# Chapter 3:  Packing Methodologies

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Page numbering and some fonts in this version differ from the original book.

# Moving the Mountain:

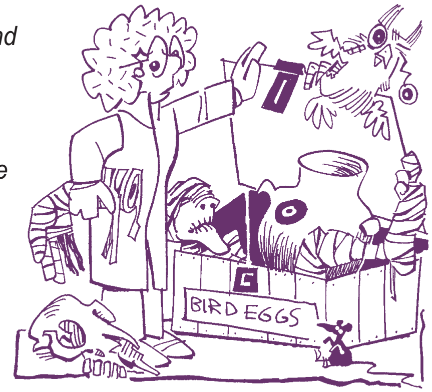
## The Science Museum of Minnesota Guide to Moving Collections

*Collections Management and Conservation Departments*
*The Science Museum of Minnesota*
*St. Paul, Minnesota*

# AN ANNOTATED TABLE OF CONTENTS FOR MOVING THE MOUNTAIN

## Part I: History of the SMM Move Project

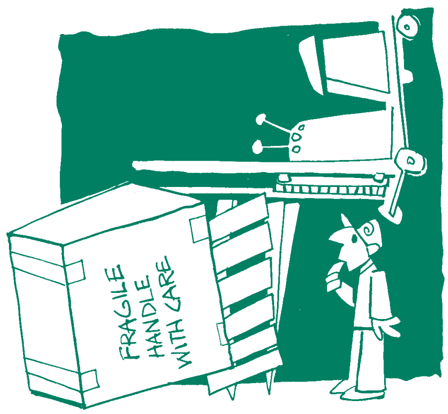
*This section, written by the major planners, describes the goals of the project and early planning considerations.*




## Part II: Moving the Collections

*Section II presents an overview and analysis of SMM procedures written for the most part by the staff who actually carried them out.*

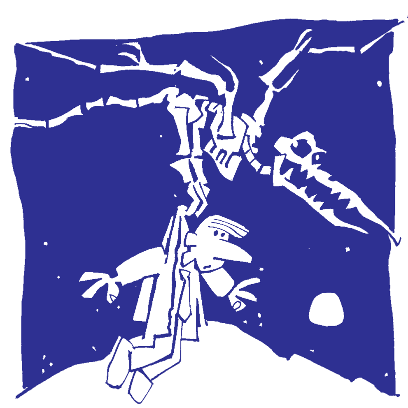





## Part III: Details

*This section includes an exhaustive description of our conservation technologies, written by the Conservator; the unique requirements of moving articulated fossils, from the Director of the Paleontology Program; and a close look at how the ethnology collections were put away in the new facility through the eyes of the Collections Technicians who did it.*





## Appendices:

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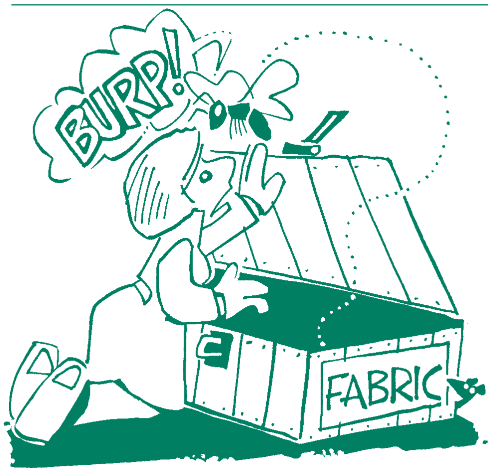
# Packing Methodologies

*Gretchen Anderson*
*Conservator*

## INTRODUCTION




For over ten years I have been working with practical ways to store and ship a wide range of artifacts and natural history specimens. I managed a major storage improvement project in our old facility funded by the Institute of Museum and Library Services (IMLS) as well the packing and crating of objects for many of our touring exhibits. SMM touring exhibitions focus on natural history and often move around the country for ten years or more with objects and specimens that are very fragile (e.g., taxidermy birds). The methods used to pack a dozen raptor eggs or an antique teddy bear could easily be turned to moving the collections.

When it became a reality that the museum was going to move, the Conservation Department began to apply what it had previously learned to safely moving and storing our 1.75 million specimens and objects. We also drew from workshops I had attended presented by the Canadian Conservation Institute (CCI) and the Society for the Preservation of Natural History Collections (SPNHC).

The basic idea was to make things as simple as possible. We initially planned a phased move, moving groups of objects and installing them into the new collections storage facility with as little handling as possible. While the schedule was dramatically shortened early into the project, we were still able to achieve a phased move by spreading out move days and by using SMM's offsite warehouse for interim storage of less sensitive materials. We were able to reuse a fair amount of packing materials as planned, thus reducing the amount we had to purchase and subsequently dispose of. Since we knew we would have more time on the front end of the move than the back end, we also wanted to construct proper, permanent storage mounts and containers (see page 18) that would not need to be replaced after the move. We were able to achieve this as well.

***Conservator Gretchen Anderson*** *in the spooky costume she donned for the Halloween party we held in the EMPTY old Vault!*

### Major Challenges for this Move

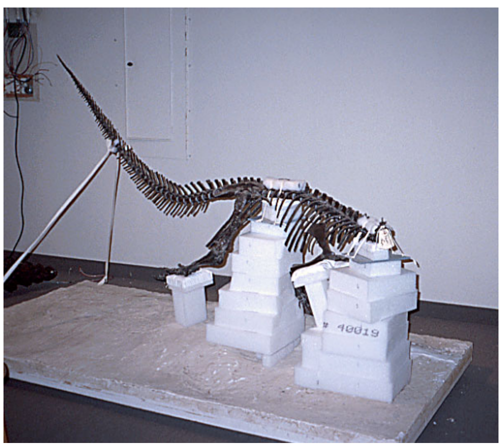
There was little space to pack or stage collections in the old facility.
Collections were so overcrowded in cabinets that we anticipated they would take up five to ten times as much space when packed to move (including packing materials).
Many dinosaurs had been constructed inside the building and would be a problem to get through doors or into the freight elevator.
We had limited staff, time, and budget.
We would need huge amounts of packing materials.

## SPECIAL NEEDS

We began planning packing by looking at ways we could systematize solutions into virtual production lines. All ethnology that would fit was to be packed in the new Delta drawers (which we had delivered to the old museum) so they were ready to install into their waiting cabinets; our old Kewaunee drawers were to be used as often as it suited the project as well (see Drawer into a Padded Tray on page 66). There were still many items that required special attention. The "scary things" were objects that did not fit into any manageable box or cart. Designated staff was devoted to these kind of problems.

Many specimens and ojects are large, awkward, and/or fragile and presented special problems. What do you do with a fully articulated, partially fossilized Pleistocene bison, a specimen that cracked if you looked at it cross-eyed? Since there was no way to take it apart, we constructed a series of braces and lashes to mitigate the vibrations. To do this, an entire cage was constructed around it. The specimen survived without damage. In addition, special condition reports were made that allowed us to track the many cracks that already existed in it.

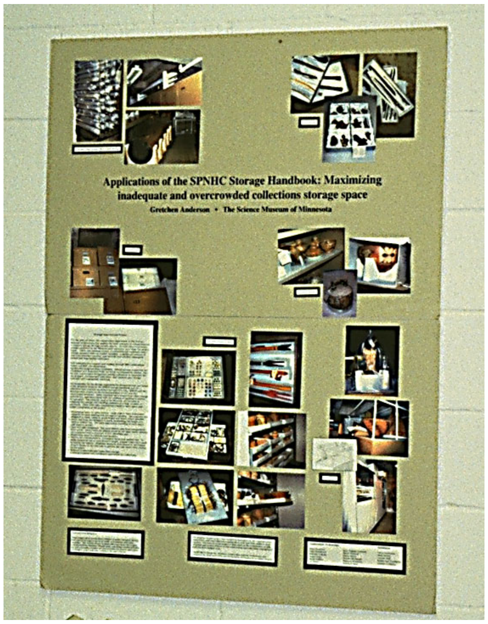
**Volunteer Jim Kreche and Part-time Staffer Brad Bredehoft**
*build a portable corral to move a bison.*



**Thescelosaurus**
*was carefully and completely braced with Ethafoam.*

What do you do with the plaster cast of a *Thescelosaurus* skeleton in a running pose, with one foot (and only one foot) on the ground, when the plaster is so brittle that each time it is jarred it cracks? A single Conservation Technician worked for over a week on this one. Using a combination of braces made out of Ethafoam and twill tape lashing, this former engineer was able to control the vibrations so there was no breakage during the move. It was transported on one of the special 4' x 8' carts describedon page 87. Not to mention the full-scale, mounted *Triceratops* with a skull that weighs a thousand pounds or the 15-foot *Mosasaurus* made of fragile plaster and suspended 18 feet above the lobby floor.

On the other end of the weight scale, what do you do with a huge wicker basket that barely fits on a pallet? This was an interesting problem, different from most in that the object was large and awkward but very light, leaving the pallet too light even to get a pallet jack under it with out major jarring. The problem was how to secure the basket without damaging the fragile structure. This would have been an ideal situation for a pallet with wheels, but by the time we encountered it we were short on time and out of wheels. The Conservation Department came up with a terrific solution: we padded a pallet with 1/4-inch Ethafoam and placed the basket on it, resting it on its rim, and placed a strap of elastic banding around two edges of the pallet. Finally, we took a length of muslin wider than the basket, threaded it through the banding and over the basket, applied enough pressure to keep the basket from moving but not so much as to put pressure on any single part of the basket, and tied it off near the strapping. In addition, some metates were tied in the center of the pallet to add weight. The move went perfectly!




**Training Poster**
*was displayed prominently in the Packing Room.*

## CRITERIA FOR PACKING

The materials we used for packing were very diverse. Wherever possible and practical, we used archival packing materials, especially for permanent storage mounts. For temporary shipping containers, we used whatever would work in the most efficient manner possible, even if it was not archival. We were looking at a 10-block move and anticipating that collections would not be kept in packing for more than six months.

Price was a factor in purchasing materials. Limiting the number of types of materials that we used in packing and standardizing box sizes as much as possible, we were able to purchase in bulk, thus reducing our cost.

Another reason for limiting the types of materials we used was to make it easier on the volunteers who were doing the actual work. A poster, shown at the left, was made identifying the primary types of archival packing we were using. This was posted in the packing room and available for reference during the entire process.

Criteria for choosing packing materials and methods were based on conservation standards and budget. The primary goal was to get the collections from the old building to the new facility without breaking anything.

Archival vs. nonarchival: We used archival materials whenever possible, but if the specimen was less sensitive to short-term contact with an acidic environment, the requirement was eased. For example, nonarchival boxes were used and reused for collections as needed as temporary shipping containers. Archival materials were used for all long-term storage and containers or if the object was particularly sensitive.

Reuse: The original plan was to move in phases. We wanted to reuse as many materials as possible for reasons of budget, storage, and disposal. Many shipping and storage materials do not degrade and take up huge amounts of room either in a warehouse or a landfill. Even with our compressed move schedule, we were able to reuse many cardboard boxes, pallets, and different kinds of padding, including the peanut pillows (see Definitions, page 62).

Simplicity: Given the range of collections held by the museum and the range of skill levels of the volunteers who worked on the move project, we needed to standardize and simplify the materials and methods that we used as much as possible. In addition, we had limited space to store bulk storage materials, so the fewer materials the better.

Fragility of the object or specimen type: The material that an object or specimen was made of determined what kinds of packing materials could surround it and how much packing there would be. For example, packing would be different for a bird (study skin or taxidermy) than for a mammal (study skin or taxidermy). Feathers are generally more fragile than fur and require a different style of packing.

Standard vs. customized packing: Whenever possible, standard-sized boxes and trays were used. This allowed us to purchase in larger quantity and get a price break on both both acid-free and acidic materials. When necessary, we built custom trays and boxes out of coroplast or other sheet material. We also customized standard acid-free trays.

Once we determined the material needs of a collection and had chosen the packing method, we wrote a protocol. The protocols were designed to describe the methods in a clear manner that could be easily understood by volunteers and non-Conservation staff members. The protocols were also designed to be flexible and adaptive so they could be used across similar types of collections. We supervised the packing process to assess how the protocols worked. This was facilitated by the fact that the Conservation Assistant supervised the volunteers as part of her job and spent most of her time in the Packing Room. The protocols were adapted and amended as necessary, based on the practical experiences of packing.

## Important Lessons

*We learned some important things about keeping a collection safe during the move:*

**Keep things simple:** By keeping both packing methods and materials simple, we were more efficient and we saved money.

**Know your staff (both paid and volunteer):** It was important to know what they were capable of doing. Make assignments that make sense. If someone is enthusiastic but has poor manual dexterity skills, find something they can do and praise them for it! One of our most dedicated volunteers was somewhat limited by his age but was very good at making peanut pillows, telling jokes, and keeping up morale. Assign the jobs based on indiviual skills.

**Keep things fun:** The work is hard and frequently tedious. Volunteers will not keep coming if they are not enjoying themselves. We varied projects and tried to schedule compatible people together. The Packing Room staff played an important role in keeping the volunteers happy.

**Know when to let go of an idea:** Prototypes often needed to be adjusted and adapted. Sometimes things needed to be simplified. Let those changes happen and listen to your staff and volunteers, as they are the ones doing the majority of the work. Allow others to run with your ideas. Volunteers came up with some great variations on the original designs, and they got the credit for it.

One of my favorite stories about this happened when a mentoring colleague from CCI was visiting. A volunteer had developed a very successful variation for mounting starfish and I had the pleasure of showing my colleague these mounts with the volunteer present. The volunteer received the compliments directly from the person who had taught me to use the materials.

As with any large project, there needs to be a common set of terms used to describe or explain what is to be done. This is like shorthand, so that when the work director says that certain specimens are to be packed with *snakes* or in *cavities*, everyone knows what that means.

## Containers Defined

**Containers** are what the object or specimen is placed in to protect it from damage in the move. We took a broad view of containers–they could be almost anything, from standard cardboard boxes (many sizes, archival, acidic) and old crates to storage drawers or cabinets. Cabinets were put on wheels. Drawers and boxes were stacked on pallets, shrink-wrapped, and banded to keep them from shifting. Some specimens were too large and awkward to be put in a standard box so "open crating" methods were used (see photo of spear box on page 65).

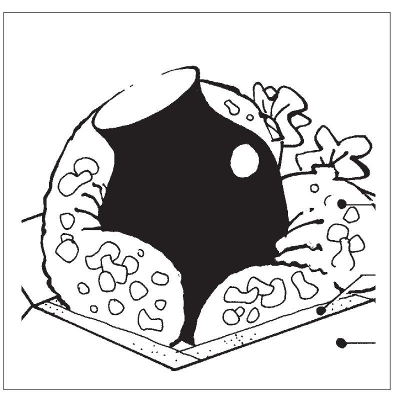
*Examples:* Smaller items such as shells; study skins; or lesser geology, invertebrate paleontology, and archaeological specimens could be placed in a Kewaunee drawer, padded, then stacked on a pallet. Ceramics, which were too large for the drawers, were placed in padded acidic boxes (acidic cartons were acceptable because they were for transfer only, not long-term storage, and they were less expensive). Large items that did not fit in boxes were placed on large wheeled carts (see Custom Carts on pages 86-87).

## Pads, Pillows, and Separators Defined

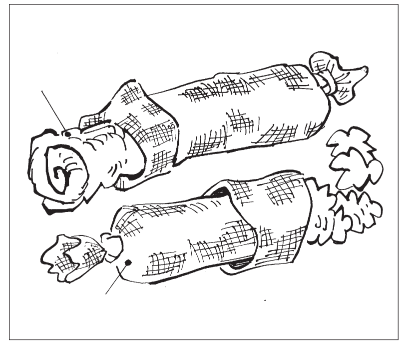
The **type of padding** used in each case was chosen by application of the previously described criteria. These materials provide buffering and anchoring against shifting as well as separation to keep breakables from colliding, abrading, or in other ways becoming damaged.

### Peanut Pillows

These were indispensable. They fit all of the criteria–reusable, simple to make, and flexible–and they can be form-fitted around most objects to keep them stable. To make the pillows, we used two sizes of polyethylene garbage bags and various sizes of zip locking plastic bags. The bag was partially filled with styrofoam peanuts, then as much air as possible was squeezed out and the bag was tied shut (a variety of methods were used: twist ties, tying the bag, or a cotton cord). The pillow could be formed around an object with as many pillows added as needed to stabilize it. The big advantage of the peanut pillow was that the peanuts stayed in one place; that is, in the pillow. Also, objects that were nested into the pillows could not settle to the bottom, and it was very easy to remove the peanuts in the bags since static electricity was not a factor. This was a great job for volunteers, especially those who wanted to help but did not have the dexterity to do more-complicated jobs.

