The Care of Feathers

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The delicacy, resiliency, and exquisite beauty of feathers have captivated people for centuries. Almost every culture has used feathers in some manner to enhance personal adornments, sacred or ritual objects, and decorative arts. Feathers also have many functional uses, down comforters and quill pens come readily to mind.

Feathers are sometimes collected individually for their inherent beauty. More often, feathers are used in conjunction with other materials, sometimes as the focus of a piece, as in a feather lei, sometimes as part of an assemblage, as in an 'uli 'uli. The type of artifact and the techniques used to manufacture it will determine an individual artifact's treatment. The public is always welcome to make an appointment with a conservator to have individual artifacts examined.

Because of the scope of feather work, this article will not go into the care of the varied types of artifacts. Rather, it will discuss the feathers themselves to allow better understanding of their structure, sensitivity to the environment, and need for care.

What is a feather?

Structure

Feathers are composed of about 91% protein, 8% water, and 1% lipids. The type of protein in feathers is called keratin, a sulfur containing, fibrous protein. The structure of the keratin gives the feather its strength and suppleness. The two types of feathers most commonly used in artifacts are the contour and down feathers.

Contour feathers are those found on the backs and wings. The central stem, or rachis, of the feather is constructed of a thin, solid outer layer. The interior is thick and spongier, stiffened by internal ridges. The rachis is more commonlyreferred to as the quill. Barbs project from either side of the rachis to make up the body of the feather, or vane. Each barb has a fine network of barbules. Interlocking hooklets on the barbules give feathers their stiffness and flexibility. It is the undamaged hooklets which allow you to run your fingers up a split vane and make it whole again.

The down feathers are usually found under the contour feathers and provide warmth to the bird. These feathers have shorter quills and barbules without hooklets. This gives the feathers a softer, fluffier appearance.

Color

Feather color occurs because of two different phenomena. The first involves the absorption of specific wavelengths of light by certain chemical molecules in the feathers. The unabsorbed light is seen as colored. For example, melanins form brown, dull yellow, or black pigments. Carotenoids form the brighter yellow, reds, and oranges. The second phenomenon is caused by the structure of the feather. The surface layers of keratin have many air filled spaces which form reflecting or refracting surfaces to scatter light. Again, we see this as color. Many of the blues, some of the whites and the iridescence seen on feathers is caused by structural pigmentation.

Surface Coating

Feathers often seem water repellant. When birds preen, they rub their bills and heads against uropygial glands. These glands secrete oils which the birds transfer to their wing and body feathers. The secretions keep the feathers from drying out and help them to remain supple and healthy.

What can hurt feathers?

Insects

Devastation by insect infestation is quite common. Because keratin contains sulfur, it is an attractive food item to some types of insects. Clothing moths and dermestid beetles are especially fond of keratin containing materials.

In Hawai'i, the most common type of clothing moth is the casemaking clothes moth Tinea pellionella (L.). It is approximately 1/4" long, with a slender, dusty-brownish body. On close inspection, the moths have a characteristic pattern of three indistinct dots on the lower portion of each wing. Adults have no mouth parts and cannot eat the feathers. It is the larvae, identifiable by the tubular shaped cases that it spins, which causes the damage. Often pieces of the feather that the larva is feeding on are included in the case so that cases are similar in color and texture to the feathers. Larvae cannot live outside of their cases.

Dermestid beetles also feed on keratin containing materials. Two of the many beetles found in Hawai'i are the common carpet beetle Anthrenus scrophulariae (L.) and the varied carpet beetle Anthrenus verbasci (L.). Again, it is the larvae which feed on and damage feathers. The larvae appear fuzzy because of the numerous hairs which extend from their bodies. A tell-tale feature of the dermestid beetle is that the tail hairs are longer than the dorsal, or side, hairs. Larvae often appear larger than the mature adult beetle.

