

COLLECTION FORUM

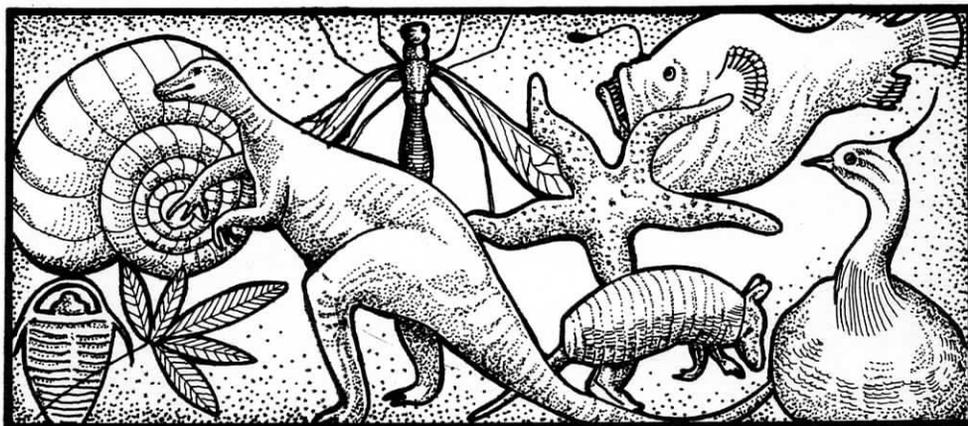
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**ANNUAL MEETING OF THE
SOCIETY FOR THE PRESERVATION
OF
NATURAL HISTORY COLLECTIONS**

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COLLECTION FORUM

Volume 2, Number 2, Fall 1986

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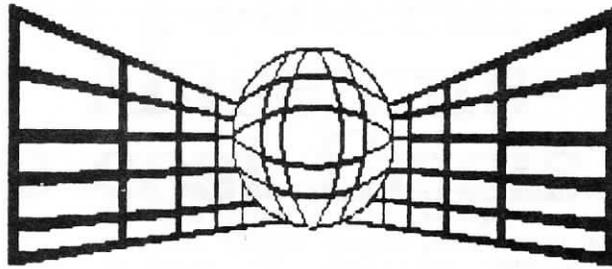


TABLE OF CONTENTS

OPINION

We've had it 2
Orphaned and Endangered Natural History Collections
— A Statement 2

FEATURE ARTICLES

A Common Problem for Museums — The Space-Cost Crisis
By Dave Fenner 3
Ideas on how to better preserve collections of natural history
By Mary Lou Florian 6

RESEARCH ARTICLES

Preparation from preserved dissection discards of skeletal material for teaching and display
By A.P. Russell and B. Curtis 8
Preservation of Douglas fir branches for display purposes
By C. Romero-Sierra and J.C. Webb 10
Preparation of freeze-dried hearts for use as teaching aids
By C. Romero-Sierra, J.C. Webb, G.W. Lyons,
J.K. Desmarteau and K.C. Carlson 11

1986 MEETING ABSTRACTS 14

NEWS AND REVIEWS

Meetings 15
Miscellany 16
Reviews 19
Supplies and Equipment 19

SOCIETY BUSINESS

Letters 20
SPNHC meets in Washington D.C. 21
1987 Meeting in Montreal 21

COVER: View down an aisle of a mobile storage system at the University of Alaska. Courtesy, Spacesaver Corporation, Ft. Atkinson, Wisconsin

Opinion

WE'VE HAD IT!

Several events occurred during this last year, which when taken together, will probably establish some kind of record among natural history organizations. They included: our Society (SPNHC) became operational with an international membership; Norway established a national natural history organization (NNML), which includes individual members and natural history museums; the Mountain-Plains Museum Association in the United States established the Natural History Affinity Group (NHAG); the ICOM Committee on Conservation established a Natural History Working Group; the Canadian Museums Association tried to create a natural history section; and finally the Natural History Museum of Los Angeles County established the first-ever pilot training project on the care and maintenance of natural history collections. Each event is insignificant but together they demonstrate considerable effort on the part of natural history staff to meet together. Why did all these events occur during the last twelve or so months?