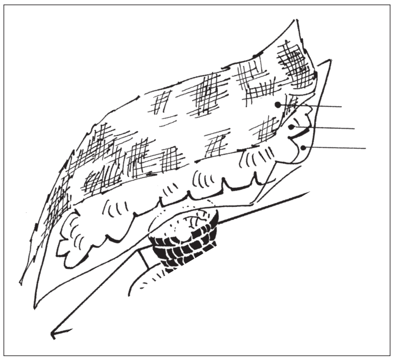


### Snakes



Two-inch cotton stockinet was cut to standardized lengths and stuffed with polyester batting. The ends were knotted. Snakes were used to stabilize and support objects. These are very flexible and provide soft and even support.

### Tyvek or Muslin Pillows/Layers



Another invaluable method we used to stabilize specimens and objects in bulk was to sandwich sheets of polyester batting between Tyvek and/or muslin. A layer of muslin or Tyvek was laid on the drawer full of specimens. The next layer was a sheet of polyester batting (thickness was determined by the amount of space needing to be filled). A layer of muslin was laid on top of the batting and the next drawer full of items was set on top. We had originally planned to actually sew pillows but found that for a short-term, one-time-only move, the layers were more than sufficient. All pieces were cut according to the standard-size Kewaunee or Delta drawers we were using as shipping containers.

Tyvek was used as the separator when the surface of the specimens or objects were fragile or susceptible to abrasion. The top layer of muslin prevented the batting from catching on the drawer above.

### Liners and Separators

In general, these are materials used to line containers, separate objects/specimens from each other, and provide some protection from movement. Materials could include any of the foams (1/8” to 1” thickness, determined by what was needed by the object), tissue, Tyvek, muslin, polyethelene sheeting, mylar, acid-free cardboard, or coroplast. Cardboard separators were often placed between objects to prevent them from colliding. Tissue was used to wrap an object to protect it from contact with its neighbor.

## Braces Defined

**Braces** were made from various materials determined by the needs of the object. For example, a large wooden slit drum was braced with a wooden structure and padded with Ethafoam and Tyvek. Smaller items might have employed a brace made of foam. Braces were used both as internal and external mounts. These help keep the objects stable. The photo at the right shows Ethafoam used as support and bracing for a dinosaur.

*Ethafoam Blocks were used extensively to support standing skeletons. These were cut to fit as a brace and then wrapped into place and secured with 1/4-inch Ethafoam sheeting.*

## Helpful Hints

**To cover Ethafoam with Tyvek,** cut slits in the Ethafoam into which you can push the edges of the piece of Tyvek.

**To create a ring for a ring mount**, cut a piece of backer cord the right size to support the base of the object and join its ends with hot glue to make a circle; glue to cardboard base.

**When using hot glue**, use an applicator like a wooden craft stick, otherwise the glue may melt the backer cord or Ethafoam.

**If hot glue drops on your skin**, let it cool before removing it and no skin will come with it.

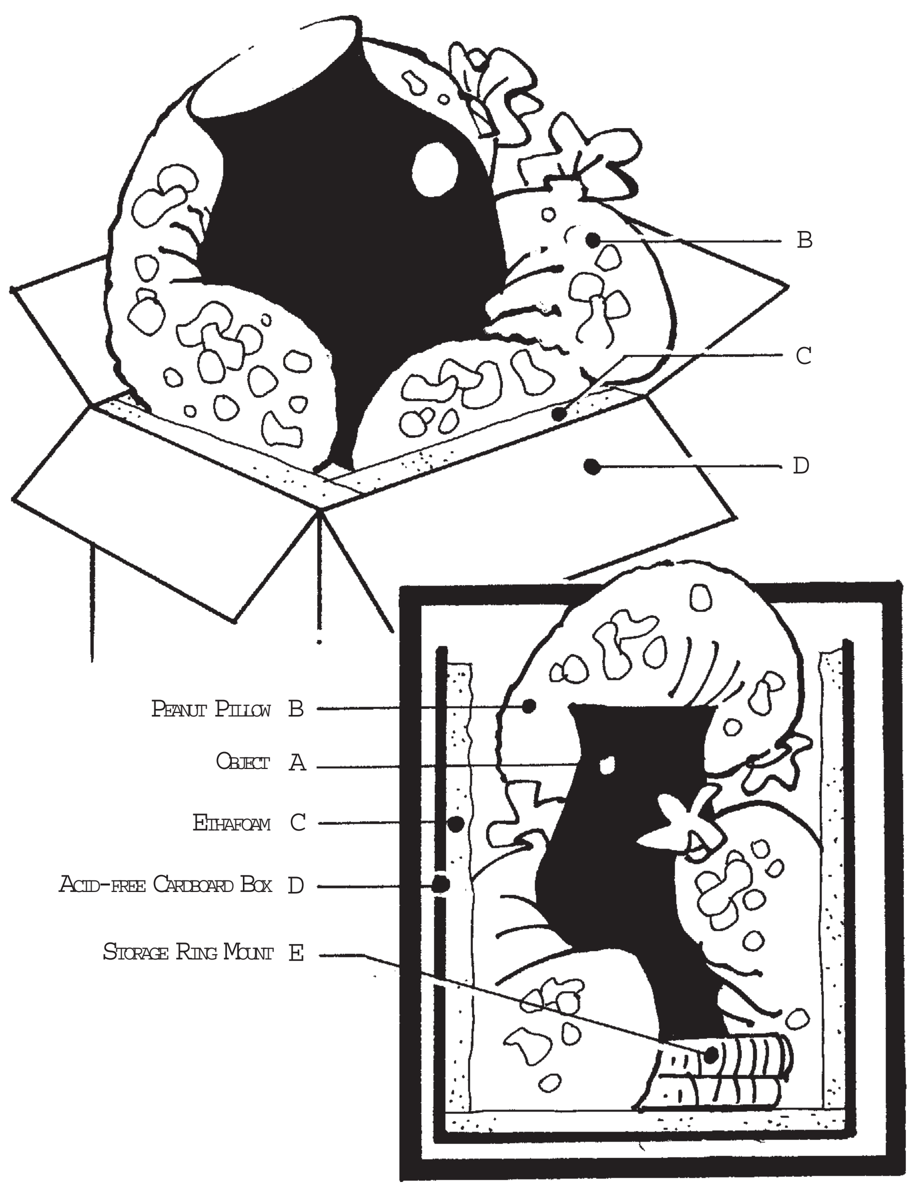
## Boxes and Trays

### Padded Boxes

Shipping cartons were often the packing boxes. To make this transformation, they were first lined with 1/4-inch or 1/2-inch Ethafoam, depending upon the fragility of the item being packed. The fragile object was placed in the box with its own mount and/or padding and additional lining was added to make it stable.

*Example:* The object to be packed is a large ceramic vessel. It is placed on a ring storage mount designed to fit. The box is prepared with 1/2-inch plank Ethafoam placed on the bottom and the sides. The ceramic on its mount is placed in the box and peanut pillows are formed around it to prevent the object from shifting.

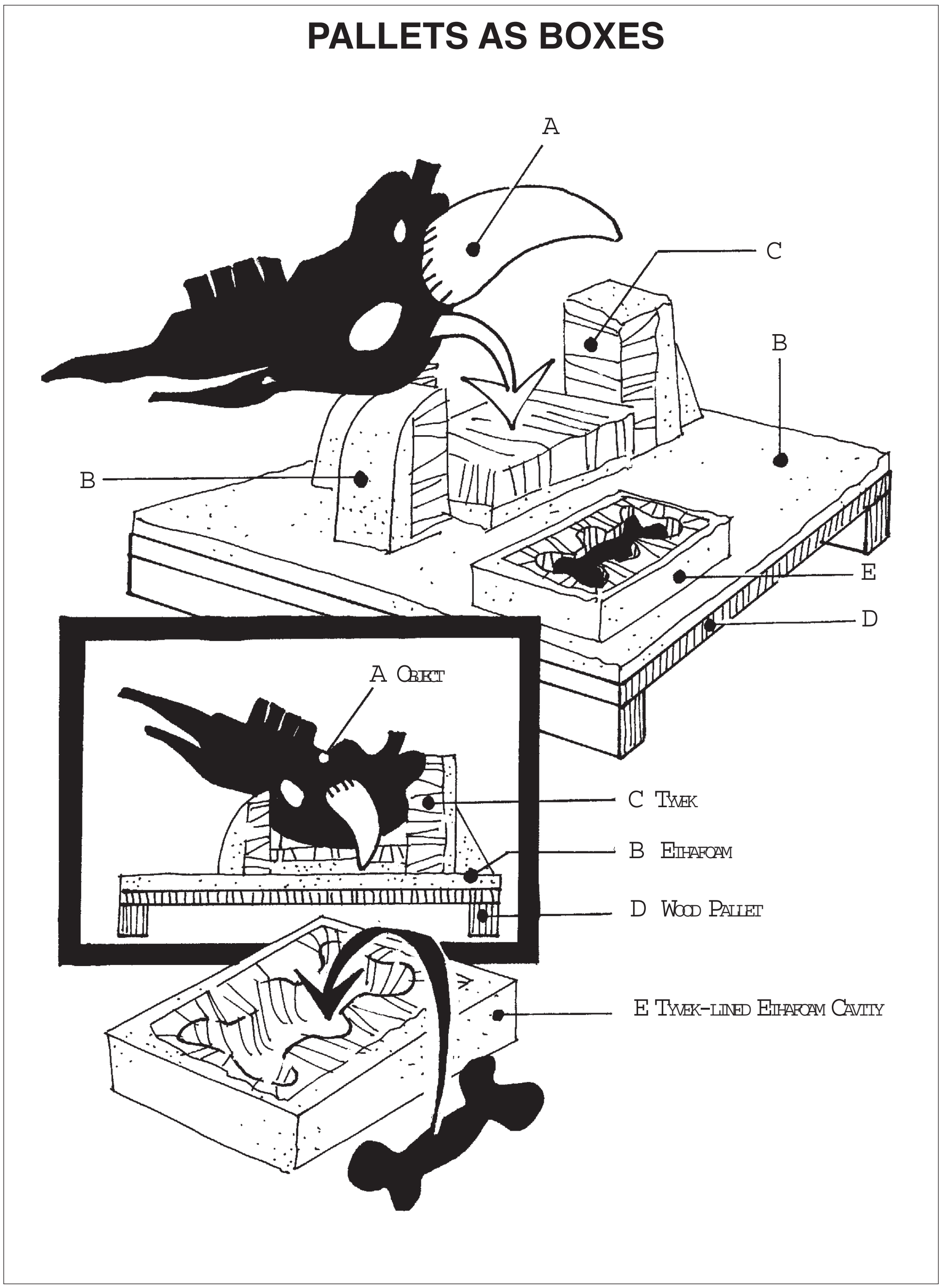
**PADDED BOXES**



### Pallets as Boxes or Trays

For transporting large objects or specimens that did not fit in to any standard carton, pallets were adapted. The base was padded with Ethafoam, its thickness determined by the weight of the target object and how much vibration mitigation was required. If a mount was required it was constructed. The illustration below demonstrates a specialized pallet for a Pleistocene bison skull. The pallet was custom-made to hold a single skull and associated bone. The pallet is solid plywood with an Ethafoam liner. The mount is made of carved Ethafoam blocks covered with Tyvek where the rough foam comes in contact with the fragile surface of the skull. A cavity mount was constructed to hold additional bone from the specimen.

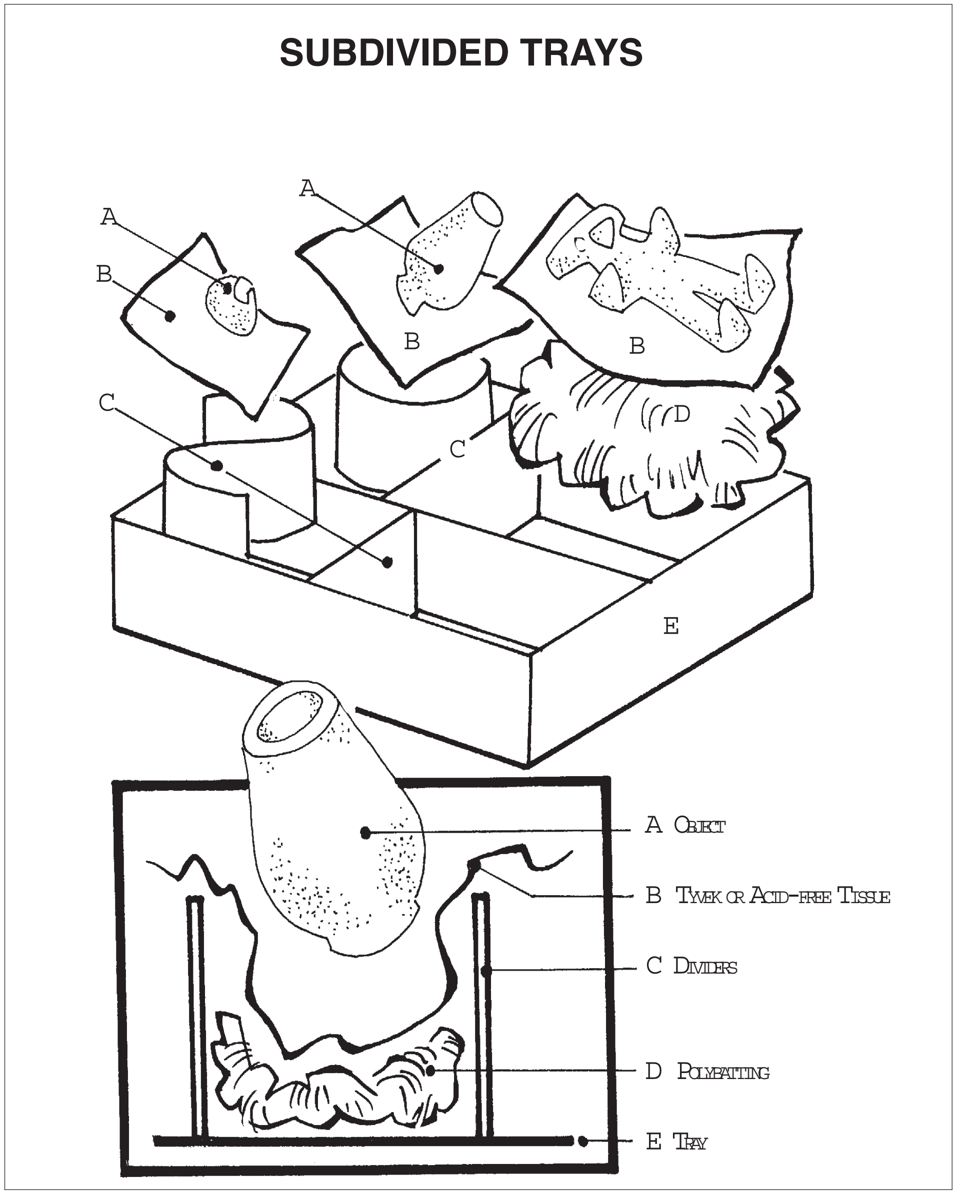
*Example:* The photo below shows a completed box for spears. Coroplast sheeting was used to deck the pallet and to make the sides, which were simply stapled onto the pallet and taped together. The bottom and sides were lined with 1/2-inch Ethafoam and the spears were layered with 1/4-inch Ethafoam. This box was so big, to accommodate the length of the spears, that we needed to put it on wheels in order to move it around.




**Conservation Assistant Rebecca Newberry** *pulls the wheeled spear box into the new vault, where spears will be stored in racks built in the narrow space left between cabinet and wall.*

## Subdivided Trays

Acid-free trays with variable subdivisions were purchased for small items in the collection. The trays are designed to stack in a standard-sized banker's box. They come in several configurations of dividers, which we often manually altered to fit objects' shapes. After they were altered (cut and folded), a piece of foam was cut to the dimension of the bottom of the cavity. If needed, polyester batting was laid down to make a nest. Tyvek or muslin acted as a separator between the object and the batting. If additional dividers were required to inhibit movement, they could be made out of a scrap of foam or cardboard.