Dust

Dust is another common problem in the home. Dust is readily caught and embedded in the feather structure. Oils on the surface of the feather can also trap and hold dust. Dust in Hawai'i commonly contains mineral particles and cellulose fibers. The abrasive quality of the mineral component can tear or damage hooklets and barbules if dust is not removed carefully. The salt and fibrous components tend to attract and hold moisture. Microscopically, this tends to raise the humidity on the surface of the feather. Deterioration is accelerated, especially in very acidic or alkaline environments. Surface deterioration will result in loss of the sheen and smoothness of feathers.

Light

An obvious cause of damage is color fading from exposure to light. Although less obvious, light may also cause other types of damage. As the energy contained in light strikes your feathers, it will begin to break molecular

bonds. The breaking of these bonds results in color fading or change, yellowing, and embrittlement of the feathers. If exposed to direct, intense light, damage occurs very quickly and is immediately obvious. Just as dangerous is exposure to moderate light levels over extended periods of time. Light damage is cumulative, and will slowly build up over the years. Although your feather cape may have been hanging in a dim corner of the living room, over the years the daily exposure to low light levels will add to its gradual deterioration. Usually the first indication of damage is a littering of small pieces of broken feather barbs in the bottom of the case or box. By then, it is too late to salvage or repair the feather.

pH

pH is an arbitrary measurement of acidity and alkalinity. Appropriate pH is crucial to the preservation of feathers. Acidic (pH 6 or lower) environments will cause the chemical breakdown of the keratin, leading to weakening of the feather. Storing your feathers in wooden boxes or next to degrading paper or boards exposes them to acidic environments. The rate of damage will increase as temperature and relative humidity increase.

Alkali (pH 8 or higher) can also cause feathers to degrade. Alkali will affect much more of the keratin structure than acids, which are fairly specific in breaking down only the amino acid tryptophan. Alkali are found in many household cleansers, such as soaps, window cleaners, and laundry detergents.

Temperature and Humidity

Humidity will greatly affect feathers. Below 35% relative humidity, feathers rapidly desiccate. They become quite dry and brittle, and barbs will break off at the slightest pressure. In conditions of prolonged high humidity, acid hydrolysis is accelerated and even low quantities of acid in the feather or surrounding environment will cause feather break down.

Heat acts as a catalyst in many chemical reactions. High temperatures will speed the break down of feathers. In general, ambient temperature and daily fluctuations have fewer negative effects on feathers than seasonal changes in humidity. It is recommended to keep both humidity and temperature as even as possible.

Mechanical Abrasion

One of the easiest ways to damage feather is through mechanical abrasion. Handling or use of feathers will break the delicate hooklets and barbules of contour feathers. It is extremely easy to bend or break the quills, and

to abrade the surface of the feathers, destroying surface pigmentation and iridescence. The more handling the feather receives, the likelier chances are that irreversible damage will occur.

How can you protect your feathers?

Monitoring

One of the most important aspects in preserving your feathers is frequent monitoring of their condition. It may be possible to visually check your feathers without handling them. In all instances, unnecessary handling should be avoided. Monitoring would include checking on a weekly basis for signs of insect infestation, dust accumulation, light exposure, and environmental stability.

The most obvious sign of insect infestation is observation of adults or larvae on or near your feathers. Sometimes insects may not be visible, but there will be many broken bits of feather and a fine, granular dust underneath your feathers. These are the by-products of the insects as they eat your feathers. Infestations should be treated immediately to prevent spreading of the problem. If you should find an infestation in your collection, feel free to call a conservator for instruction in the proper methods of cleaning and sterilizing your feathers.

Cleaning

Artifacts left out on display often accumulate visible amounts of dust. If feathers are new and in very good condition, they can be gently dusted with a soft, natural bristle brush. The feather should be supported from the back and the dust then gently brushed away, following the direction of the feather vane. Remember that this type of cleaning constitutes mechanical abrasion. If the feathers are aged or at all delicate, damage may occur during brushing. This type of cleaning will also only remove surface dirt. If the dust build-up on the feather is significant, particulates embedded in the feather structure will not be removed. Likewise, oily dirt is often not affected.