I have attended a number of Annual Conferences of the Canadian Museums Association; on one occasion I was invited to present a talk. After attending each Annual Conference I felt empty, as though I learned nothing new from the experience; I have heard the same from my natural history friends and colleagues. What are the problems? One, I believe, is that natural history staff are fed up with being led around by art and historical types. Another problem is the fundamental nature of natural history museums. Most staff are involved in a certain amount of research, curatorial, or conservation work. At such conferences these staff find very few things of help or interest for their work. Neither will college nor university museum staff in natural history fields find anything helpful at a national museum association conference.

Natural History staff now realize that scientific or curatorial staff of museums will learn more and be fundamentally more content to meet with other natural history types. In most cases they have similar training and have friends and colleagues in common. It is extremely encouraging to see the events mentioned above happening in the 1980's. To me, it demonstrates that natural history types are beginning to see the light and that they are making the extra effort to start natural history organizations. Ten years ago such events would have been unthinkable. I suggest, we natural history types must support some of these efforts at organization and hopefully we will develop a web of communication which will help to develop and secure our invaluable natural history collections for generations to come.

D.J.F.

ORPHANED AND ENDANGERED NATURAL HISTORY COLLECTIONS

Many museum, academic and institutional scientists, researchers and administrators are deeply concerned about the effective maintenance and use of systematic collections. These concerns cross conventional discipline lines, to include collections of anthropological and archaeological artifacts, fossils, living populations, and preserved botanical and zoological materials. Many collections, in all of the preceding categories, have suffered from withdrawal of financial, staff, or other support; still others fall into an endangered category as institutions confront fiscal realities and/or the collection's champion nears retirement with no direct replacement in sight.

Both the Association of Science Museum Directors (via an *ad hoc* committee chaired by Robert M. West) and the Association of Systematics Collections (Committee on Collections, chaired by Lloyd Knutson; sub-group on Orphaned Collections, chaired by Robert M. West) have recognized this problem and are gathering data necessary to address it.

The essential data for a full analysis of the magnitude of the orphaned and endangered collection problem are scattered. Numerous professional societies have full or partial accounts of the status of collections in their particular fields; many museums have documentation of collections adopted or dispersed; and many individuals can contribute information on both institutional and personal collections and their futures.

During late 1986 and early 1987, I will be drawing together information from the above sources as well as from all others that come to my attention from my ASMD Committee colleagues, ASC sources, and others who can assist. This certainly includes readers of *Collection Forum*.

I urge that comments, data, and recommendations of contact people be directed to me at Carnegie Museum of Natural History.

At present it is my intention, in conjunction with outgoing Executive Director, Stephen Edwards, to have the 1988 program of the annual meeting of the Association of Systematic Collections, held in Pittsburgh, focusing on collection dispersal/maintenance issues.

Robert M. West, Director
Carnegie Museum of Natural History
Pittsburgh, PA 15213

A Common Problem For Museums- The Space-cost Crisis

Here is One Solution

By Dave Fenner

A businessman shows us how natural history collections can be well organized for use and for storage.

As most all museum directors are acutely aware, a space-cost crisis has emerged in the 1980's. Associated with this is a continuing surge in the public's cultural interest and participation as well as a continual expansion of museum collections. Many businesses which store products or files are able to rotate their products, or when their files become full, they can dispose of them when they are no longer needed. Museums do not normally have such luxuries and in order to maintain the integrity of the collections, storage space must continually grow as the years pass on. Put simply, many museums are rapidly running out of available space.

The acquisition of new space puts an extra burden on management. Acquiring additional land can offer a solution to space problems, but few museums can move to the suburbs or split up facilities. Even if land can be acquired at the existing site, generally located in a congested urban area, this acquisition is often difficult and expensive, if not impossible.

Added to these problems are the continuing increase in museum specimens to be stored, as well as the need for additional laboratory and research space. This usually means that space for public viewing will remain limited.

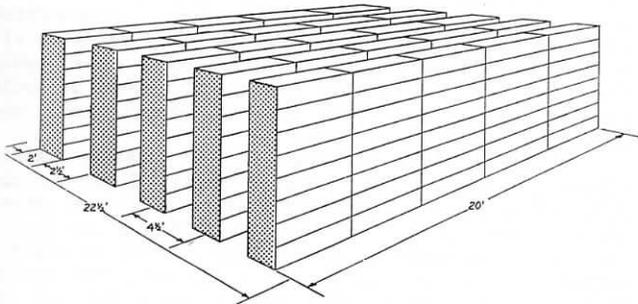
As expensive as space is, we still continue to misuse it, or at least under-utilize it, especially storage space. Most collection areas under-utilize as much as 50% of their available floor space.