## Padded Trays

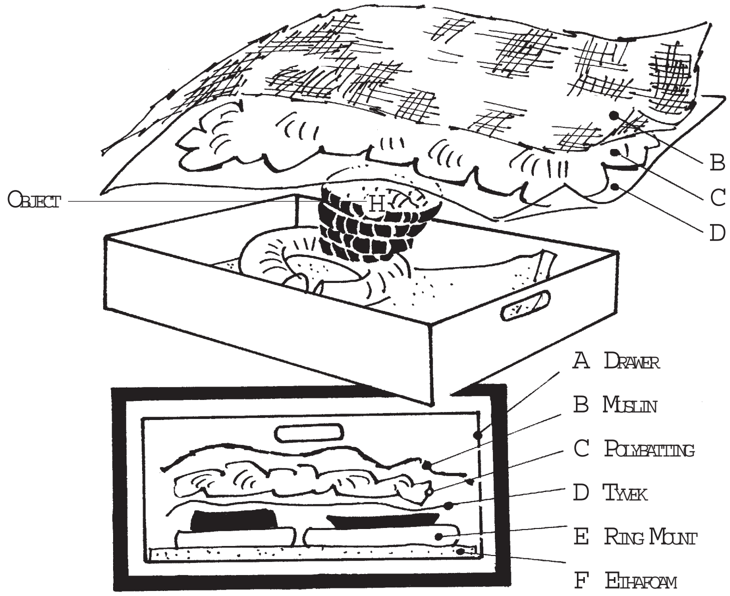
**Drawer into a padded tray:** To use on-hand, sturdy resources, Kewaunee drawers emptied of collections were often used as moving containers. The drawers were cleaned and lined with Ethafoam, the thickness of which again depended upon the collections being packed. The objects were placed in the drawer mounted on their permanent storage mounts when possible, or in some cases, as in this photo showing osteology specimens in a Kewaunee, just wrapped in 1/8-inch Ethafoam. They were then covered with a layered packet of Tyvek, polyester batting, and muslin, which was tucked lightly around the objects to keep them in place for the short move. The drawers were carefully stacked on pallets, stabilized with heavy cardboard corners, shrink-wrapped to the pallets, and banded with a metal banding machine for good measure (see page 45). Most of our ethnology collection

*Osteology Specimens in Kewaunee Drawer*

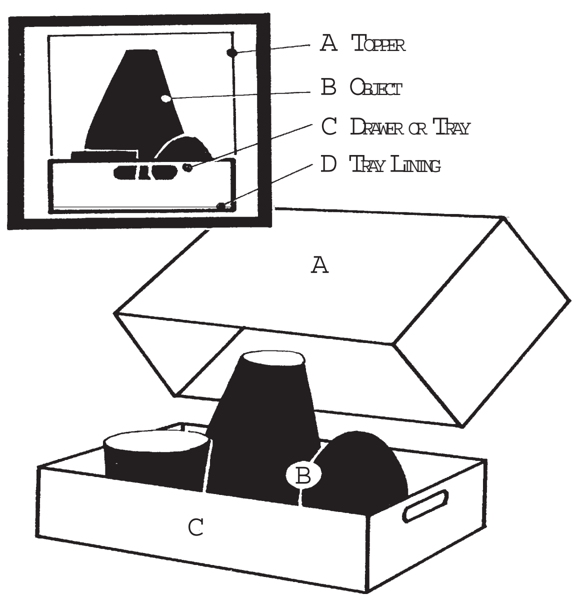
and much of the biology collection was moved in the same way, using the new Delta drawers that were to be permanent storage in the new cabinets.

**Topper to a padded drawer:** Part of the beauty of using Kewaunee drawers as trays was that they stacked so neatly on the pallets, and we tried to use this method for as many types of collections as possible. However, most collections included objects that were too tall to fit under the bottom of a superimposed drawer. To accommodate this, tall objects were put in drawers together and a simple five-sided box or top was made out of coroplast to cover them. These "topper" drawers were then used onthe top of each stack of drawers; hence, the name.

**DRAWER AS PADDED TRAY**




**TOPPERS**



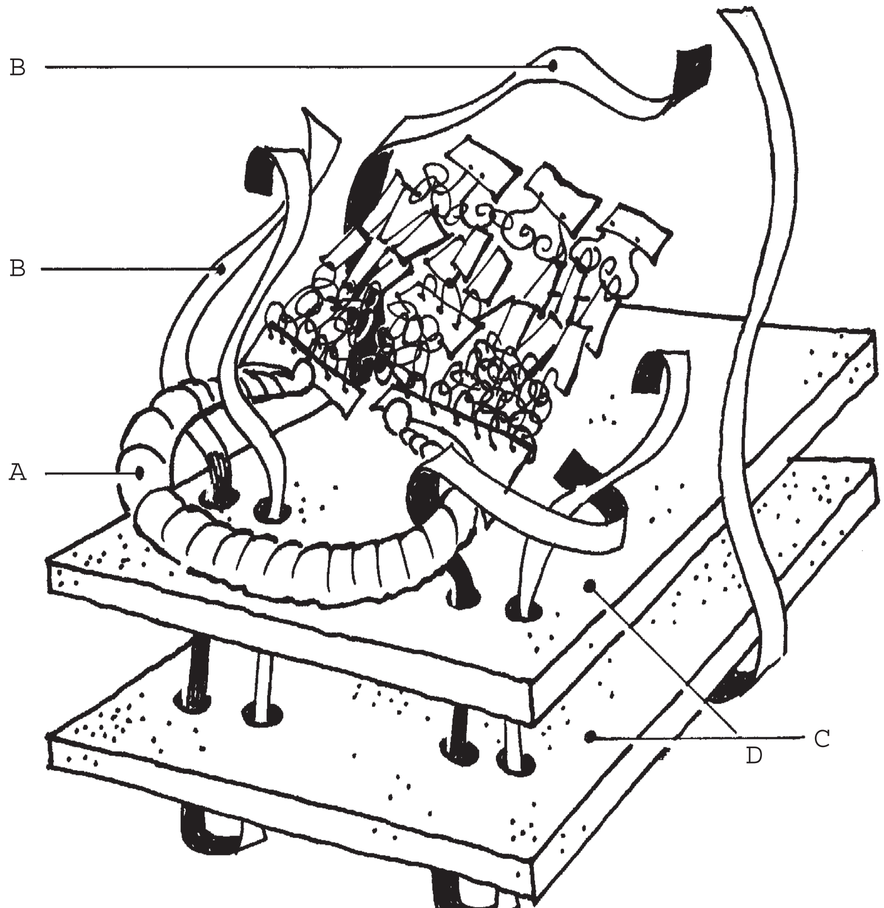

***Marine Shells (left) and Bird Study Skins (right)*** *fill biology Delta drawers used for transport as well as permanent storage. Drawers were prepared for moving as described in the illustrations on these pages.*

## Padded Boards

Some objects, even complex ones, require only a simple mount for both storage and shipping, and we tried to use as many of these as possible. We found one of the most useful mounts to be a padded board. A padded board can be easily constructed out of a rigid board (i.e., acid-free cardboard, mat board, or foam core) with a layer of padding material attached (polyethylene, acrylic felt, etc.). An alternative is to use a rigid polyethylene foam for both the board and the padding. The manner of attachment is usually with hot melt adhesive or some other mechanical means.

The diagram to the right shows a complicated silver necklace with a lot of dangling parts. It was determined that for both shipping and for storage, the necklace should be tied to the padded board using cotton twill ties. This prevented the necklace from tangling and/or shifting while providing vibration mitigation and security.

**PADDED BOARDS**



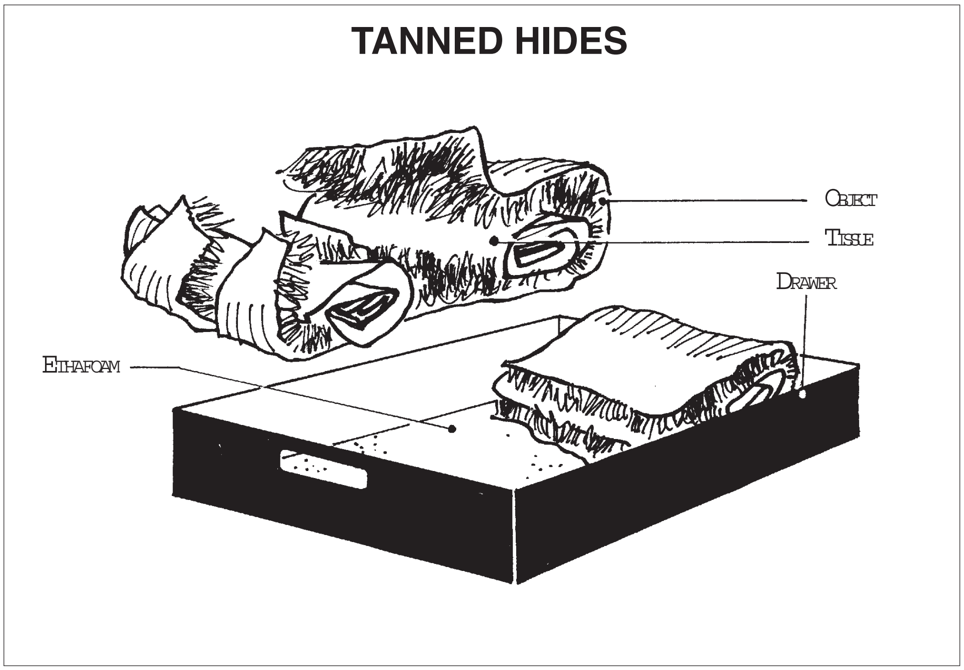

A Object
B Twill Tape
C Foam Core of Acid-free Board
D Ethafoam or Other Padding

***Bead and Shell Necklaces***
*were attached to padded boards with twill tape ties for both moving and for permanent storage in cabinet drawers.*

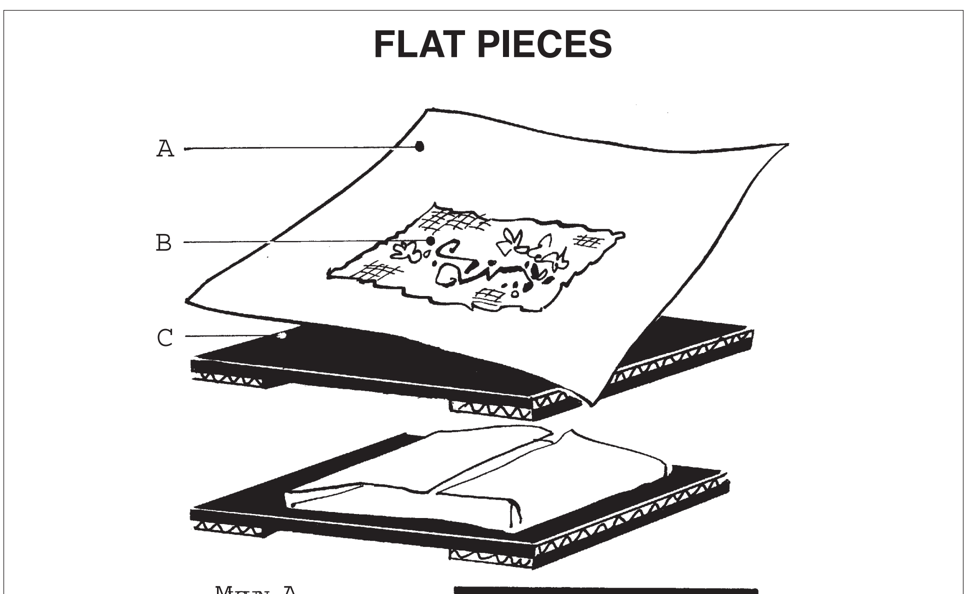

## Liners and Barriers

Under certain circumstances, a textile or tanned hide might be layered or folded on itself, then packed in a box or tray. Flat and flexible archival materials such as acid-free tissue, Tyvek, muslin, and mylar can be used as interleaving sheets between layers of stacked objects or objects folded on themselves. All folds should be padded out with crumpled tissue or snakes. The choice of material depends on the object's composition.

**Tanned hides:** Hides that need to be rolled should be packed as above. Although it is not ideal, they can be stacked on top of one another. In a perfect world, they would be laid out flat on a screen to allow for airflow, then stored in cabinets to reduce the potential for infestation. As we are short on space, the relative importance of this collection dictated that it should be stacked and folded. The interleaving and padding was unbuffered, acid-free tissue, selected for oils and dirt leached off the hides. Unbuffered tissue should always be used with hide, wool, fur, and feathers.




**Small, flat textiles:** Textiles and works on paper should be laid flat on a barrier of acid-free tissue or other selected material (e.g., Tyvek, mylar). In addition to being a barrier, this provides support for lifting and as an interleaving barrier if the pieces are stacked. If the object is particularly fragile, then an archival board should be placed under the barrier to provide additional support when handling.



## External Supports

Many of the objects in our collections are awkward and difficult to support. These objects come in all sizes and all levels of fragility. All required some kind of additional support to provide stability in order to move them.

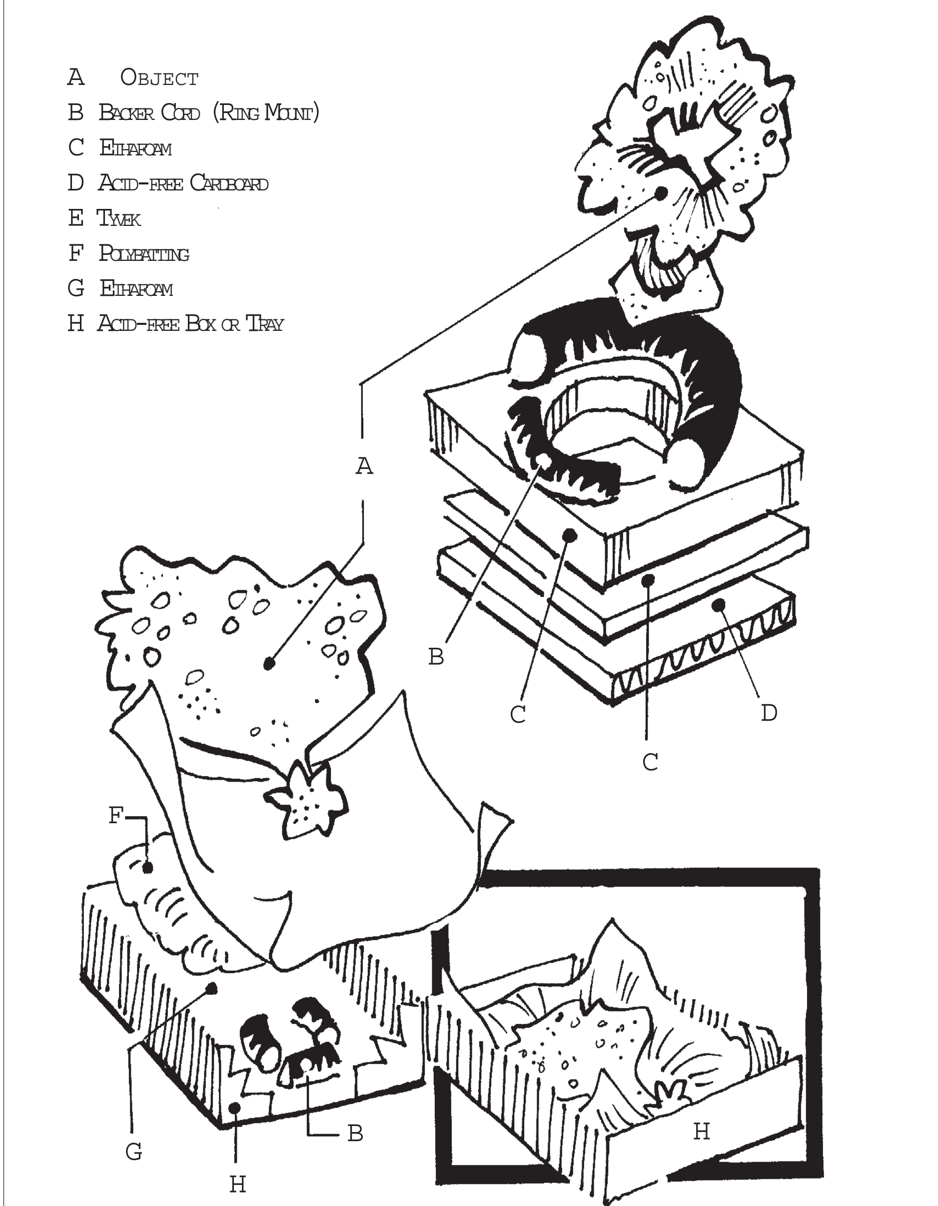
### Cavity Mounts

We have long known that cavities are one of the best methods for shipping fragile objects or specimens. They also make excellent long-term storage. The cavity must be shaped to hold the artifact as stationary as possible to mitigate vibration while giving it even support, so that the cavity must follow the contours of the object. Cavities are of two types: those made by cutting away a well in some base material, such as polyethylene foam, and those made by adding materials around the object to give it even support.