People often wonder if feathers can be washed. Down comforters and coats are often washed or sent to the cleaners with no apparent ill effect. Ornamental feathers, however, are a different matter. Wetting will often break apart the hooklets in contour feathers. Decorative feathers are often commercially dyed, and these dyes can run or fade with washing. Natural pigments, too, can be affected by washing. Washing will destroy structural color and can darken an iridescent feather or make white feathers transparent. Dry cleaning may remove natural oils and cause feathers to dry out. A conservator can help you determine if cleaning is necessary or possible, and what kind of cleaning is appropriate for your feather work. Because of the delicate nature of feathers and the

potential for damage with any cleaning technique, it is best to protect feathers against dust and avoid cleaning if possible.

Storage Environment

Like people, feathers are affected by the environment in which they live. Providing feathers with a pH neutral and stable environment will prolong their lifetime. The ideal pH for feathers is 7, or neutral. Storage in a box or covered container is a good idea because the feathers are protected from dust and light exposure, and a box acts as a buffer during rapid fluctuations of temperature and humidity. However, most wood chests and cardboard boxes tend to be acidic, at pH 6 or less. The container then becomes the catalyst for deterioration of the feathers. Placement of the feathers in a good pH neutral box will provide you with all the benefits of a box without the fear of damage from acidity. At the end of this article is a short list of some of the archival suppliers who manufacture pH neutral storage boxes.

A good storage box will buffer your feathers against rapid changes in temperature and humidity. This means that the interior of the box will slowly reflect the changes in the ambient air outside. Recommended temperature and humidity ranges for feather are 60 degrees F to 75 degrees F and 45% to 55% relative humidity. If you live in an ideal environment, the conditions within your storage box will likely be ideal. If you live in a very hot and dry climate, the conditions in your box may eventually lead to desiccation. If you live in a warm, damp climate, the conditions in your box will likewise be warm and damp. You can create ideal mini environments in which to keep your artifacts with the use of 'air tight' containers and passive humidity controls, such as silica gel.

Exhibition

Feathers will always benefit from a good, pH neutral exhibit environment. A case will provide protection against dust and unwanted handling. Cases can be made environmentally sound without detracting from the beauty and design of the case itself. Regular glass can be replaced with ultraviolet filtering acrylic sheet. UF-3 Plexiglas® is available in Hawai'i. Woods can be sealed against acid migration into the case with a number of laminate barriers or sealers. pH neutral boards, papers, and tissues are available for use within the case, as are archival tapes, staples, and adhesives. Conservators can help in determining which materials and case design are most appropriate for your artifact.

Ideal standards

If you are fortunate enough to have feathers or featherwork in your possession, preventative maintenance is the key to their preservation. The sensitive nature of feathers makes them extremely susceptible to chemical and mechanical damage. Once feathers have been damaged, successful treatment and repair is extremely difficult. The benefits of proper storage and exhibit conditions and frequent monitoring cannot be stressed enough. With good preventative maintenance your feathers and feather work will be enjoyed by many generations to come.

Standards for Preservation of Feathers:

Minimal handling and dust protection are essential. The following are tolerances for other environmental variables.

- Temperature: 60 degrees F to 75 degrees F
- Humidity: 45% to 55%
- pH: 6.5 to 7.5
- Visible light: 50 lux or less (the amount of light in a dim room)
- Ultraviolet light: 75 microwatts per lumen or less

Supplier's List for Archival Storage Materials:

- University Products
  P.O. Box 101
  Holyoke, MA 01041
  1.800.762.1165

- Light Impressions
  439 Monrow Avenue
  Rochester, NY 14603-0940

- Hawaiian Graphics (for boards and papers)
  1925 Beretania Street
  Honolulu, HI 96822
  808.973.7171

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The State Museum of Natural and Cultural History
For Museum Information, call (808) 847-3511
Bishop Museum 1525 Bernice Street Honolulu Hawai'i 96817-0916 USA

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