2021).

3. Repair and fill techniques

Before carrying out adhesive-based treatments on leather and skin objects, carefully consider the condition of the object material. If brittle, water-based and heat-setting adhesives should be used cautiously to avoid shrinkage or decay. Also, consider the strength of the adhesive repairs versus the strength of the leather or skin. Do not choose repair materials that are significantly stronger than the leather, ensuring that the repair fails before the leather is further damaged.

3.1. Wet application tear repairs

To apply the adhesives and mixes as wet applications, paint a thin layer of the mixture to each edge of the repair and gently finger clamp together until set. An added bonus of the water-based adhesives is that the water component can help relax the collagen fibers of the leather or skin for small-scale local humidification. While the original substrate does not necessarily need to be painted first with a small amount of adhesive, the authors have found that doing so yields more successful repairs. The thin edges of leather and skin almost always benefit from the use of a lining, as well. When using a lining, apply the adhesive to the edges of the original substrate first, then paint onto the lining and position it into place. Finger clamp until set.

3.2. Heat-set tear repairs

Utilizing these thermoplastic adhesives for heat-set application ensures that the repair is set in less time

and without using a clamp, which is useful when the object is oddly-shaped and/or there is limited access. Place the lining material over a piece of silicone release Mylar to prevent adhesion to the workbench, then paint the adhesives to the desired thickness (Figure 1). The thicker the adhesive layer on the lining, the easier and faster the heat-set, which is advantageous when attempting to limit heat exposure. More adhesive can be applied at any point, building up the layer to reach the desired working amount. Painting additional adhesive layers is faster and easier than when working with BEVA 371 film, which can only be thickened by using heat to apply extra layers. After the adhesive layer has dried, cut the lining to required size for the repair and peel off Mylar. Using tweezers (if helpful) to position the lining adhesive side down on the object, apply heat using a heat spatula with Teflon-coated foot (Figure 2). The Teflon coating prevents the adhesive from sticking to the spatula. If the adhesive mix has been applied to the original substrate first, the tackiness on the substrate and lining will grab and allow the lining to be pressed into place, making the heat application easier and faster.

3.3. Solvent-activated tear repairs

For leather and skin objects that may deteriorate or stain when exposed to water in the wet-set application, and that may shrink if exposed to heat in the heat-set method, Lascaux-coated linings can be re-activated using solvents nonpolar solvents, such as xylene

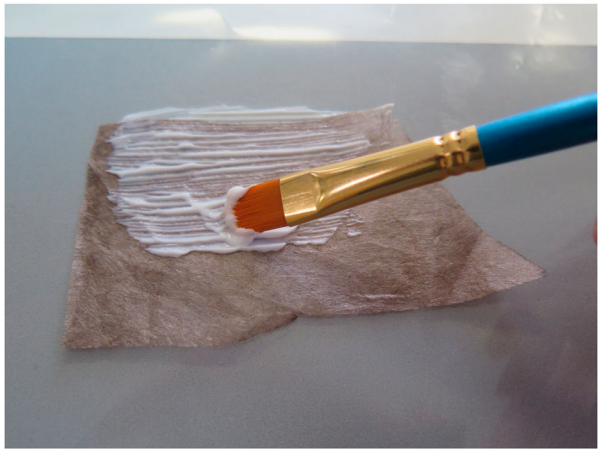

Figure 1. Coating toned lining material with an even layer of Lascaux 498HV and 303HV adhesive mix (3:1). A piece of silicone release Mylar should be placed beneath the lining material before applying the adhesive, to prevent sticking to the table. More adhesive can be brushed onto the lining, if a thicker adhesive layer is desirable. All images courtesy the authors.