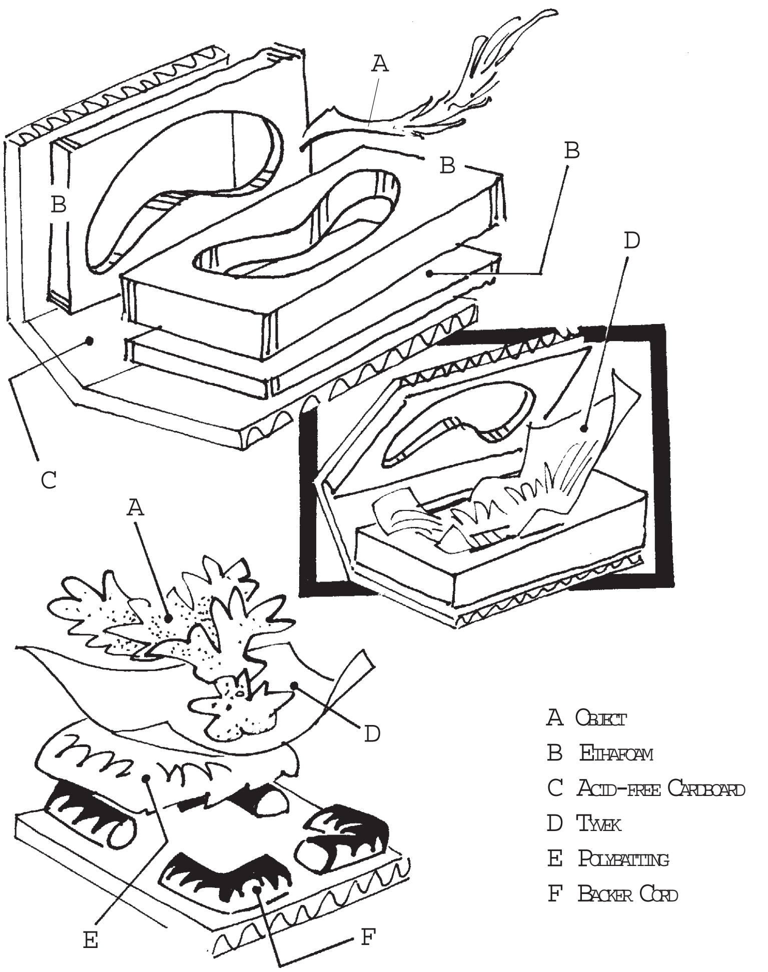
*Example:* These two illustrations (Sea Fans and Corals 1 and 2) each show two ways that we handled very fragile sea fans and corals. These shapes were often extremely awkward and the specimens were very fragile. One of the tricks we used in making some cavities was to use layers of foam. The cavity was cut larger than the specimen through the multiple layers down to the bottom layer, which was left whole. Polyester batting was then placed in the cavity and shaped so it would provide even support for the specimen. Last, a Tyvek separator was placed between the specimen and padding so that the fibers did not get stuck on the specimen.

In the upper examples, a cavity was cut through a layer of

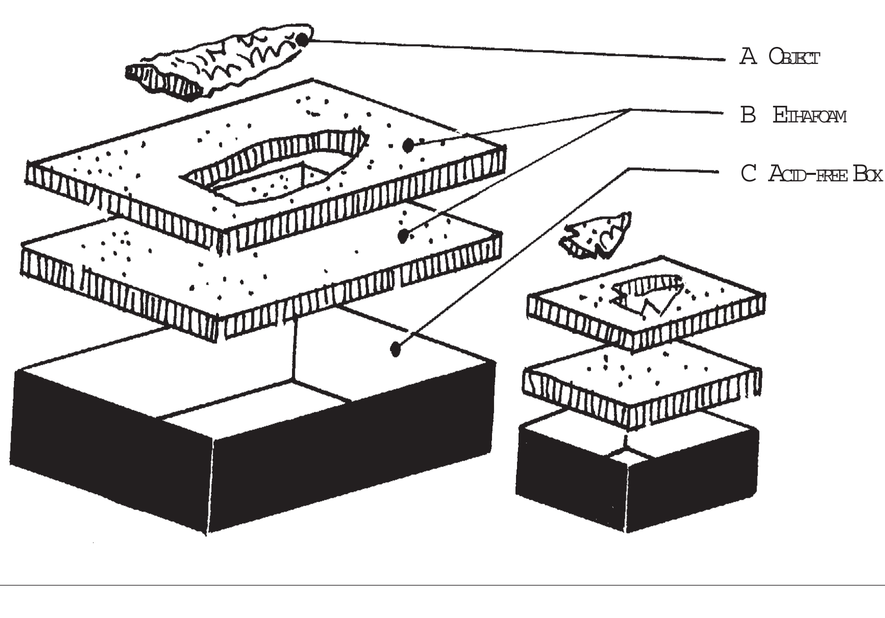
**SEA FANS AND CORALS 1**



## SEA FANS AND CORALS 2




## LITHIC DIAGNOSTICS



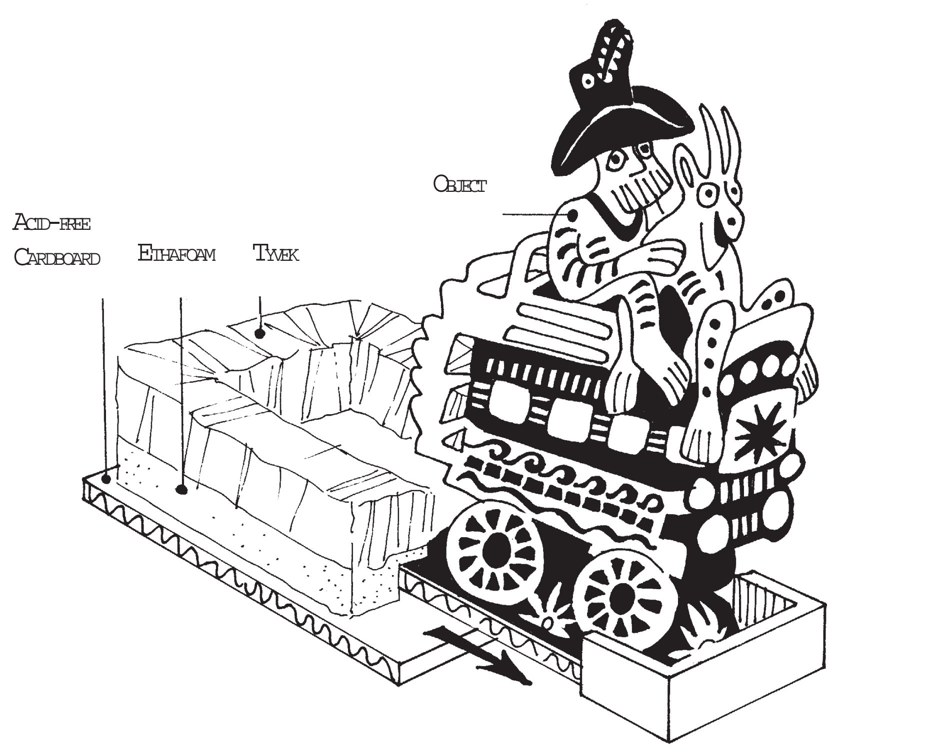

foam. In the first of these, backer cord was added around the cavity to support the coral; in the second, outer acid-free cardboard wrapped above the object to make a cover. Trays such as those shown in the lower illustrations were made of acid-free cardboard padded with foam, with backer cord added to make a cavity and additional padding of polyester batting.

*Example:* We used similar methods for diagnostic stone tools. A small standard specimen box was lined with polyethylene foam. A cavity was cut through a second layer of foam around the tool, retaining its shape, that was then adhered to the first layer of foam. The cavity was cut to be slightly larger than the specimen. This is an extremely secure method for storing and shipping these artifacts, and even though it uses up a great deal of space in storage drawers, artifacts so displayed can be visually scanned with great ease and are extremely helpful to researchers using these collections.

Braces are very useful to secure an object or specimen when it does not require a full cavity mount or even pressure from all sides. The use of braces limits the point of contact against the object and reduces the amount of material needed to keep the object from shifting. Braces also add additional support for artifacts with fragile parts that need to be kept stable.

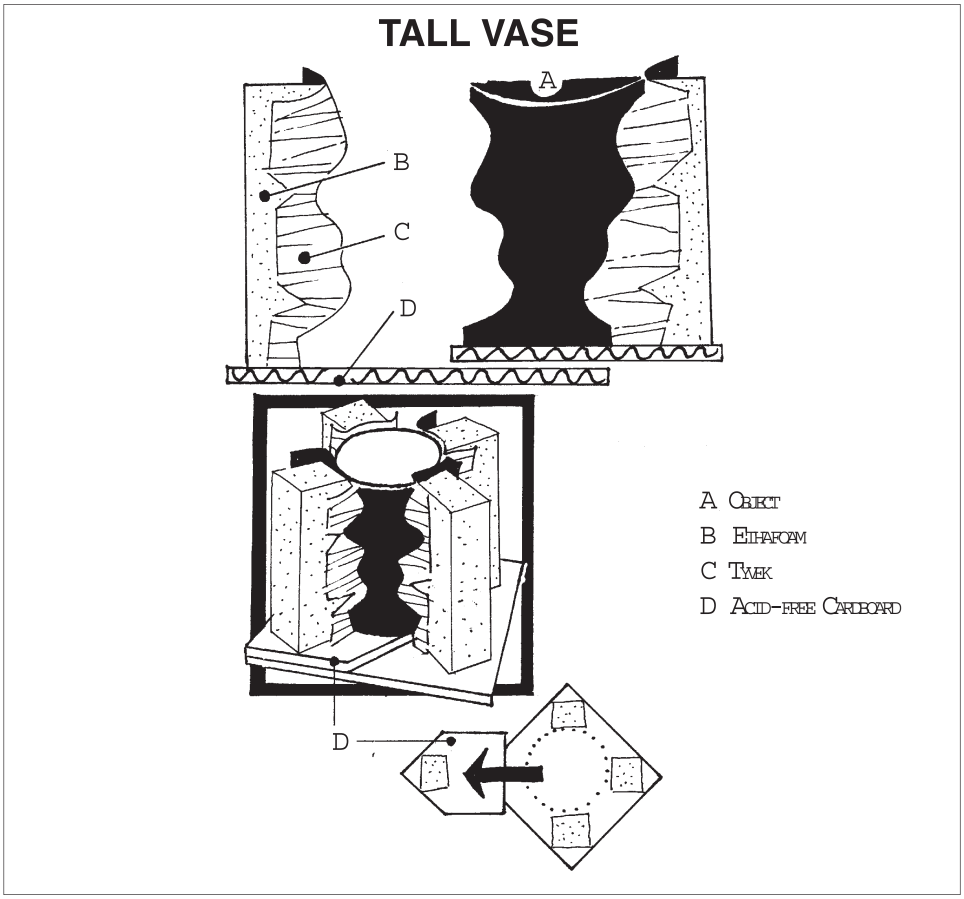
*Example:* Since all of our ceramics were destined for a somewhat mobile storage situation in a compactor unit, every one of them needed permanent mounts that could keep them from accidentally contacting each other when compactors are being rolled back and forth. This ceramic bus from Mexico is more stable than some ceramics but very fragile. It is a low-fire piece with glazing that will easily chip. It is also extremely complex, with many protrusions. The mount, designed by one of our volunteers, takes the idea of a brace and adapts it so that the object is contained as well as supported. The base is made of double-wall acid-free cardboard, and the object sits on a separate tray made out of the same material. The surrounding brace is built from plank Ethafoam covered with Tyvek to prevent abrasion. The tray that holds the object has a front brace to prevent it from moving laterally, and it and the base of the object slide into a key cut in the supporting brace to keep it from bouncing vertically.

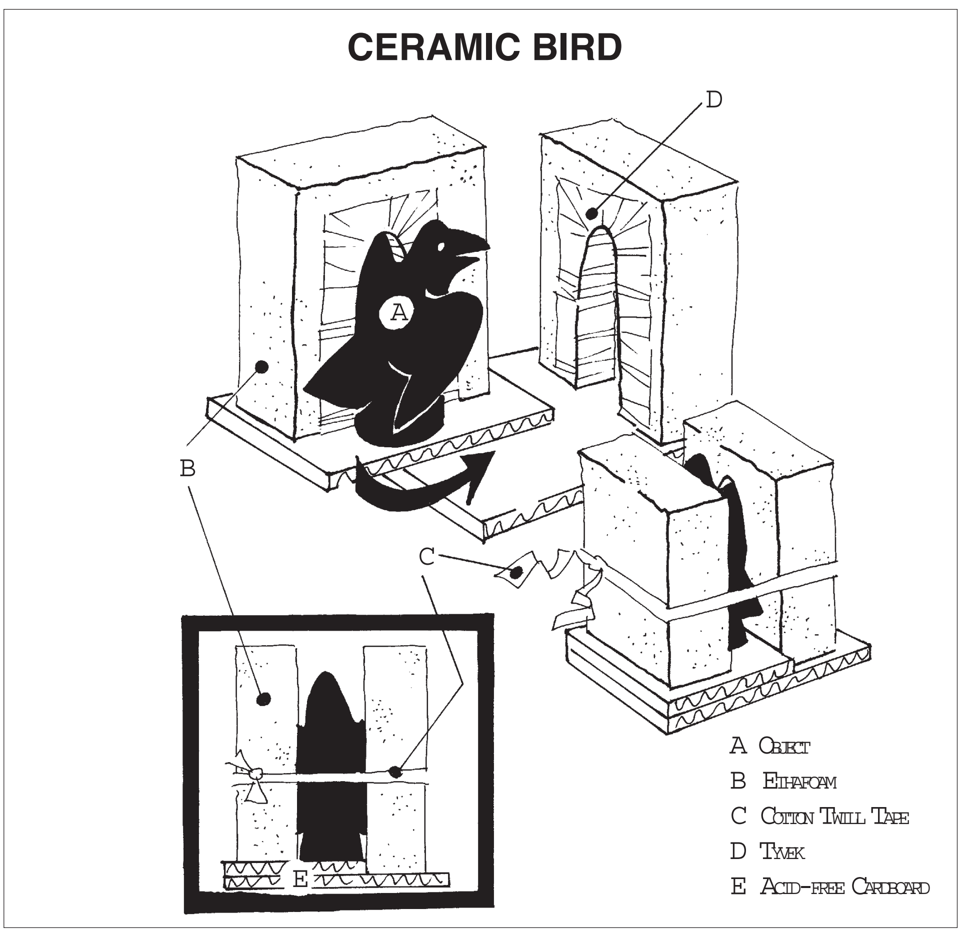
**CERAMIC BUS**




**Mexican "Arte Fantasco"**
*moved in a specially designed mount that braced and stabilized the ceramic at the same time.*

*Example:* A similar concept was used for the ceramic vase illustrated on the next page (Tall Vase). Acid-free cardboard was again used for the base and for the tray, and this object also stands completely on the tray. First, four Ethafoam braces were carved to




the contour of the vase and covered with Tyvek to prevent any abrasion. Three of the braces were attached to the base with hot-melt glue, forming the corners of a square with the fourth brace, which was attached to the tray. Then the object was placed snugly against the tray brace, and the entire tray was slid into the space in the center of the other three, on top of the base. Cotton twill tape was tied around the mount to prevent it from opening unintentionally. To remove the vase from the mount, twill tape is untied and the tray is pulled out.