While other kinds of conservation are very familiar, very little attention has been given to "space conservation", or the maximum utilization of existing space.

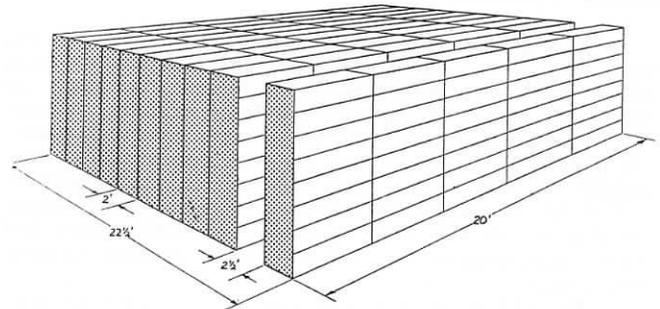
COST FACTORS

The present cost of new construction in North America ranges up to \$100 per square foot, providing land is available. Add-on buildings can be a solution, however, the added expense of energy for the new space must be included. Such costs in the United States for the average business now range over \$3 per square foot annually - for heating, lighting and air-conditioning. Additionally, annual maintenance services are now over \$1 per square foot. Frequently, museums have substantially higher costs due to temperature, humidity, and other environmental controls required for proper collection maintenance.

Under severe conditions, increased space could be



A typical storage area with non-moveable storage units. empty aisles occupy 56% of the floor area.



The same floor area as in the illustration on the left, when converted into a mobile storage system, will provide double the storage capacity with only 11% free aisle space.

made available by temporary storage in basements¹ and other non-working areas. These solutions lead to a mass of specimens and other items being hopelessly crowded together! A final "solution," which no museum advocates, is to remain *status quo* and turn away important newly acquired collections.

MOBILE STORAGE SYSTEMS

Non-productive aisles create a considerable waste of space in a normal storage area. If non-productive aisles were turned into usable storage areas, space needs could be reduced. It's a matter of efficient space utilization.

A simple, cost-effective solution to this wasted space is high density mobile storage. Solid steel rails are placed perfectly level on, or flush into, the floor and then fully grouted to support the weight. Metal carriages with precision ground steel wheels are then placed on the steel rail which holds the storage equipment; shelves, racks, specialized cabinets or whatever housing the stored materials requires. The storage units can now be rolled together, leaving only one "transposable" access aisle, eliminating all open aisles. Access is made to any aisle by simply and easily moving one or more rolling carriages, creating a new aisle whenever and wherever it is needed. Units also can be compacted together and locked for security, if required.

The space gained may now be used for other productive purposes or can be filled with additional carriages to increase the storage capacity by as much as 100% or more. It must be determined, however, that the floors can hold the additional weight. No matter how or where high-density mobile storage systems are used, they provide the most cost-effective use of increasingly limited and expensive space.

There are three types of mobile storage systems on the market today; a manual system, a mechanical-assist system, and an electric system.

Manual Systems

Manually operated units are physically pushed back and forth by operators. The effort needed to move shelves will vary depending on the quality of the bearings, size of wheel, type of rail, and guidance system. If there are three or four manual units clustered together, the effort required to move multiple units will be compounded with the number of units moved.

Mechanical-Assist Systems

This system utilizes a geared crank assembly to move the units. There are three units of measurement which must be considered when judging the ease of movement for a mechanical-assist operated carrier: First is the starting effort required, i.e., the amount of effort it takes to get it going. Second is the weight of the carrier and the material being moved. Third is the amount of movement with each 360 degree revolution of the crank handle, in other words, how many times does the handle have to be cranked to open the aisle.

The effort to move the carrier will vary according to the quality of the components: bearings, wheels, rails, type of guidance, etc. Some manufacturers offer variable movement ratios which require

more turns of the crank in exchange for easier movement.

Mechanical-assist units are available that have safety locks in aisles which effectively prevent movement when the operator engages the device on both moveable units adjacent to the open aisle. The more advanced mechanically operated units have internal brakes, which stop the unit from moving when a safety sweep, located at foot level on the base of moving units, is activated, or alternatively by the weight of a person pressing on a pressure sensitive safety floor.



Fragile birds stored in drawers enclosed in cabinets for extra protection. Little light and dust can penetrate this arrangement. There is no damage by vibration when units are moved.