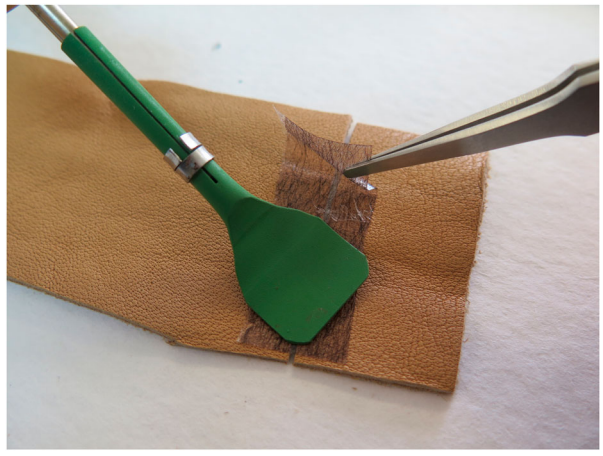

Figure 2. The green Teflon-coated heat spatula tacking down a piece of adhesive-coated lining on a leather surface.

(Mahony 2013). Lascaux 498HV can be used on its own (Anderson and Puglia 2003), or a ratio of 498HV:303HV (Sturge 2011; Mahony 2013). The solvent is applied via brush onto the lining prior to positioning, or once in place, depending on access. Although these characteristics are helpful in certain circumstances, the use of solvents introduces higher human toxicity and requires use of fume hood or respirator, making this method a less safe and more cumbersome option.

3.4. Pressure-sensitive "Tape"

Lascaux 303HV can be applied to a lining material using the same technique mentioned previously, but *without* the addition of the 498HV. Once dry, the tackiness of the 303HV creates a pressure-sensitive tape. If the tape is too strong, methyl cellulose can be added to the adhesive before application.

3.5. Filling areas of loss

To fill an area of loss, Lascaux adhesives can be mixed to a paste or lightweight spackle. For the paste, mix Lascaux 498 HV or 498 20-X with Japanese tissue, paper pulp, or cellulose powder to form a consistency that can be applied and smoothed with a metal microspatula (Figure 3). For the lightweight spackle, mix Lascaux 498HV or 498 20-X with glass microballoons until it is viscous enough to shape with a microspatula (Figure 4). For larger losses that require more severe reconstruction, Japanese tissue or spun-bond polyester and Lascaux can be applied in a method similar to paper mache. This entails applying a thin layer of adhesive, followed by a lining layer continued until

Figure 3. Bulked adhesive paste (top of the image, on tip of microspatula) formed by mixing Lascaux 498 20-X (bottom left corner) with teased Japanese tissue fibers (bottom right corner).

the desired thickness is achieved. Due to the thermoplastic property of 498HV and 498 20-V, these fills may be further shaped after drying using a heated spatula.

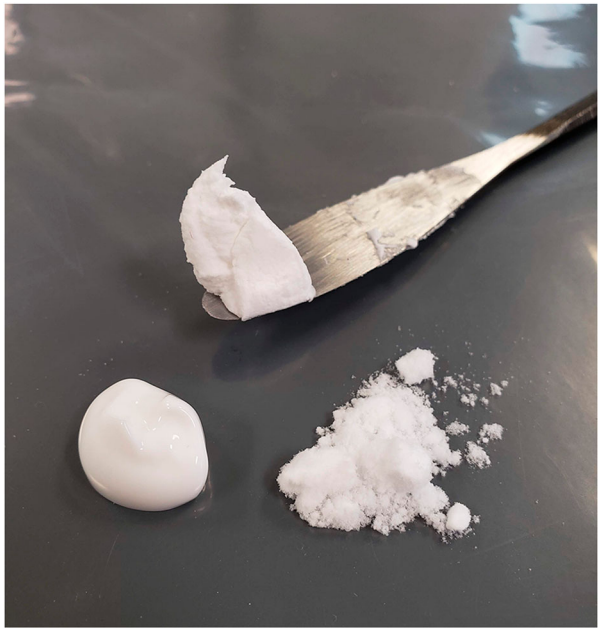

Figure 4. Bulked adhesive lightweight spackle (top of the image, on tip of microspatula) formed by mixing Lascaux 498HV (bottom left corner) with glass microballoons (bottom right corner) until achieving a thick, smooth consistency that is drier than toothpaste.