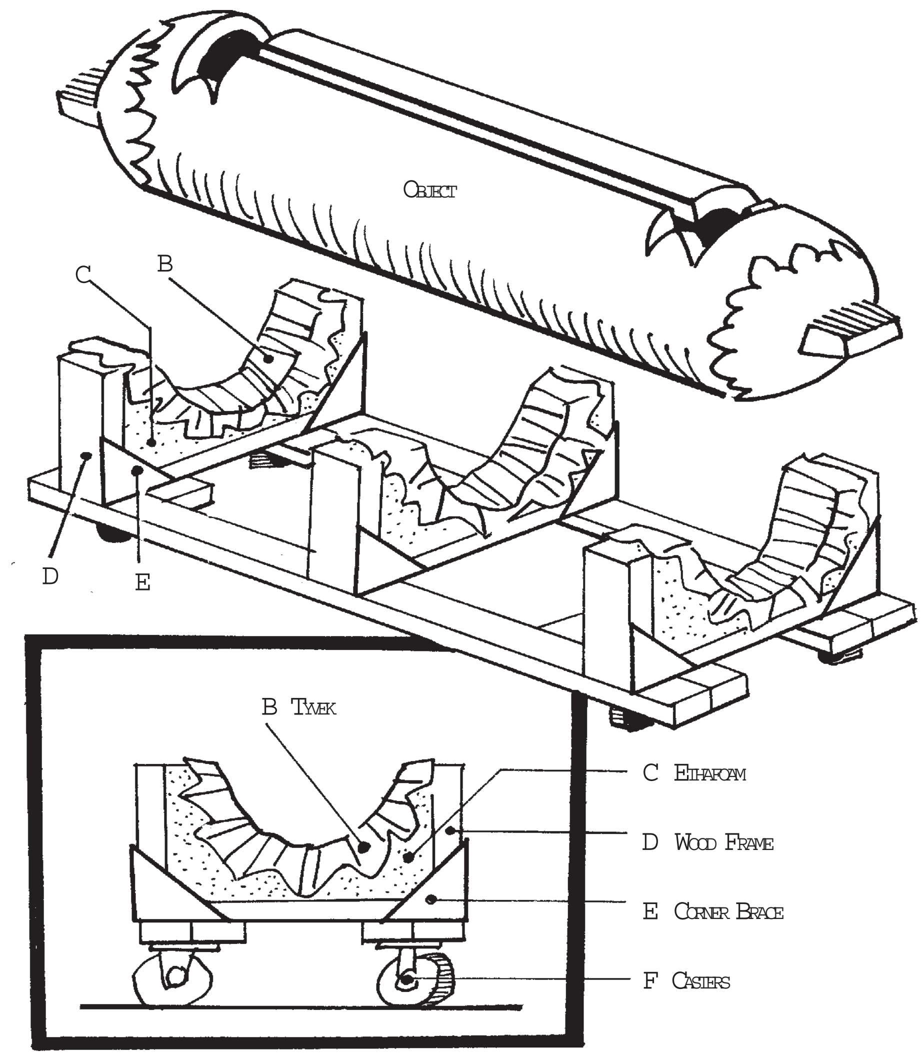
*Example:* The same support-and-contain approach was taken with this ceramic bird figurine, illustrated at the left. A Tyvek-covered well was then cut into two very thick pieces of Ethafoam into which each wing could fit snugly. One support and the object were placed on a tray that slid over the base with the other support, and twill tape was used to hold the two sides together.

### Cradles

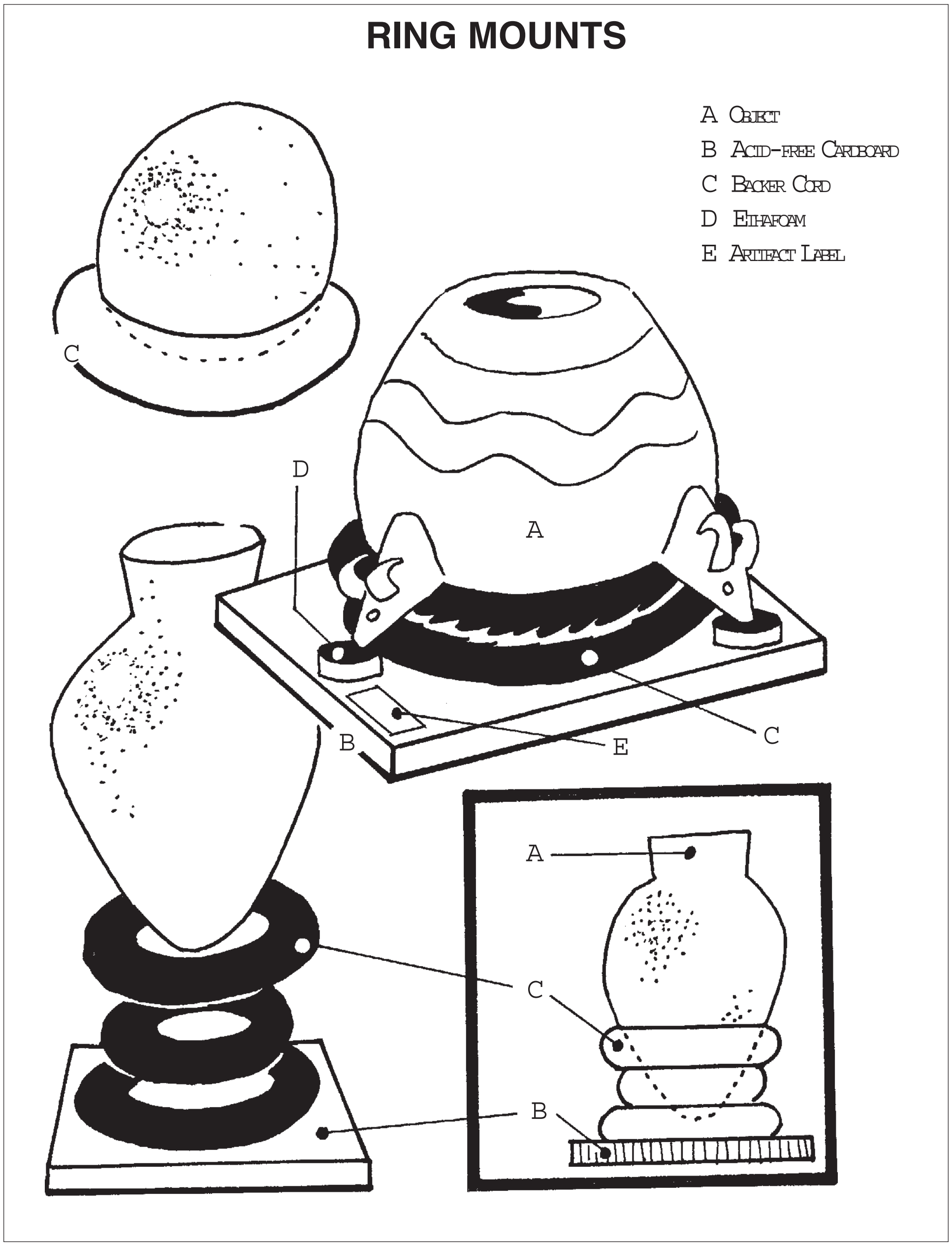
Cradles are an excellent method for keeping specimens that have both a rigid structure and also a rounded base stable for shipping and for storage. We have used cradles for a variety of artifacts and specimens, including ceramics, canoes, and drums. The cradle can be made of a variety of materials, depending on the object being supported. The material of the object, its size, and its weight all are determining factors.

*Example:* For the slit drum illustrated at the right, which is about 6 feet long and weighs 200 pounds, we made a wooden structure with foam-covered supports to increase overall rigidity. The thich foam is cut out to carefully fit and fully support the curve of the base. In most cases, we lined the foam with Tyvek to prevent abrasion, as we did here. For all large and heavy artifacts, castors were placed on the frame to facilitate moving the object (see Wheeled Carts, page 86). For less-heavy ceramic objects, we used acid-free cardboard as a substrate with Ethafoam cut into wedges and shaped to hold the object, as pictured at the left.

**SLIT DRUM**




***Ceramic Patterned Bowl***
*is supported on its own base against one of four Ethafoam braces carved to fit the curve of the piece's bottom. When it slides into place it is supported in all four directions.*




## Ring Mounts

Ring mounts are one of the easiest mounts to make as well as the most flexible kind of mounts to adapt, particularly for ceramics and baskets. A ring mount provides even support all around the base of the piece, the simplest consisting of a backer-cord ring attached with hot-melt glue to a tray made of acid-free cardboard. The cardboard can be a flat tray or it can be one with reinforcing sides that increase its strength. Backer cord is made into a ring by using hot-melt glue or hot air (see Handy Hints at the beginning of this section).

The supporting ring can be made any size, as required by the artifact. It can be stacked and glued as high as necessary to give as much support as needed. It can be formed to the best shape to support the artifact. The conical ceramic in this illustration is an excellent example, as the rings allow the artifact to nest into them without putting any pressure on the pointed base.

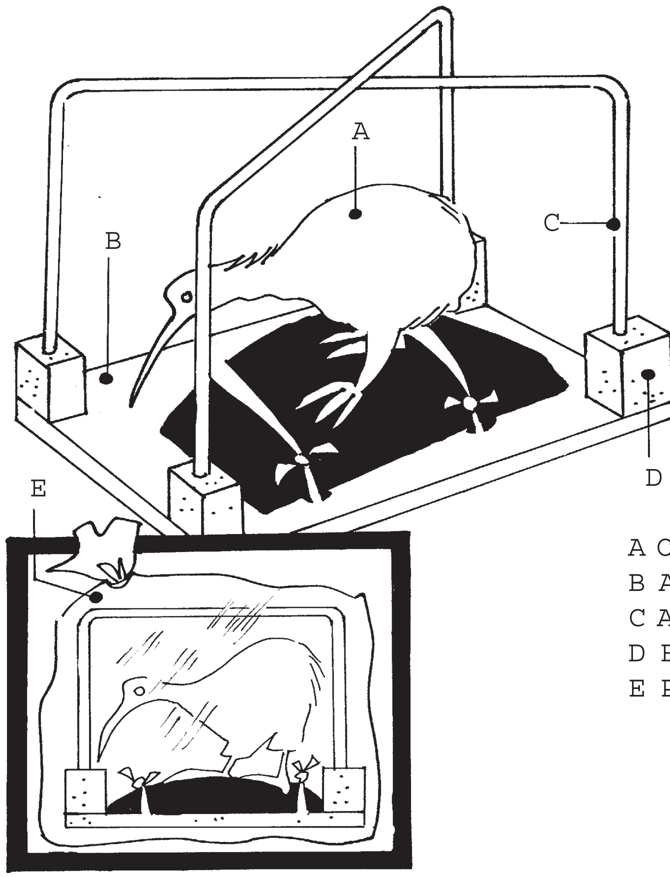
***Objects with Rounded Bases***
*are ideal candidates for ring mounts, like the ceramic vase on the left and the drum below.*

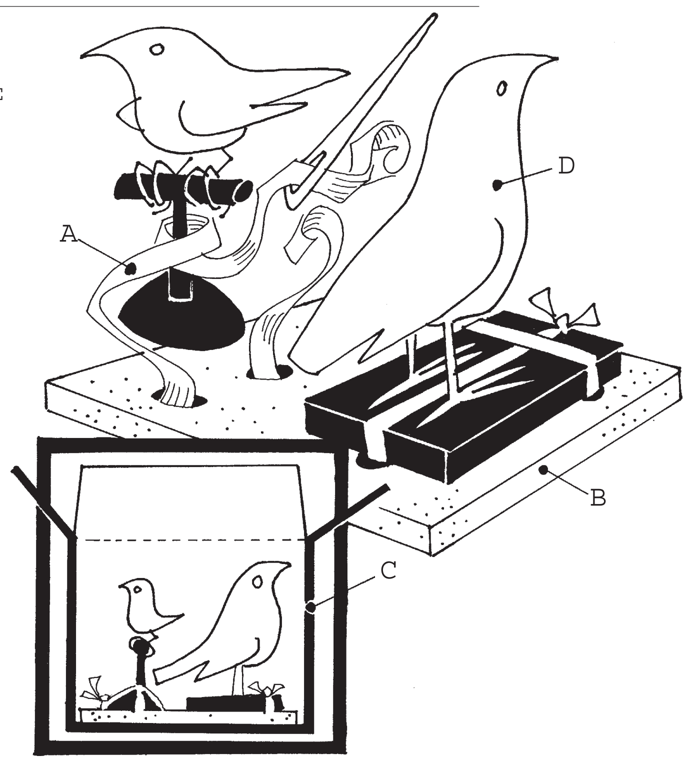
## Lashing

Lashing, or tying down, was used extensively for specimens that could not be boxed or supported easily without damage. We had been experimenting with lashing for six years to find a solution for storing and moving small- to midsized taxidermy pieces for pest control. The kiwi bird in the illustration is an excellent example: feathers on the bird are extremely delicate and break with the slightest pressure. Acid-free cardboard or foam core was used as a base, to which the object's mount was lashed with cotton twill tape. A structure of Ethafoam block and acrylic rod was then constructed to keep the dust cover (a clear polyethylene bag) from touching the object. Much of the taxidermy was moved in this manner, sometimes with many small birds lashed onto a single tray and the trays stacked in boxes for easy handling.

Other candidates for lashing included some of the dinosaur mounted skeletons (see Chapter 4) as well as more modern mounts.

### TAXIDERMY BIRDS

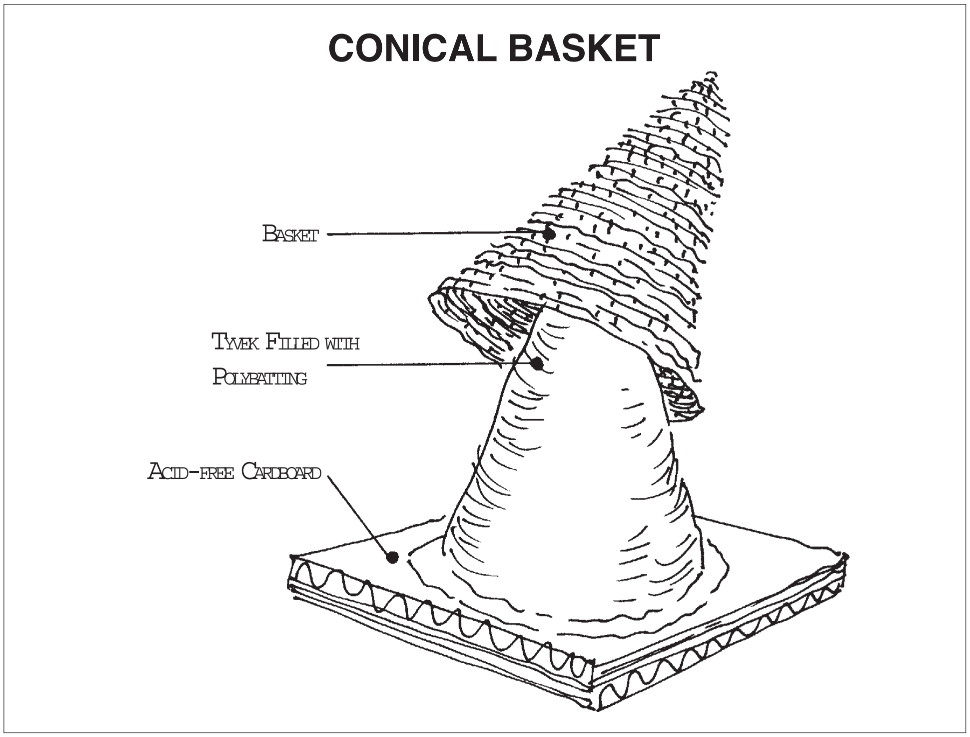


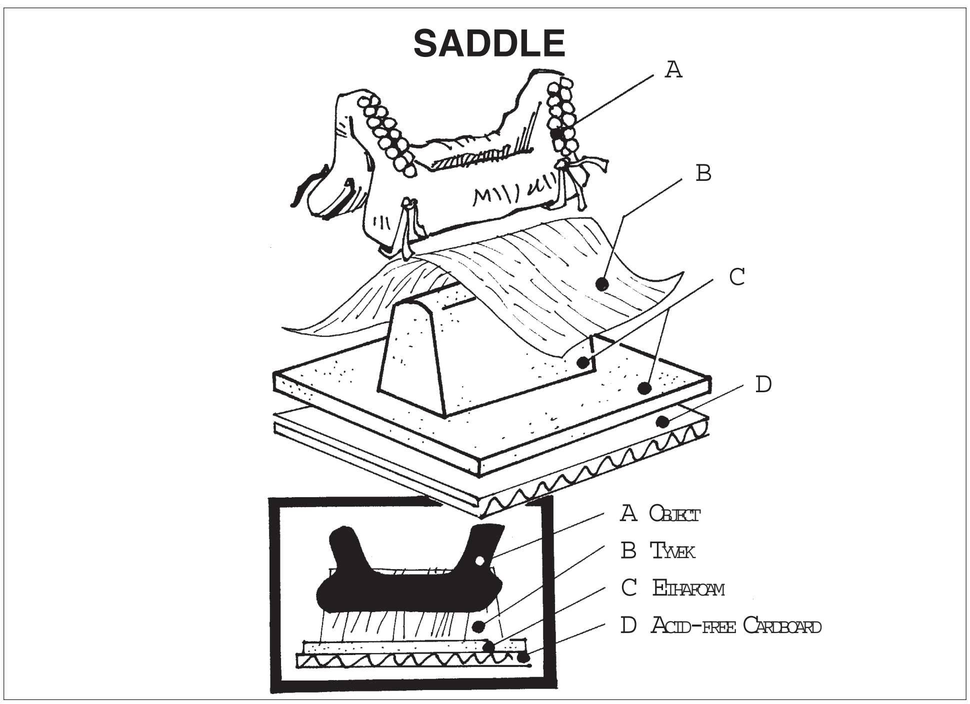



## Internal supports
### Bracing

Bracing can be made to support the internal as well as the external structure. Bracing should be made out of whatever kind of material is most appropriate for the particular object.

