

Bone, Antler, Ivory, and Teeth

Found in such items as tools, jewelry, and decorations

Identification and General Information

Items derived from skeletal materials are both versatile and durable. Bone, antler, ivory, and teeth have been used for various tools and for ornamentation. Because ivory is easily carved yet durable, it has also long been used by many cultures as a medium for recorded information.

Bones and teeth from many different animals, including mammals, birds, and fish, may be found in items in all shapes and sizes. Each culture uses the indigenous animals in its region. Identifying bones and teeth used in an item can be easy or difficult, depending on how they were processed and used. Frequently, bones and teeth were minimally processed, and the surfaces are still visible, allowing identification by color (off-white to pale yellow), shape, and composition. Bird, fish, and reptile bones are usually lighter in mass and color than mammal bones.

Bone and antler can be used in their natural form, or polished with sand and other abrasives to a very smooth and glossy surface. Bone is sometimes confused with ivory, which is also yellowish and compact. Sea mammal ivory, which is the prevalent source used by American Indians, is distinct in structure. Walrus ivory, the most common sea mammal ivory, has a dense outer layer and a mottled inner core.

Bone and antler in archaeological collections are often burnt and can be blue black to whitish gray. Charred bone or antler can be mistaken for wood. Magnification helps to distinguish bone from similar materials, as it has a thin solid layer surrounding a porous interior structure with a hollow core where the marrow is contained.

Antlers are composed of bone and are shed once a year. They have a soft membrane on

the outer surface (velvet) when first grown. The internal structure of antler is similar to bone, with a large porous area below the surface. Deteriorated archaeological antler can be confused with wood. The outer surfaces can be distinguished from bone by the fact that the larger sections of antlers generally have raised bumps and protrusions, whereas skeletal bones are smooth except in attachment areas.

Teeth have two major components: the root area, which is similar to bone in composition and appearance, and the upper surface, which consists of compact enamel. The root area is usually a yellowish tan color with a matte surface, and the enamel is shiny and can be white or yellowish white. The enamel layer is generally resistant to decay and breakage. The root section, however, can dry out and split, causing stresses to the enamel layer that may result in further delamination and breakage.

Bone, ivory, and teeth are composed of both mineral and carbon-based materials. The mineral part of bone is made up mostly of calcium, phosphorus, and fluoride. The carbon-based portion is composed of a protein called ossein. This protein is similar to the collagen found in skin.

In general, the conversion of bone, ivory, and teeth into usable materials for tools and ornaments includes the following essential steps:

1. Detaching: separating the bone, ivory, or teeth from the muscles and connective tissue of the animal
2. Cleaning: removing the blood and marrow from the interior of the bones
3. Drying slowly to avoid cracking and splitting
4. Working the bone, ivory, or teeth into the desired shape by cutting with stone or metal tools, grinding with stones, polishing with abrasives, and decorating incised areas

with pigments such as ochre or charcoal

The deterioration of bone, antler, ivory, and teeth is caused by

- extreme dryness;
- excess heat, which leads to destruction of the protein portion and loss of moisture, causing shrinkage and cracking of the surface;
- excess moisture, which leads to swelling of the protein portion and promotes mold growth;
- combination of excess heat and moisture, which destroys the ossein and can cause warping and cracking when the items dry out;
- rodent attack, especially on bones and the dentine of teeth;
- acids;
- exposure to strong visible and ultraviolet light, which causes bleaching of the natural color of ivory.

The following descriptions further clarify these materials.

Bone: material that makes up the skeleton of vertebrate animals.

Antler: the seasonally shed outgrowth of the skin and skull of various large mammals; similar in composition to bone.

Tooth: a bonelike structure rooted in sockets in the jaws of most vertebrates; teeth are generally composed of a core of soft pulp surrounded by a layer of hard dentine that is coated with enamel at the crown and is used to seize, hold, or chew.

Dentine: the calcareous part of a tooth, beneath the enamel, containing the pulp chambers

and root canals.

Ivory: the hard, smooth, yellowish white dentine that forms the main part of the tusks of sea mammals and of living and extinct elephants.