Electric Systems

Electrically operated high density mobile storage systems, which are properly designed, contain design features that provide safeguards for *all* environmental considerations. They contain vibration-free operation and running rail guidance characteristics which are necessary with both manual and mechanical-assist equipment.

Introduced in the last two years are D.C. motors and controllers with *soft start* and *soft stop* features. These features allow current to be gradually applied with gradual acceleration, rather than 100% power all at once-causing a lunge when they start. When the units reach running speed, which can vary from 1 to 3 1/2 in. per second, they continue at the same rate until the control button is released or until the aisle limit-switch instructs the unit to stop. At that time the *soft stop* control decelerates the unit to a smooth stop. The new electronics in electric systems start and stop the units so smoothly that any operator, whether it be a 250 pound athletic man or a petite lady, can operate the units with the same controlled reliability.

Typical safety features include passive safety floors and ramps. The passive safety floor is the only safety feature which requires no conscious effort on the part of the operator to activate or reset. When a person walks onto the floor, which is usually adjusted for a sensitivity of 25 pounds, the system locks itself. When that person walks out of the system, it normally resets itself and is ready for the next operation. Likewise, if an artifact or other object weighing 25 pounds or more is inadvertently left in the aisle, the same lock-and-stop will take effect. An optional safety sweep, which is located at foot level along the base of each moving unit, protects objects, carts, or aisle ladders inadvertently left in the aisle. A safety sweep is so sensitive that it will protect a book left in an aisle. Other safety considerations may include vertical and hori-

1. A recent flood at the Chicago Historical Museum caused considerable damage to items stored in the basement.

zontal safety edging which stop carriages immediately when touched. They are normally placed on edges of the face panel to protect an arm or leg if someone should put theirs into an actively closing aisle.

Overhead aisle lighting can be adjusted to illuminate only the open aisle. Manual override units are able to move any unit in the event of a power failure. Manual ratchet types and even hand-held battery powered units will move carriages with the touch of a button. Often overlooked with mobile system are: dust, water and light seals which are affixed to the top and sides of the shelving and/or cabinets.

Another advantage of electric systems with their automatic braking systems is that they keep units in a closed, tightly sealed position whereas manual and mechanical-assist equipment tend to drift or roll back and not keep the seal fully compressed. The very nature of compacting and closing the units together reduces the exposure to particulate matter such as dust, volcanic ash, smoke, and other airborne pollutants. They also reduce the exposure of light to light sensitive specimens and they provide additional fire protection with compaction by reducing oxygen, thus retarding the spreading of flames. They also provide security by allowing single carriages or entire modules to be locked together either mechanically and/or electrically. And finally out of sight storage deters pilferage and vandalism.

With vibration problems virtually eliminated with today's hi-tech electric systems, the electric system not only provides cost efficient storage but the most ideal environmental conditions for long-term storage of natural history collections.

CONCLUSIONS

Vibration is a key concern with most curators and collection managers, and in fact, has frequently been the only reason that a mobile storage system was not considered for their collection. However, mobile storage "state-of-the-art" has improved tremendously in the last decade. All vibration - with quality equipment - has been virtually eliminated with the implementation of fully machined wheels and rail components, along with permanently lubricated roller guidance bearings. These completely eliminate the vibrating movement associated with railroad type flanged wheels.

Space Conservation, becomes an essential key to museum economies and services both now and in future years when costs may well double or triple. Staff in the mobile storage and filing equipment industry are devoting research and engineering skills to this end.

The real benefits of space conservation realized by the high-density mobile system concept go well beyond economic factors. By opening up additional storage areas, valuable collections will have the necessary space for an orderly access, rather than being doomed to Dead Storage. Enlarged facilities in a secure, organized environment provide more efficient working areas for museum personnel, researchers and scholars.

Dave Fenner is the Museum Market Manager for Space-saver Corporation in Fort Atkinson, Wisconsin. He presented a modified version of this article at the 1986 Annual Meeting of SPNHC in Washington D.C. 

Ideas

On How to Better Preserve Collections of Natural History

We now need to do something

By Mary-Lou E. Florian

Traditional curatorial techniques are questioned concerning their suitability for long-term storage. Can one person become familiar with so many different techniques?

Natural history specimens encompass a tremendous variety of materials, from mineralized tissues such as bone and teeth to transparent tissues of planktonic animals. A multitude of methods of preservation have been devised over some 200 years of fervent collecting. Preservation techniques have been devised, mainly, as a method for convenient handling for future research. Perhaps it is time to improve some methods of preservation which do not keep specimens in suitable condition during long-term storage.