*Example:* A base was made for this large conical basket out of two layers of acid-free cardboard. The channels were crossed to make it stronger. The basket had been folded at one time and there were breaks in the side and along the rim so that it was in very fragile condition. An internal support was made of Tyvek stuffed with polyester batting. The support is shaped so that the stress to the basket is taken by the pointed section, which is the strongest area. Pressure from the mount is evenly distributed.



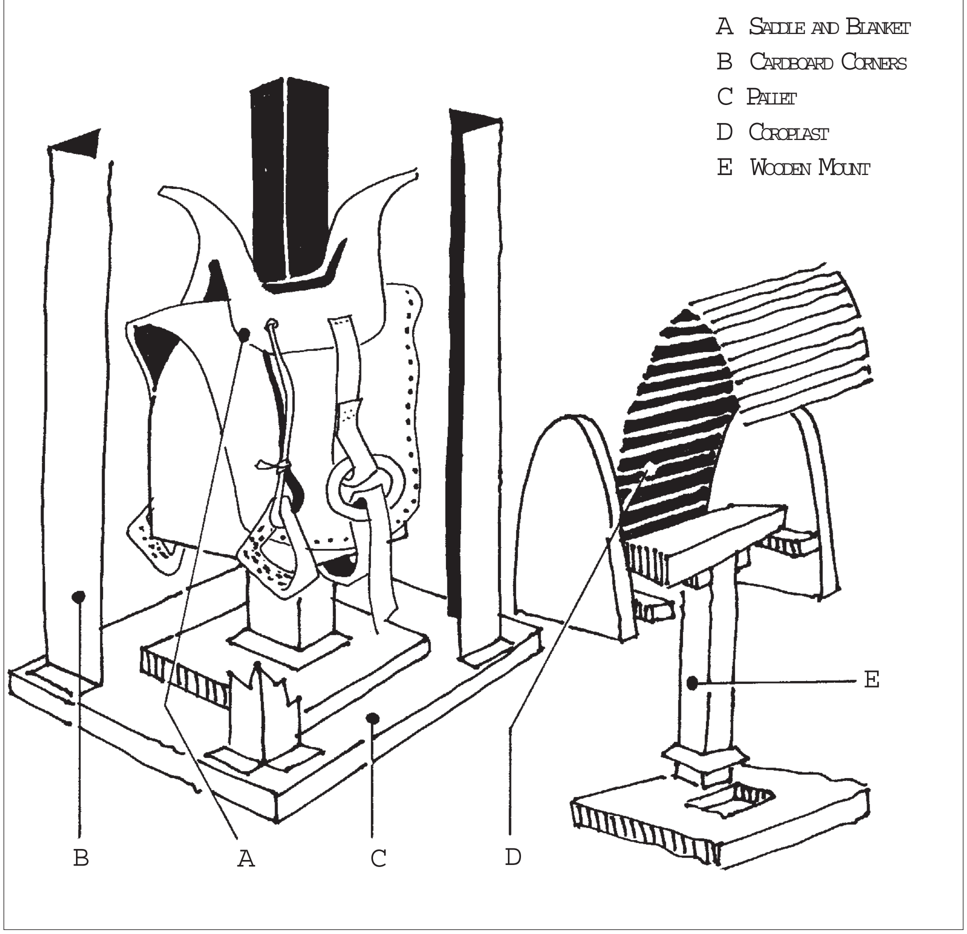

*Example:* A padded board was made for the Native American saddle illustrated above and pictured at the right. The base is acid-free cardboard with an Ethafoam pad. Block Ethafoam was carved to match the shape of the inside of the saddle and covered with Tyvek to prevent abrasion. In this way, the dangles on the saddle can dangle and not be torn or crushed.

**Native American Saddle**
*is supported by Ethafoam carved to emulate a "horse" and covered with Tyvek to reduce abrasion potential.*

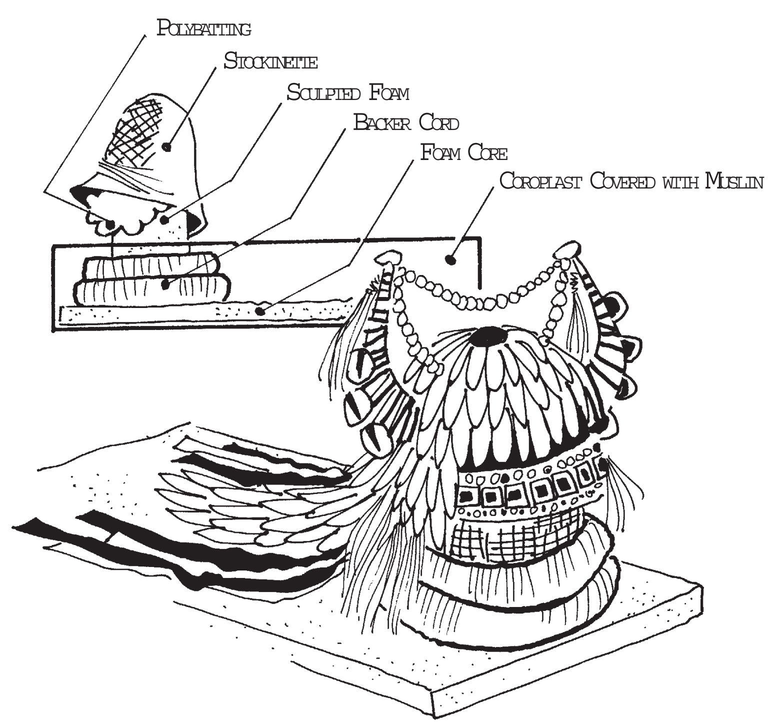
*Example:* This tall saddle rests upon a mount that was originally designed for exhibition. Wood was used for the base, the support, and the internal brace. For the move, we covered the "horse" with a thin layer of polyester batting and a piece of muslin. Wood was appropriate here in order to provide stable support for the height required to store the saddle without folding the stirrups and the attached blanket, but the following alterations were made to make this into a shipping mount: the cinch and stirrups were tied carefully with cotton twill tape to keep them from swinging; cardboard corners, usually used to keep stacks of boxes or drawers straight on a pallet, were used as additional protection, like an open crate; and the saddle itself was lashed into position with cotton twill tape.

*Example:* The horned bonnet in the illustration at the right has a multiuse mount, an Ethafoam cylinder carved to support the interior of the bonnet. The cylinder is covered

**TALL SADDLE**



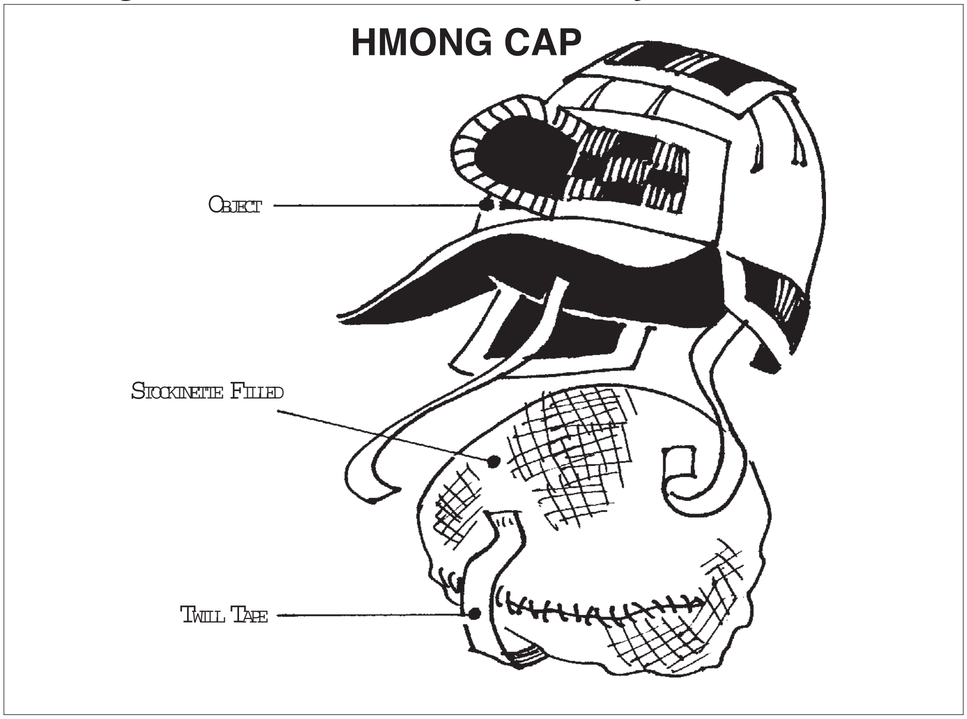

**HORNED BONNET**



with polyester batting to fill the voids in the bonnet and is covered with cotton stockinette. The base is a plank of Ethafoam with backer-cord rings to hold the bonnet brace. The brace can be removed to display the bonnet. The base provides support to the trailer. A coroplast box was made to ship the bonnet in.

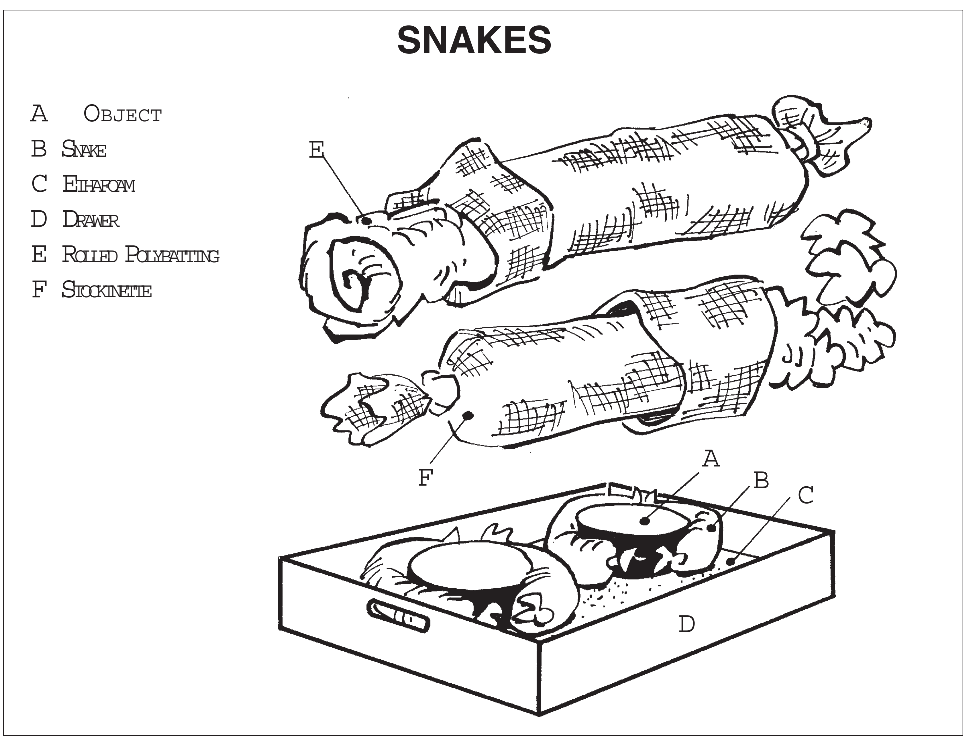
### Pillows

Many artifacts, particularly clothing, need to be stuffed out to support their structure. The Hmong baby hat at left is made of layers of fabric and needs to be stuffed to keep it from creasing over time. The more common way to do this is to use a crumpled piece of acid-free tissue to fill the void and create support. However, we wanted to create simple and long-term supports that would stay with the object through the shipping and into storage. By taking cotton stockinette, stuffing it with polyester batting, and stitching the ends, a permanent pillow mount was created. A twill tape tab stitched onto the pillow facilitated its removal from the hat.

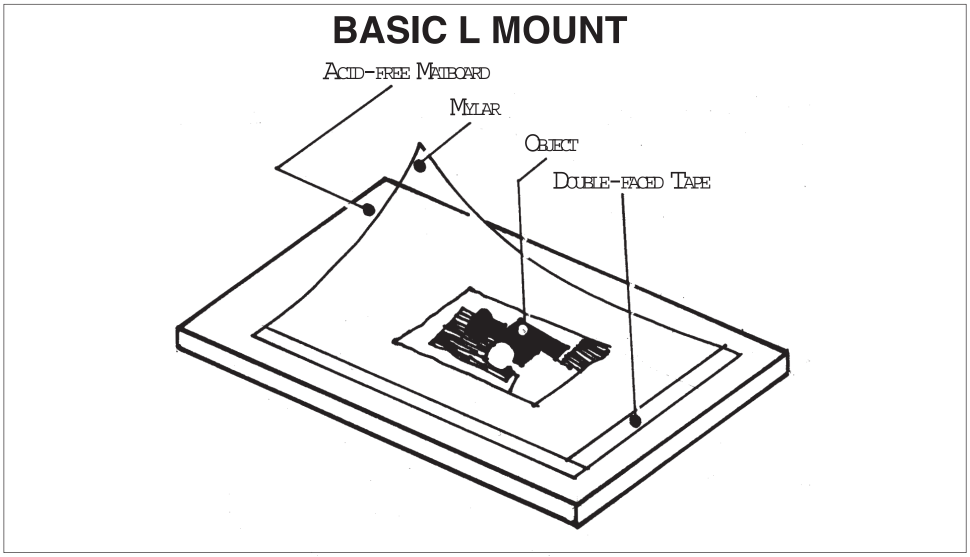



### Snakes

Snakes can be used handily for either internal or external supports. The snake was often used to fill gaps in otherwise-braced mounts. They were frequently used as a temporary solution during the move. Also, we crumpled and/or rolled acid-free tissue and then wrapped it around an object or used it as support to keep a textile from folding.



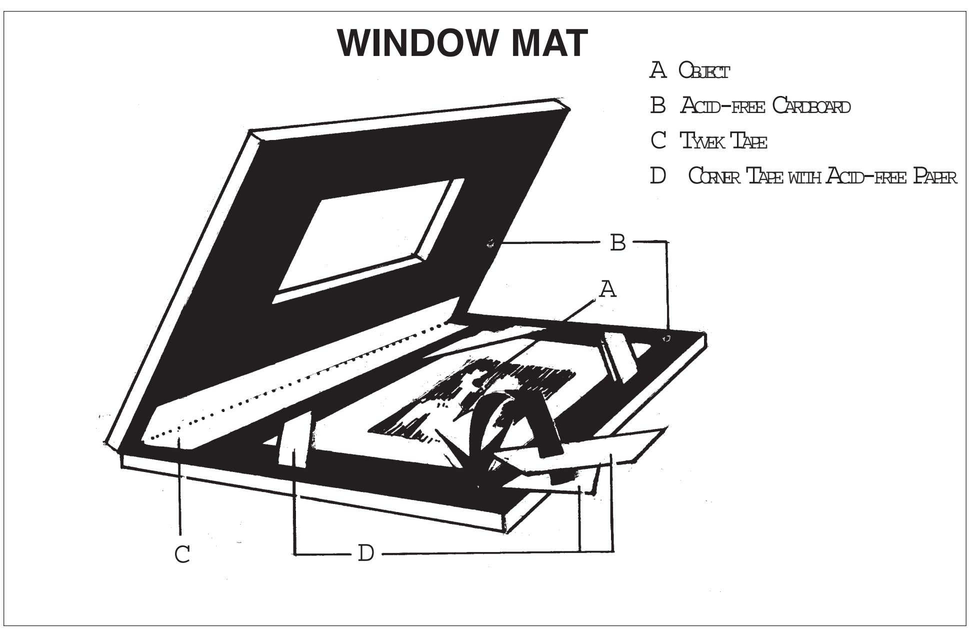
## Flat Object Mounts
### Boards




**L mounts:** A variation of a simple board support is the classic L mount commonly used with photographs, various archival materials like letters and newspapers, and small flat textiles. The base of the mount is an acid-free board (foam core, mat board, or cardboard) that is cut to a standard size larger than the object. Mylar, also cut to a standard size, is secured to the board along two edges (bottom and one side) with a double-stick adhesive tape (we used 3M 415, 924, and 969). The flat object is slipped inside the pocket, to be held by pressure. Care must be taken so that the object does not slip into the adhesive.