4. Case studies utilizing Lascaux adhesives for repairs and fills

4.1. Zane Grey's doctor bag

4.1.1. Description and background

A leather doctor's bag was treated by Objects Conservator Fran Ritchie at the National Park Service's (NPS) Harpers Ferry Center. The bag was used by author Zane Grey during the turn of the twentieth century when he practiced dentistry before pursuing a career in writing western novels, for which he gained notoriety. Grey and his family lived in a farmhouse in Lackawaxen, Pennsylvania, and the home is currently on display as part of the NPS Upper Delaware Scenic and Recreational River site.

The vegetable tanned leather bag has a cream-color painted cloth interior, a center leather-covered metal frame and metal clasps for closing, and a carrying handle. The interior leather is sewn to laminated paper to create thicker, more substantial walls on the long sides of the bag, creating the shape of the bag and supporting the metal frame. The opening and closing of the bag relies on the flexibility of the leather end pieces.

4.1.2. Condition

The embrittled leather of the doctor's bag could no longer flex when the metal frame was opened and closed. Each end tore from the seams, exposing the cloth interior and causing the bag to slump (Figures 5 and 6). The leather curled along the edges of the long

Figure 5. Embrittled and broken leather of end one of Zane Grey's doctor bag from Upper Delaware Scenic and Recreational River NPS site (UPDE 1058).

Figure 6. Embrittled and broken leather of end two of Zane Grey's doctor bag.

sections/body of the bag, as well as from the metal frame. The bag could not be displayed in its deteriorated state, and intervention was required to prevent further loss to the torn edges of leather.

4.1.3. Treatment

After the conservator performed overall surface cleaning with a brush and HEPA vacuum, the tears in the end pieces of the bag were stabilized using a lining of toned medium weight spun-bond polyester sheeting coated with a 3:1 mixture of Lascaux 498HV and 303HV. First, the torn edges of the bag were painted with a thin layer of the Lascaux mixture that was allowed to dry. Then thin pieces of the coated lining were placed on the interior side of the leather and set into place using a heat spatula with a Teflon-coated tip (Figure 7).

After the end pieces were repaired, gaps remained between the body of the bag and the ends, due to shrinkage of the leather. The leather was too brittle to "force" into its original position, so a toned fill was added to bridge the gap, creating a visually integrated support. The same Lascaux mix was applied with a brush to the edges of the leather on each side of the gap, then the tinted and coated spun-bond polyester was heat-set around the perimeter edges. Once in place the adhesive-coated side remained outward-facing, providing a surface onto which toned pieces of thick Japanese tissue paper were directly applied using heat (Figure 8). The tissue was painted to blend further with surrounding leather and thinner pieces of toned Japanese tissue were applied to feather the line between fill and leather (Figure 9). The process was repeated in two other gaps, the largest in size being approximately 15×7.5 cm and shown in Figures 8 and 9. With the repairs and fills in place, the bag is able to be opened and closed, if required.

Figure 7. Detail side view of one end of Zane Grey's doctor bag after torn pieces of leather were repaired using linings of toned medium weight spun-bond polyester sheeting coated with a 3:1 mixture of Lascaux 498HV and 303HV, adhered using heat applied with a Teflon-coated heat spatula on the interior surface. Note the gap that remains between the end piece of leather and the body of the bag, exposure the beige inner fabric lining.

Figure 8. During treatment images of one end of a doctor bag. After tears in the leather were lined and repaired, a large gap remained between sides of the bag, as illustrated in the image on the left. Due to shrinkage of the leather, the gap could not be closed and instead was supported and filled by applying a tinted piece of spun-bond polyester coated with Lascaux 498HV:303HV 3:1 mixture. After painting the adhesive mix to the interior of the leather edges, the fill was adhered around the perimeter of the gap using a heat spatula. Note the shiny appearance of the adhesive-coated toned fill in the image on the right.

Figure 9. During treatment image of one end of a doctor bag, the same area depicted in Figure 8, but with a toned fill of thick Japanese tissue paper applied directly onto the coated lining using heat applied by a heat spatula. The edges of the paper were then covered with a thin piece of Japanese tissue to feather the line between fill and leather, as shown circled in red. Both the fill and the thin tissue "feathers" were painted further to better integrate with the original leather.