UNCERTAINTIES ABOUT THE PRESERVATION OF NATURAL HISTORY SPECIMENS

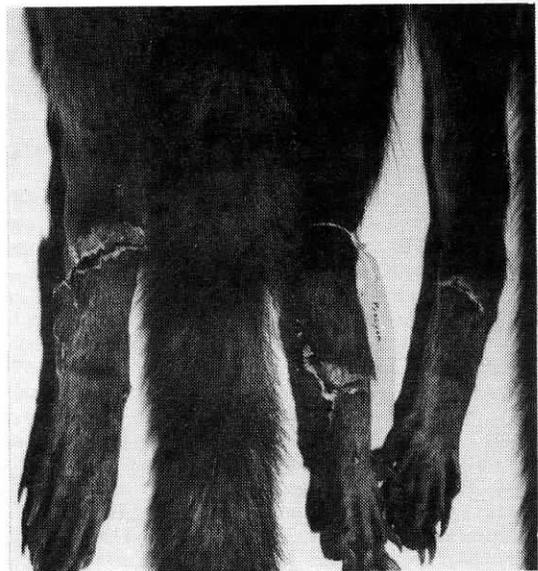
I am impressed at the ethical concern of curators of natural history for the care and maintenance of their collections, while I, as an individual, am overwhelmed at the complexity and diversity of methods of preservation.

I am concerned about the continual questioning of natural history preservation methods: Are they adequately preserving delicate color and cellular or morphological details? Are they slowly causing deterioration? Are they interfering with the research potential of specimens? Also, I am troubled that concerned individuals question the appropriate parameters of the storage environment for natural history collections. I am especially concerned because preservation methods are being used without knowing the answers to these questions but I am encouraged that we are finally asking these questions.

In addressing the question of preserving color in wet preparations, Taylor (1981) wrote "Many present curation practices and concepts when applied to color preservation are of dubious value and some are probably harmful". And further states that "records are not retained of details of specimen preparation from formaldehyde fixation through subsequent alcohol preservation, thus limiting interpretation of satisfactory curatorial methods". Have things changed since 1981? Certainly some valuable information is now available. Nagorsen (1980) discusses the deleterious effects of the chemicals, alum and borax, commonly used in hide preparation on the color of pelage. Are these chemicals still being used in 1986?

In addressing whether or not preservation methods are causing deterioration of the material, let us

look, for example, at hide preparation for mammalian research collections. Upon reviewing the literature on methods of preparation of hides, it becomes apparent that tanning is used most commonly. It is important to realize that tanning was developed to increase serviceability of the hides, that is, to make them soft and pliable for wearable garments or waterproof for shoes. In the tanning process the proteinaceous materials are chemically altered to make them more resistant to wear, but the complex of chemicals used may over many years actually enhance deterioration of the proteins. The question then arises, why do we tan mammalian skins in zoological collections? Is it for ease of handling and storing, or for longevity of the specimens? Do we have our priorities right?



The severe cracking on the feet of these raccoon specimens was probably caused by fluctuating environmental conditions in its storage area.

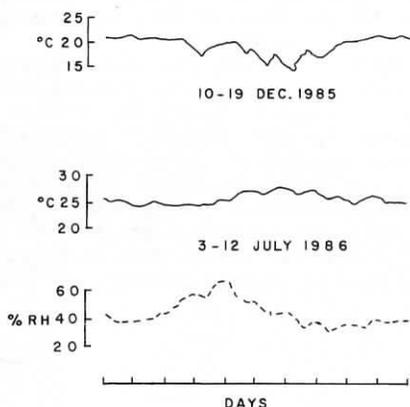
Photo, courtesy S. Williams, Carnegie Museum of Natural History, Pittsburgh.

In addressing the question of possible intervention of preservation methods in altering or destroying the research potential of specimens, the use of isoelectric focusing for species identification is important. In a specific project, species identification of gut samples used in Inuit garments was undertaken (Belliveau et al 1982). It was realized and shown by experimentation that if these garments had been fumigated with ethylene oxide that the isoelectric point of the proteins or peptides would be so altered as to give spurious results.