Basic Care and Storage

A consistent temperature and humidity are important for these materials. Generally a relative humidity level of not less than 30 percent in the winter and not more than 55 percent in the summer is best, with fluctuations of not more than 15 percent during each season. When possible to achieve, the optimum temperature is 68° F with fluctuations of no more than +/- 3° a day. Avoid storing and exhibiting items containing bone, antler, ivory, or teeth near radiators, heat pipes, outside windows, or incandescent lights, which can cause excessive drying and temperature fluctuations.

Items with holes, straps, appendages, or other attachments must never be hung or supported by those attachments. A support can be provided at the base of the item, and the handle or strap can be supported in a natural position.

Special Pest Concerns

Bone, antler, ivory, and teeth items are not particularly susceptible to insects. Rodents and other small mammals can cause structural damage by gnawing on the surfaces of these items.

Maintaining good housekeeping, following an integrated pest management program in storage and display areas, and employing regular pest control services will help prevent infestations.

Consult your licensed pest control operator as to which methods best suit your situation.

Bone, antler, ivory, and teeth items can become infested with mold, particularly if the

relative humidity in the storage or display areas is allowed to exceed 60 percent for long periods of time. Mold infestations can be recognized by a white or greenish fuzzy growth on the surface of items. Good ventilation and air circulation in storage and display areas will help prevent mold. If mold does occur, take measures to reduce the relative humidity around the items, and ask a conservator about how to clean the surfaces safely. Personal safety is the primary concern when dealing with mold infestations, as many types of mold can cause serious and permanent health problems.

Routine Handling

The general methods and techniques for handling all items apply as well to bone, antler, ivory, and teeth (see *Handling Practices*). These items can be handled with bare hands as long as they are clean and dry. Body oils, however, can stain bone, antler, dentine, and enamel, especially those that are light colored and have a matte, porous surface texture. For this reason, wearing cotton or latex gloves is suggested for handling most items of bone, antler, ivory, or teeth.

When lifting and moving an item that contains bone, antler, ivory, or teeth, make certain that it is supported well and that no stress is placed on weak areas or attachment points. Use a tray or other support if necessary. This can be made from a piece of acid-free corrugated board that is cut to the standard sizes of drawers or other storage units.

Display Issues

The temperature and relative humidity ranges mentioned in the Basic Care and Storage section also apply to display conditions. Apply the display guidelines discussed in *Display* to items containing bone. Bone items are consistent in their reactions to display conditions.

Rotate bone, antler, ivory, and teeth items that are going to be used for display for an

extended period, such as five years. Light exposure will bleach surface color from ivory.

Incandescent floodlights inside cases and dioramas can cause extreme drying, leading to damage, especially of teeth. Consider the particular item itself when determining the length of time it can be used for display and the amount of light to which it should be exposed. Contact a conservator or exhibits lighting specialist for further details.

Mounts and Supports

External supports can be fabricated from acrylic plastic sheeting, such as Plexiglas, and shaped with heat to conform to an item's surface shape. It is best to attach items to mounts with padded wires or flat acrylic plastic clips. Avoid using metals directly in contact with bone, ivory, or teeth. The fats that might remain in those items will react with the metals, forming corrosion products that will permanently stain the items. Also, avoid all adhesive mounts.

Cleaning and Minor Repairs

Periodic inspection and maintenance is the best way to insure the long-term preservation of bone, antler, ivory, and teeth items. Surface dust can be removed with a variable speed vacuum, brushes, and micro-attachments (see *Cleaning Practices*). Soft, lint-free cloths can be used to remove minor accumulations of dust. If the soiling is heavier, vinyl eraser crumbs and vulcanized rubber sponges can be used to surface clean stable, compact bone and ivory surfaces. Care must be taken to inspect the item before cleaning for loose attachments and fragile decorations such as friable paint layers.

Avoid using liquid-based cleaners or detergents on bone, ivory, and teeth items. If further cleaning appears to be required after dust and soil has been removed with the methods suggested above, contact a conservator for advice.

Using over-the-counter adhesives to repair cracks and breaks is discouraged, as these repairs are difficult and may result in staining and embrittlement as the adhesives age. Breaks and cracks can be evidence of use and may provide historical information. Unnecessary repair of such damage can obscure historical evidence. Consult a conservator if major repairs are needed.

Avoid wax or other protective coatings as these can obscure surface details and can age over time, resulting in yellowed or darkened surfaces. These coatings can also become difficult or impossible to remove without damage to the item.