Lifting leather on the metal frame was also secured with the Lascaux, but in these areas, more 303HV was added to the mixture to increase the tack for adhesion to the smooth metal. The mixture was applied with a brush to the metal and to the underside of the leather and clamped until set. Curling leather along the edges of the long sections/body of the bag were first relaxed into position using local humidification (damp blotter paper laid over a semi-permeable membrane). Shrinkage and loss of the leather in these areas also required a fill material. A piece of toned Japanese tissue paper was adhered on top of the edge of leather and extended over the gap of missing leather. Because the fibers on the edge of the tissue have a feathered effect, a lining or fill can be applied to the front (or top, in this case) of a repair and still blend with surrounding surfaces.

The spun-bond polyester and Japanese tissue paper were toned using Golden acrylic paint and QoR watercolor paint (Watercolor pigment mixed with Aquazol binder, sold by Golden Artist Colors, Inc.). Although now structurally stable and visually cohesive with the toned repairs and fills, the bag was not restored to look brand new, but instead retains the look of use (Figures 10 and 11). Scuffs/shallow abrasions in the leather were not toned because upon closer inspection it could not be determined whether the damage was recent. Although the vegetable tanned leather will continue to lose flexibility over time, with minimal handling it may be displayed for many more years.

Figure 10. End of the doctor bag depicted in Figures 7–9, after treatment to stabilize leather and fill gaps that could not be repositioned.

4.2. Two preserved butterfly specimens

4.2.1. Description and background

The two specimens from the entomological teaching collections at the Bournemouth Natural Science Society (BNSS) were brought to private conservation practice "Palumbo Conservation Services" for treatment by Natural History Conservator Bethany Palumbo. Miranda Birdwing Butterfly (*Troides miranda*), a species that inhabits Borneo and Sumatra, is yellow and black

Figure 11. After treatment of end two of the doctor bag. Before treatment, this end is depicted in Figure 6. Steps to stabilize the leather and fill gaps on this end of the bag are the same as those described for the opposite end, depicted in Figures 7–10.

in coloration and has a wingspan of approximately 15–20 cm. The second specimen, a male Dark Green Fritillary Butterfly (*Argynnis aglaja*) is a smaller species native to the United Kingdom. This species is orange and brown in coloration with a smaller wingspan of 6 cm.

4.2.2. Condition

Both specimens were in poor condition, with significant structural damage. All six legs, the head and abdomen of the Miranda Birdwing were detached but extant (Figure 12). The head and left forewing of the Dark Green Fritillary were detached but extant (Figure 13). In order to serve the BNSS as educational specimens, conservation treatment was required to fully restore them to an accurate representation of their species. Repair materials had to be suitable for the specimens' extreme natural fragility while withstanding the handling that occurs in teaching collections.

4.2.3. Treatment

Lascaux 498 20-X was selected as the adhesive of choice due to its flexibility and longer working time, allowing the segments to be adjusted slightly if necessary as they dried. The Miranda Birdwing was treated first. The specimen was turned onto its back and placed onto a piece of soft foam. Lascaux adhesive was applied to the legs and head which were gently guided into position on the thorax and secured with steel entomology pins, acting as a brace to hold each segment in place while the adhesive dried. The pins could then be removed. The abdomen of the Miranda Birdwing however was more complicated to attach. Due to the original preparation method, it was completely hollow, with little surface area on which to apply the adhesive. To remedy this, the Lascaux adhesive was mixed with Japanese tissue (Tengu 11gsm) to form a paste, which was applied approximately 5 mm into the abdomen and onto the adjacent area of the thorax. Once slightly tacky, the two sections could be adhered together with finger pressure. The repair was then secured in place with steel pins which were removed once the repair was dry (Figure 14).

The Dark Green Fritillary was also repaired using the Lascaux adhesive and Japanese tissue paste. It was applied

Figure 12. The broken but extant fragments of the Miranda Birdwing specimen before treatment. The specimen is from the entomological teaching collections at the Bournemouth Natural Science Society (BNSS).