A variation of this is to use mylar as both the back and front of the mount. Two pieces of mylar are cut to the same size, larger than the piece to be encapsulated. Double-sided adhesive tape is laid down along the bottom and one side. The object is slipped into the center, not touching any of the adhesive. The other two edges can be enclosed in the same manner if it is determined that the "L" is not enough to hold the piece. This allows both sides of the object to be examined without handling the fragile item. An alternative to using adhesive is to heat seal the mylar with a soldering iron.

**Window mats:** A standard window mat provides both stability and security to a flat artifact (work on paper, archaeological textile fragments, etc.). This also allows for the possibility of stacking even the most fragile items. Two pieces of acid-free board (foam core, mat board, cardboard) are cut to the same size. A window is cut into the upper piece. The size of the window is determined by what goes in the mat. The window is attached to the backing board with an acid-free tape or Tyvek tape hinge. The artwork is secured on the backing board using a small piece of acid-free paper under corner tape. The paper

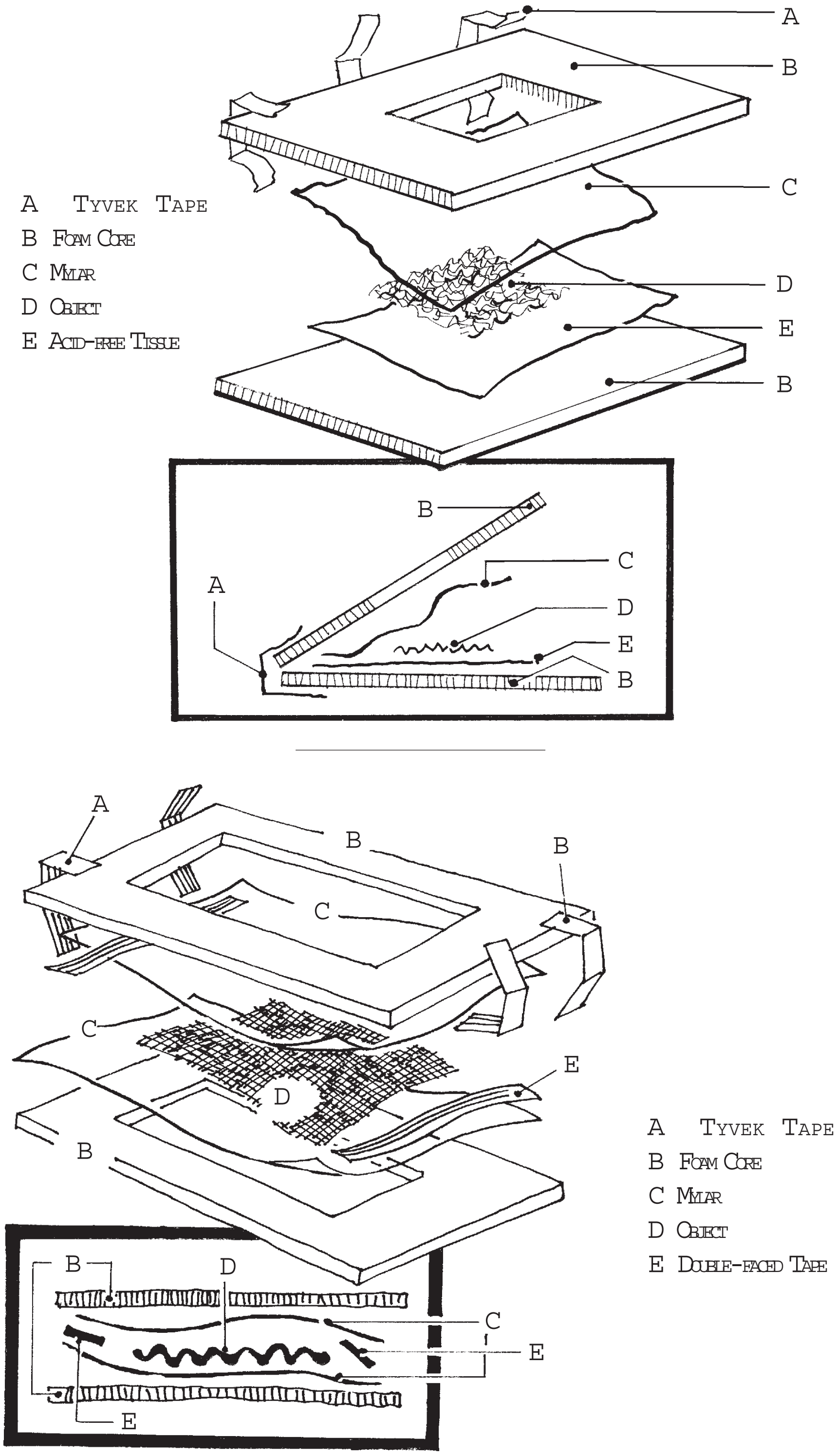


is placed under the tape so that there is no adhesive in contact with the artifact. There are several ways to do this, including using mylar or acid-free paper corners that can be purchased.

We used variations on this method for archaeological textiles from Peru. This is a major study collection used by local weavers and researchers. The fragments are extremely fragile and many do not hold up well to handling. Standard sizes of acid-free foam core were cut. Windows were cut slightly larger than the fragment. Tyvek tape was used to hinge the window to the backing board. Then the fragment was laid on a piece of acid-free tissue in the center of the backing board, a piece of mylar was placed over the fragment, and the window was closed down. If the textile needs additional security, then additional hinges can be placed around the perimeter. This method is particularly good for the more sturdy of the textile fragments.

Another variation was used for extremely fragile pieces. First the piece was encapsulated in a mylar sleeve (as described above). Then the two pieces of board were cut, but this time both were cut with a window. The encapsulated fragment was secured between the two boards with double-stick tape and the boards hinged together. In this way the textile can be shipped, handled and stored without damage. It is fully supported and both sides can be easily studied.

**VARIATIONS ON WINDOW MAT**



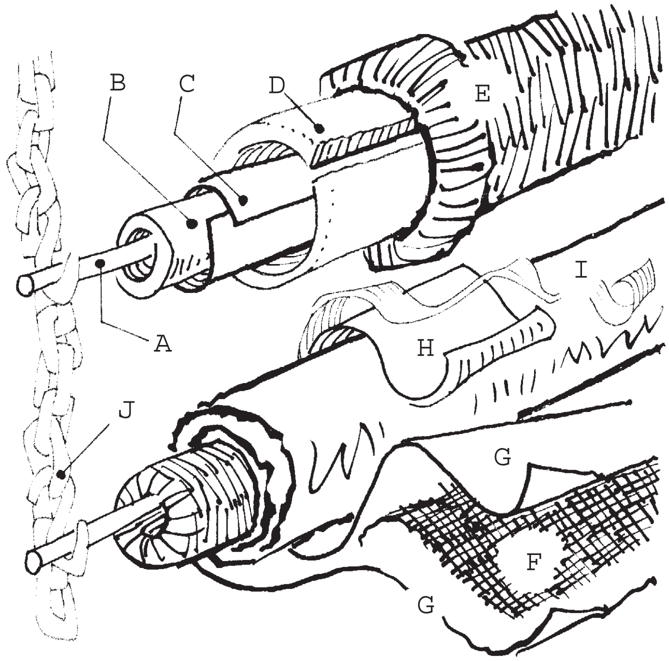
### Padded Tubes

This is a basic method for storing and shipping large flat textiles (rugs, tapestry, etc.). There are many variations, but the basic concepts will be understood by the examples below.

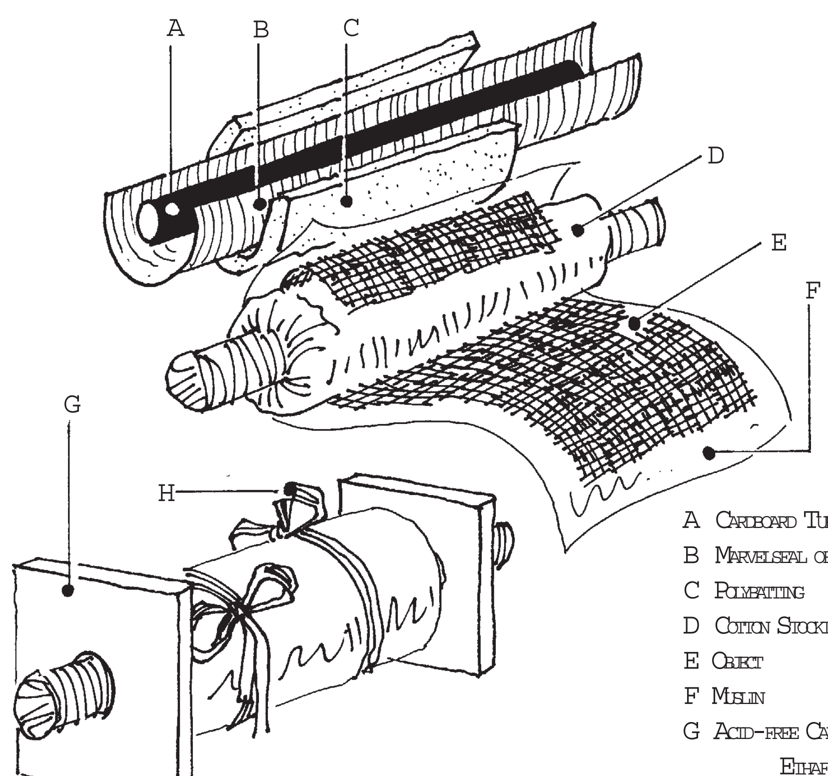
*Example:* For most collections we used a basic-sized tube of acidic cardboard, owing to the high cost of acid-free tubes. To deal with the acidic nature of the tubes we used, the tube itself was wrapped and tucked at the ends with Marvelseal, a metal and plastic laminate developed by the National Aeronautics and Space Administration (NASA) and used by the food industry. Marvelseal is an excellent vapor barrier.

A thin layer of padding (acrylic felt or polyester batting) was placed over this, taking care that the seam was even and not overlapped to make a bump. A precut length of cotton stockinette was then placed over the padding, usually tucked in to the end of the tube. The textile was rolled evenly on to the tube with an interleaving layer of acid-free tissue or muslin (the latter es-

**ROLLED TEXTILES HUNG ON RACKS**

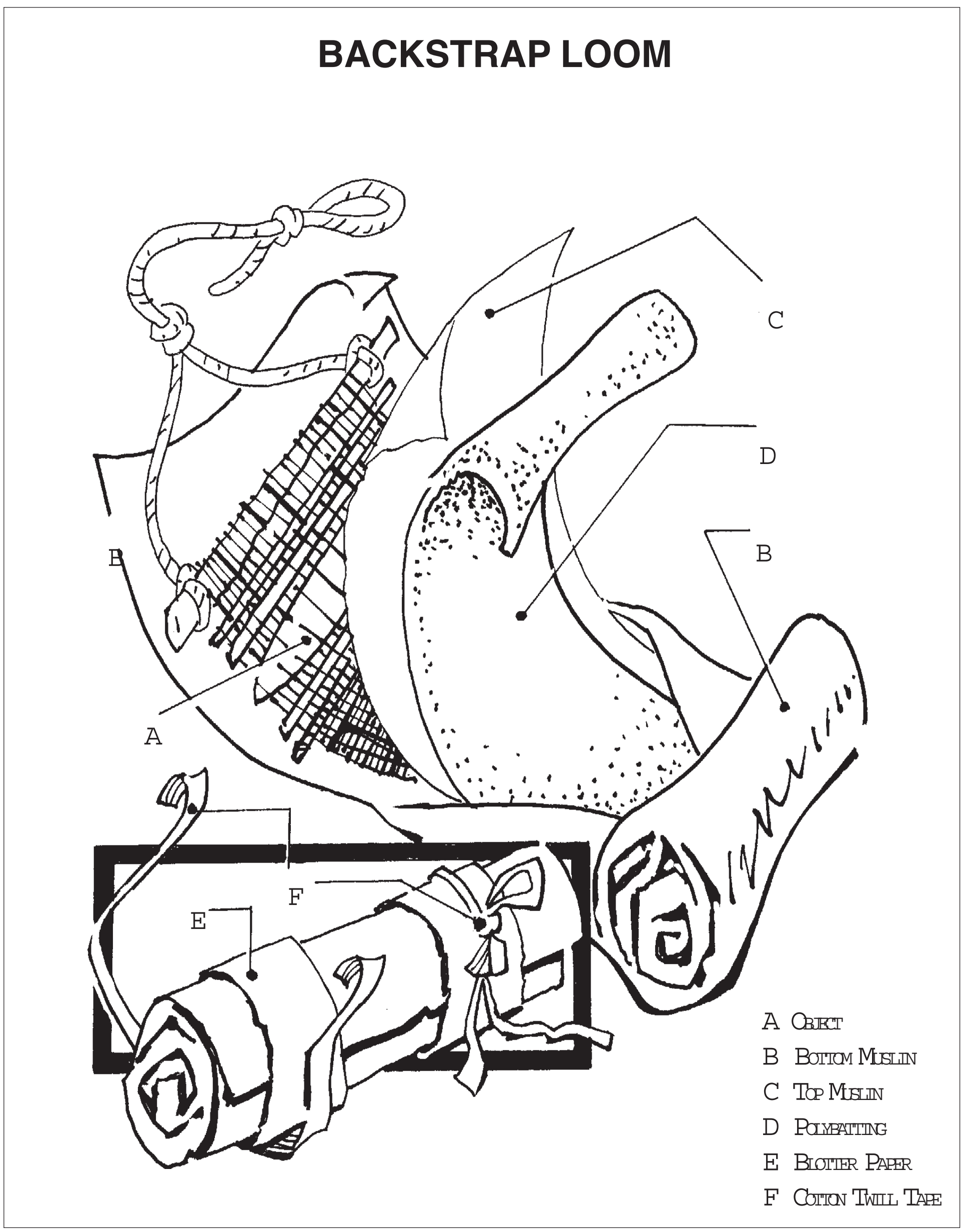



**ROLLED TEXTILES WITH INDIVIDUAL SUPPORTS**

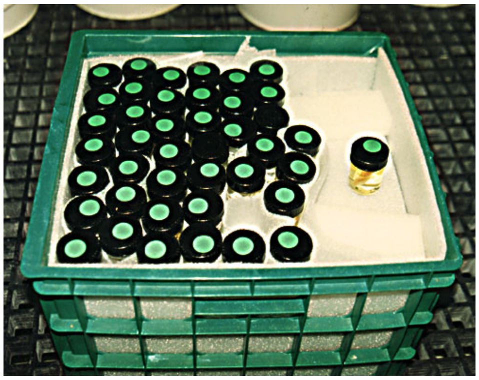


pecially if the textile is very fragile and requires additional support). Finally, the completed, rolled textile was covered with mylar so that the textile could be viewed. (This method should only be used for textiles that will be stored in cabinets. If they are not protected in this way, they should be completely covered to prevent light damage.) All of the materials were secured with a cotton tie over a strip of acid-free blotter paper, helping to distribute any stress from the tie. Finally, thin rods were inserted through the tubes that were then suspended from metal chains.

*Example:* Several variations were used. For small, long, flat textiles like Maya belts, end supports were made for the rolled tubes. The padded tube was made the same way except that the ends were not padded or covered with stockinette, so that the Marvelseal-covered tube extended out either end of the rolled textile. A pair of rectangles made of acid-free board or 1-inch Ethafoam are cut with a hole in the center through which the tube is inserted. In this manner, the small textile can be rolled and suspended using a minimum of space.




*Example:* Another interesting variation was used for the series of Maya and Navaho backstrap looms. These are looms with partially woven fabric on them and all of the additional loom parts. They can be large, and they tangle easily. We found that the best way to store them was to roll them, but without the tubes. The loom was laid on a length of muslin. A second piece of muslin was laid on top of the loom as a separator. The final layer was a length of polyester batting. The object was rolled loosely as shown in the illustration and tied into a bundle. This is bulky, but it does keep all of the parts of the loom together and takes the pressure off of the object.