Figure 13. The broken but extant fragments of the Dark Green Fritillary specimen before treatment. Courtesy of Bethany Palumbo.

Figure 14. After reattachment of broken Miranda Birdwing butterfly body parts using Lascaux 498 20-X applied directly and as a paste bulked with Japanese tissue fibers.

to the thorax with a microspatula and the left forewing and head positioned in place with gentle pressure (Figure 15). The specimen was then pinned onto a piece of soft foam to allow the repair to dry (Figure 16).

4.3. Golden eagle taxidermy mount

4.3.1. Description and background

The visitor's center of Bryce Canyon National Park exhibits taxidermy and cultural material to interpret the local flora, fauna, and human history of the park. The park is known for the columnar geologic features called hoodoo, and in the visitor's center, a taxidermy mount of a golden eagle perched on top of a faux hoodoo creates a striking visual encounter for tourists. The eagle is in a semi-flying pose with wings outstretched and mouth open, arrested in the act of shrieking at an intruder.

4.3.2. Condition

After years on open display, pest damage incurred on both feet – the eaten skin revealed the cartilage and bone of several digits (Figure 17). Pests may have also created a quarter-size area of loss in the skin on the front of the proper left leg (tarsus), which also revealed the interior proteinaceous and manikin materials (Figure 18). A moderate layer of dust accumulation coated the entire mount, obscuring the natural shine of bird feathers. NPS Objects Conservator Fran Ritchie completed treatment onsite at the park to stabilize and improve the appearance of the specimen.

Figure 15. Underside of the Dark Green Fritillary butterfly specimen with a repair to the thorax executed using bulked adhesive paste Lascaux 498 20-X with Japanese tissue fibers. Courtesy of Bethany Palumbo.

Figure 16. After reattachment of broken Dark Green Fritillary butterfly body parts using Lascaux 498 20-X bulked with Japanese tissue fibers to apply as an adhesive paste.

4.3.3. Treatment

After an overall cleaning using a soft bristle brush and vacuum, the losses in the feet were repaired by first covering the exposed inner materials with a wet application of Japanese tissue paper and 3:1 Lascaux 498HV:303HV mix. The tissue covering provided a barrier layer and

Figure 17. Golden eagle taxidermy mount with pest damage on the toe, resulting in loss of skin and exposure of internal soft tissue (circled in red). The mount is on display at Bryce Canyon National Park (BRCA 1393).

Figure 18. Loss of skin on the front of the proper left leg (tarsus) of a golden eagle taxidermy mount, revealing the interior proteinaceous and manikin materials (circled in red).

smooth surface onto which a fill material could be built and modeled to mimic the texture of the feet (Figure 19). Lascaux 498HV was bulked with glass microballoons until a thick paste/spackle consistency. The 303HV was not added to the mixture to ensure no dust would stick to it once dry. The final shaping of the spackle was achieved with a heat spatula, once again taking advantage of the thermoplastic properties of 498HV. The fill was toned with QoR watercolor paint (Figure 20).

Figure 19. Area of skin loss on a taxidermy golden eagle toe that has been rebuilt using lightweight spackle of Lascaux 498HV bulked with glass microballoons (the white material).

Figure 20. Bulked adhesive fill from Figure 19 after being toned with QoR watercolor paint to integrate visually with surrounding original skin.

The skin loss on the leg was also stabilized and restored. A piece of Japanese tissue paper large enough to cover the loss was coated with the Lascaux mix and once dry, inserted under the edges of extant skin. Because the leg skin is thin, a heat spatula could activate the adhesive coating when the heat was applied to the top of the skin – a necessary quality since the back of the lining was inaccessible. The bulked Lascaux

Figure 21. Area of loss on the taxidermy golden eagle leg filled with a lightweight spackle of bulked Lascaux 498HV and glass microballoons.

Figure 22. Fill on the taxidermy golden eagle leg from Figure 21 after final blending with trimmed poultry feathers. The feathers were adhered by first dipping the ends of the quills in a tiny amount of Lascaux 498HV and then inserting beneath original feathers.

498HV was spread onto the tissue paper with a microspatula to the required thickness to level the repair with surrounding skin (Figure 21). Thin pieces of Japanese tissue with feathered edges were added around the perimeter of the fill to blend the edges, set using heat that activated the Lascaux fill material. After drying the spackle was toned with QoR watercolor paint. To further blend the repair, trimmed poultry feathers were inserted under existing feathers and extended over the fill (Figure 22). The quill ends were first inserted into a small amount of Lascaux 498HV, then immediately tucked into place under extant feathers.

5. Other considerations

5.1. Reversibility/re-treatability

As with other acrylic emulsions and adhesives that can penetrate organic materials, Lascaux when applied wet is not a 100% reversible treatment. The adhesive lining can be removed by applying heat or solvents such as acetone, xylene or toluene (Anderson and Puglia 2003). However, portions of the adhesive that were absorbed by the collagen fibers will remain and be visible as shiny areas. Even if a lining was applied using the heat-set method and therefore did not deeply penetrate the collagen fibers, there most likely will be a ghosting on the surface of the lining is removed. If a previous fill or repair fails, the area may be re-treated, since a Lascaux lining can be removed and fresh adhesive can be applied on top of existing adhesive.

5.2. Pre-mixed adhesives

Lascaux adhesive is pre-mixed and therefore conservators do not have control over exact formulations and ingredients. Although the company has been transparent on the use of a biocide, the exact components and ratios remain a trade secret and require trusting the manufacturer. In addition, the solvents used in its manufacture cannot be altered. Unlike 498HV and 303HV, Lascaux 498-20X contains 15–20% xylenes and trace amounts of ammonia and 1,2-Benzisothiazol-3(2H)-ONE (SDS provided by manufacturer, 2017 revision). Conservators who are familiar with the aqueous line of Lascaux products may be surprised to find these additions.

6. Conclusion

While BEVA film, BEVA D8 dispersion, Jade R, and Paraloid F-10 remain viable adhesives, the Lascaux adhesives should not be overlooked by conservators working on organic materials, especially leather, skin, and preserved animals. Lascaux 498HV and 303HV, mixes of the two, and 498 20-X are versatile adhesives that can be applied in different ways on different types of materials, as the case studies demonstrate. In the treatment of a deteriorating vegetable tanned leather doctor bag, a 3:1 mixture of Lascaux 498HV and 303HV was used to coat toned spun-bond polyester for use as a heat-activated repair lining. To reattach fragile butterfly segments, Lascaux 498 20-X was used in wet application, and as a bulked adhesive with teased Japanese tissue fibers. The manipulation of Lascaux 498HV was further demonstrated when bulked with glass microballoons and used as a fill for missing skin on the feet of a golden eagle taxidermy mount. In one project, Lascaux adhesives can provide structural support as repair linings, as well as esthetic compensations in the form of easily applied and toned bulked fills.

Just as the other flexible adhesives commonly used on leather and skin objects, the pre-mixed Lascaux adhesives are made to a manufacturer's formula which will never be completely known and may be altered at any time. Leather and animal skin is also extremely fibrous, meaning that applying adhesives will never be 100% reversible. Thermoplastic Lascaux adhesives give the conservator the option to apply wet or using heat, which minimizes penetration. Lascaux adhesives are easy to access and apply, can be coated onto different linings (such as Japanese tissue paper, spun-bond polyester, and goldbeater's

skin), and can be mixed with many types of bulking agents (such as Japanese tissue fibers and glass microballoons, among others). The strictly water-based 498HV and 303HV are easily transported and used without fear of exposure to chemicals or flammability. They dry clear and remain flexible over time.

Ultimately the working properties of one adhesive, plus lining or bulking materials, may be better for certain projects over others and it is up to the conservator to assess suitability. The authors hope that this article has made a case for adding Lascaux adhesives to the toolbox, if not already in it.

Sources of materials

Preservation Equipment Ltd
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