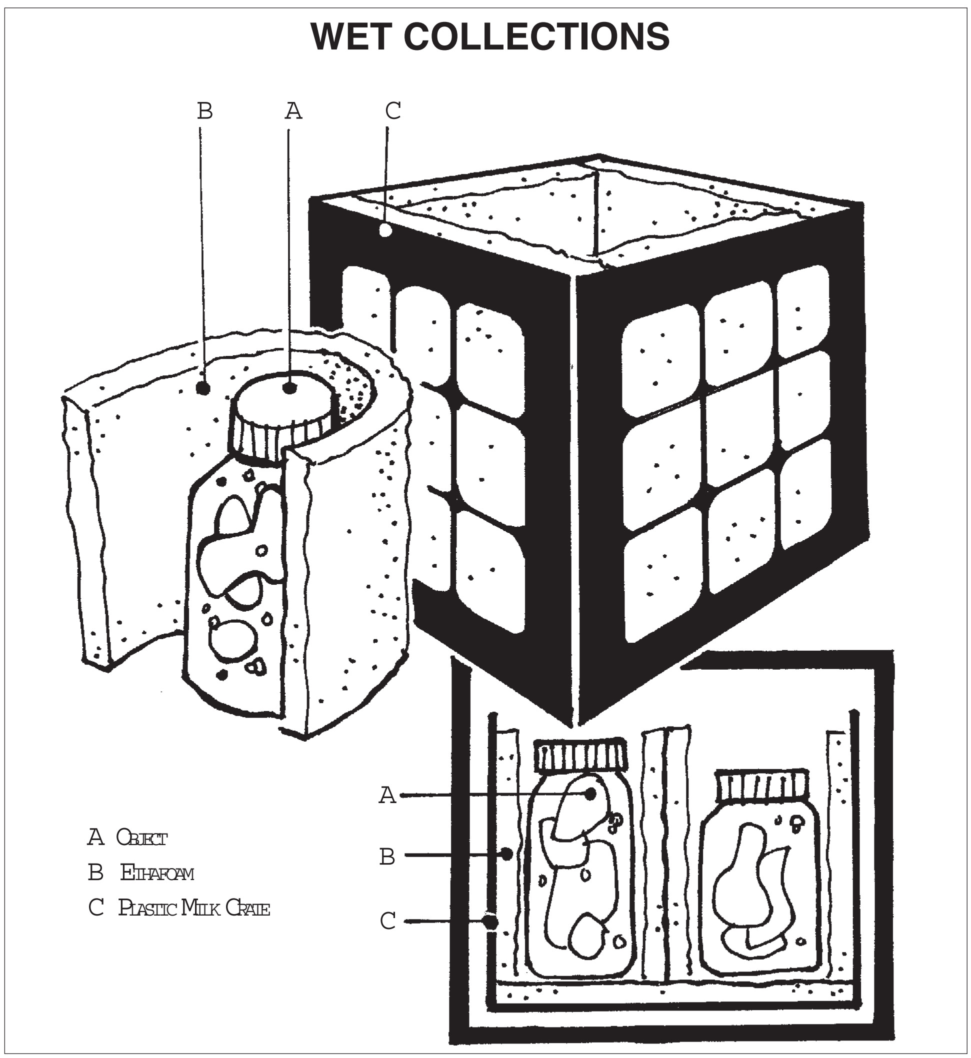
***Jars of All Sizes***
*were packed in milk cartons for transport.*



### Wet Collections

Wet collections are collections that are preserved in some sort of fluid, usually alcohol, formalin, or glycerine. They are commonly stored in glass jars or plastic bottles, which presents a particularly difficult problem in shipping. Our collection is not large, but it contains jars of all sizes, 5-gallon buckets, and vials. The buckets were easy to move; they were piled two high on a pallet and shrink-wrapped for stability. The jars were another matter. We chose to use plastic file/milk carton crates to put them in. Each crate was lined with 1/2-inch Ethafoam plank. Jars were placed in the crate and separated with Ethafoam strips or plank. If there was enough room, we stacked the jars, again with Ethafoam dividers. This proved to be a good project for some of the volunteers who had trouble with more intricate procedures. We stationed one volunteer who was able to lift moderate weight with two volunteers who packed the jars, and soon the crates were stacked three high on pallets for staff to shrink-wrap. The move was successful and there was no breakage.

The milk crates proved to be a good idea for recycling as well. When we were finished with them, other departments in the museum found a variety of storage uses for them, including housing them to be made available statewide for disaster recovery.




### Insects

The pinned insect collection had numerous concerns. The Science Museum uses the traditional method of storing this type of collection by pinning specimens into Cornell drawers, a wooden box with a glass top that slides into a specially designed case.

It is also common for the specimens to be treated with pesticide, usually paradichlorobenzene (PBD) or naphthalene.

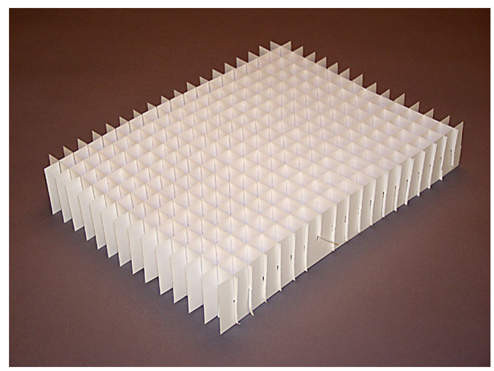
We decided to move the collection inside its cabinets. This meant that we had to pad the cabinets to reduce vibration so that the delicate parts would not be damaged. The Conservation Assistant first removed the loose pesticide from each drawer, then placed padding under and behind the drawer. Finally, when each cabinet was padded, a sheet of Ethafoam was placed on the interior of the door. The movers used a two-wheeled upright dolly to maneuver each cabinet from the old facility to the truck and into the new facility, with special attention to the amount of tilt allowed (see Small Mammal Skulls below).

**Entomology Cornell Drawers**
*were moved inside their herbariums whenever possible.*

### Small Mammal Skulls

We used a similar method for our collection of 50 thousand small mammal skulls. These are stored one to a vial in wooden trays inside herbarium cases.

Again we decided to move the collection inside of the cabinets. Since the collection was stored in trays of glass vials, we needed to find a way to keep the vials separated. To do this, a biology volunteer and former engineer developed a scheme for creating interlocking cardboard separators that we had specially cut to fit each tray, Cardboard strips about 2 inches high were clipped on one long side 1 inch deep and the width of a single vial apart. Horizontal and vertical strips were then hand-interlocked by our volunteers, making a tray-sized "fence" with a compartment for each vial. These fences could then be flattened by pulling on diagonal corners for easy storage until they were opened and inserted into the trays between the vials. Blocks of Ethafoam were added to stabilize the vials if needed.



**Interlocking "Fence" for Glass Vials**
*(above) was made from slotted strips of cardstock cut exactly to fit the drawers where vials were stored (below).*

We then padded the trays and the cabinets to reduce vibration during the move, much as we had for the insect collection, which is housed in taller herbarium cases. The Conservation Assistant first placed 1/2-inch Ethafoam padding under each tray. This was meant to cushion vibration and shock during the move. A coroplast brace was cut for the top of each tray to prevent the vials from bouncing.

The moving company, after much consultation with us, used regular refrigerator dollies to maneuver the cabinets from the old facility to the truck and into the new facility. The herbarium cabinets were too tall to pass upright through the doors and also too tall to move upright from the dock to the truck; the dollies were used to carefully lower them through these tight spots. We agreed to this only because there seemed no other way and on the condition that we could pick the mover who performed the operation. As in all cases, our staff was on hand every minute to make sure that great care was used. We also found it helpful to explain to the movers what it was that they were moving so they understood the fragility issues, especially when they were handling 50 thousand glass vials. Such explanations were not only effective but had the added advantage of getting our crew interested in science!

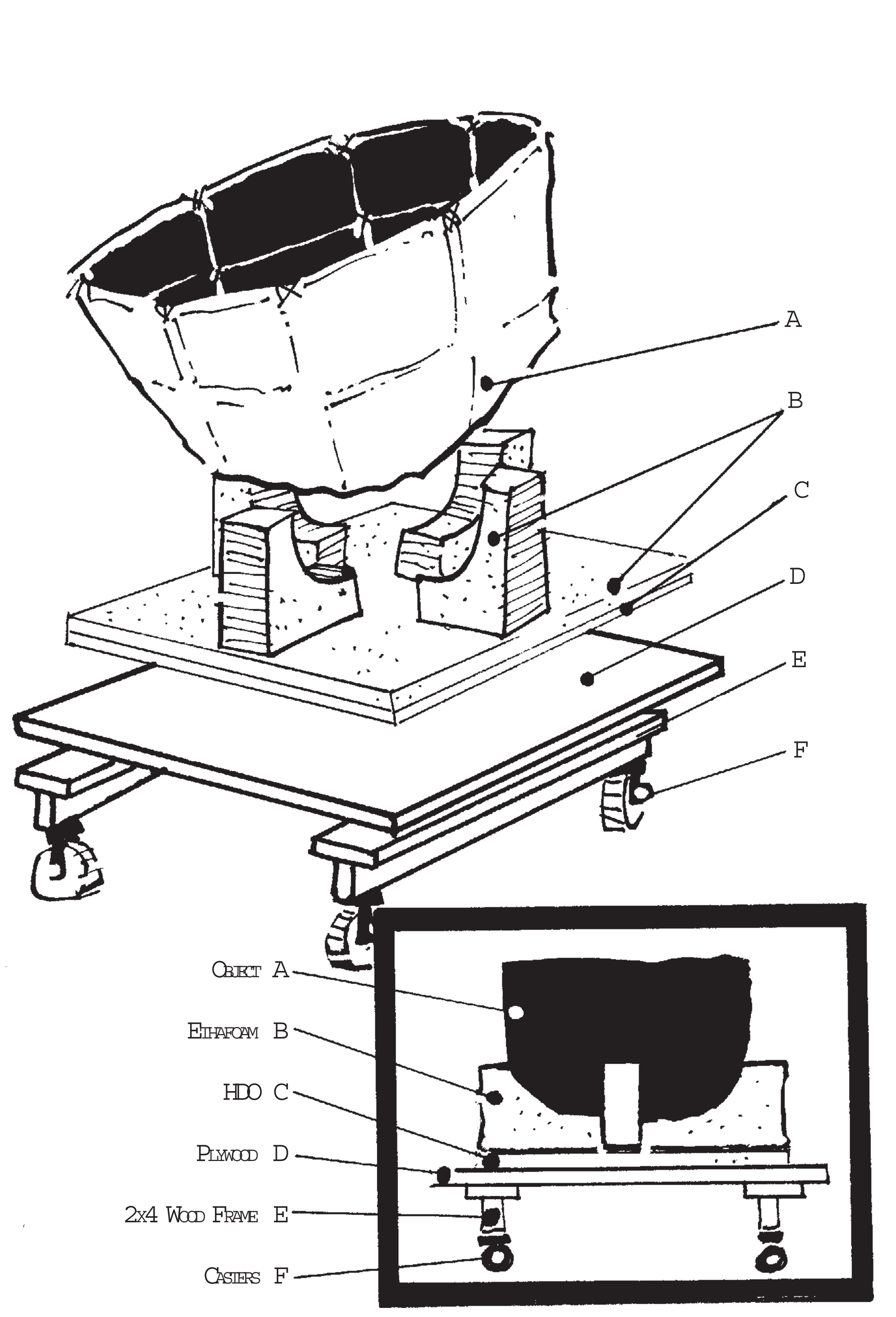
## Wheels

What would we have done without wheels? One thing we have learned over the years is to never skimp on wheels or castors (wheels do not pivot like castors, so most of our needs were for castors). They need to match the requirements of whatever the job is. Not only must they be up to the job (properly rated for the load weight), but they must be able to pivot so that the cart can be maneuvered. We got so we would put wheels on almost anything!

### Custom Carts

Custom carts are a perfect solution for many objects and specimens that are not easily moved in any other way. The cart usually consists of a frame with a deck large enough to accommodate the object(s), wheels or castors, sides or a mount to hold the object, and a handle to maneuver it. We moved a birch bark canoe, a bull boat, and two large slit

**BULL BOAT**



drums on custom carts consisting of wooden frames with wood and Ethafoam cradles. Castors were attached to the four corners so that the objects could be maneuvered in any direction, making it easier to slip them into tight storage spaces. These carts became the permanent storage mounts for each object.

### Other Carts

**Gondolas:** The moving company had a special cart called a gondola. This is often used for moving books, office equipment, and so forth. We found them particularly useful with some collections. There were awkward things that did not fit in standard boxes that worked perfectly on the gondolas. Some of the wet collections moved on them. The part of the insect collection that was not in cabinets moved on them. The shelves were padded if necessary and the specimens were placed on them and padded or wrapped as was appropriate. Then the entire gondola was shrink-wrapped.

**Gondolas (Book Carts)**
*supplied by the moving company were most useful for small boxes, drawers, and miscellaneous collections of all kinds.*

**Kewaunee Carts:** For moving Kewaunee drawers full of high specimens, we customized ten half-size metal Kewaunee cabinets to roll like the seven existing wooden Kewaunees from the labs; we could slide drawers in these slides differentially according to how much head space the objects needed. Our Exhibit Shop was asked to devise a method for attaching castors, which turned out to be a simple wood platform bound to the cabinet with movers' straps. The straps were reinforced with 1"x4" wood lengths to keep the sides from bowing under the weight of sometimes very heavy fossils. Specimens in drawers were packed carefully and padded on top with muslin pillows, and the ride proved to be smooth and problem-free. We used these for most tall fossils, emptying them on the receiving side as soon as they were delivered by the trucks and sending them back to be refilled on the last truck of the day.

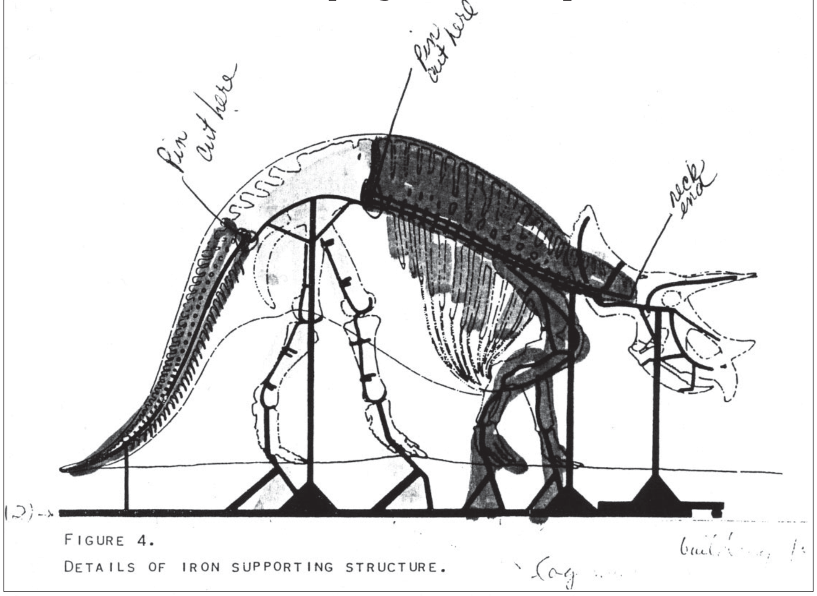
**Dockmaster David Allen**
*helped movers and Move Team staffers get Kewaunee carts to their destinations.*

**Blue Carts (ITWCTs):** The Science Museum had in the past designed a flexible, large cart for a traveling exhibit (called If These Walls Could Talk; hence the acronym) to facilitate the transport of our touring exhibitions. Each cart consisted of a 4'x8' bed on 4-inch high castors. End and side panels could be added by slipping them into slots on the corners. For the move, we had a dozen wooden shelves constructed that keyed into the end panels so each cart could function as a flatbed or a double- or triple-tiered cart.

**ITWCT Carts**
*proved to be most versatile and useful for large objects and specimens.*

Perhaps the most stunning use of custom carts, both ITWCTs and those specifically constructed for a specimen, used with a combination of packing method, was the move of the museum's mounted dinosaurs. The large skeletons were to be remounted in the new facility and had to be judiciously disassembled (skulls removed, parts disarticulated, armatures cut) into manageable sections so they could be removed from the old building, moved, and installed in the new one. We tried, whenever possible, to cut the armature in large cohesive units (see Chapter 4). Some of the skeletons were placed almost completely on ITWCTs. In these carts, the castors had actually been welded onto the metal base supporting the skeleton.

***Disassembly Diagram for* Triceratops**




The most dramatic example of this technique was used for the museum's *Triceratops*. The specimen is the largest and most complete *Triceratops* in the United States, and getting it into pieces was a special project all in itself. Large metal frames with heavy-duty castors were welded together. The specimen was disassembled, first the skull and then the rest. Metal supports for the skull were welded onto its cart, while the tail was suspended from the framework of an ITWCT and lashed into place. Each leg was placed on an ITWCT as well, generously supported with peanut pillows. The rib cage and pelvis were separated and individually welded to metal frames on castors. The carts could then be rolled onto the waiting trucks and transferred to the new facility. Carts were tied to the trucks so that they could not shift.

**Triceratops**
*is led off the moving truck by Staffer Dan Miller and unknown helper.*

***Staffer Brad Bredehoft***
*contemplates the beauty of* Triceratops *while both wait to get on with the move.*