The question of appropriate environmental parameters for storage is indeed complex. Today our major concern is to prevent fluctuations in relative humidity which cause materials to swell and shrink. Each

time this happens things never really go back to the unaltered state and in some cases has been shown to be damaging. The major concern should be the moisture retained by the material and the optimum moisture content for each material. For example, at the same relative humidity (50%), leather, cellulosic and keratin materials will have different moisture contents. Consequently lowering the temperature and maintaining 50% Rh will increase the moisture content of the materials. Is one relative humidity and one temperature adequate for all materials? Should we have specific storage environments for different materials? Hawks et al. (1984) discuss the role of the fur vault and give pros and cons to refrigeration. They recommend "an acceptable environment for the fur vault would be 20-22°C and 50-60% Rh on a continuous year-round basis". Since the late 1800's cold storage was used to store furs to protect them against insect damage without thought to their moisture content.

Over a period of time many artifact materials decrease in their moisture content and become dry and brittle. Is this happening, for example, with furs in zoological collections? It seems logical that simple tests of weight loss could be run to determine in which environment less bound water is lost.



Fluctuating environmental conditions in the building where the Fish Collection of the National Museum of Natural Sciences is held. Summer temperature (°C) and humidity (%RH) records from 3-12 July, 1986, and winter temperature record from 10-19 Dec., 1985. Data courtesy Ichthyology Section.

DISCUSSION

Collections' Conservation arose from a need to make fine art restoration more "scientific". Some Museum Conservators are now becoming material scientists. They examine the chemical and physical properties, the state of deterioration of the materials of the artifact, and the interaction of the conservation treatment and the material. Only then do they decide on preventative or active conservation treatment.

The conservation literature on the preservation of inorganic materials is voluminous but very little on organic materials exists. The preservation of Natural History specimens needs this same approach. Mu-

seum Conservators all around the world are asking these very same questions in reference to collections of historic, archaeological and ethnographic artifacts.

An awareness of the need for this information has developed and in the past few years significant workshops and seminars have taken place. Some of these proceedings and papers have been published (Florian 1985, Fogel 1985, Rose and Von Endt 1984). Materials are being looked at in a holistic framework which includes not only the nature of the materials but also storage and display environments, conservation treatments, stabilization, etc.

Museum Conservators and Natural History Preparators and Curators each have an expertise which should be shared. They should become more actively involved in co-operative investigations to enhance the longevity of the precious collections of our natural history heritage.

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Mary-Lou Florian is a conservator with the Conservation Division of the British Columbia Provincial Museum in Victoria, B.C. She developed her interest in this field while working with the Canadian Conservation Institute in Ottawa. 

Preparation, from preserved discards, of skeletal material for teaching and display

By A.P. Russell and B. Curtis

Department of Biology, University of Calgary 2500 University Drive N.W., Calgary, Alberta, T2N-1N4

Anthony P. Russell and Barry D. Curtis. 1986. Preparation, from preserved dissection discards, of skeletal material for teaching and display. *Collection Forum* 2(2):8-9

A method for preparing skeletal material from discarded, commercially available, preserved dissection specimens is described. This method employs trisodium phosphate to loosen the soft tissues. Because large quantities of skeletal specimens may be reclaimed cheaply and easily, the opportunity to experiment with such material for innovative teaching and display purposes is increased. Based on average current prices, commercially prepared skulls cost about twice as much, and complete disarticulated skeletons about four times as much as complete dissection specimens. Thus, the method described herein not only is useful for reclaiming skeletal material from already used material, but may also provide a cheaper source for the primary acquisition of skeletal material required for teaching and display purposes.

Preserved dissection material routinely used in the teaching of courses in vertebrate anatomy represents a potential supply of skeletal material for teaching and display purposes. Usually, however, this material is discarded once the class for which it was purchased has terminated. Commercially available skeletal material for such courses and for general demonstration purposes is very expensive (Drabek, 1985) and its cost limits its availability and subsequent innovative treatment. Fierstine et al. (1974) have indicated that bone-muscle preparations can be produced quite simply from discarded dissection specimens. It is also possible to prepare skeletal material of reasonably good quality from the same discards. A method of doing so is outlined herein.

Methods

Discarded dissection material must be kept saturated with embalming fluid (Walker, 1986:377) until preparation begins. If the preserved material dries out, the soft tissue becomes much more difficult to remove.

The discards are gently simmered for about one day in an aqueous solution of trisodium phosphate. We used a large, electrically heated, thermostatically controlled boiling tank to prepare many specimens at once. For every 100 litres of water 238 grams of trisodium phosphate are used. Such treatment loosens soft tissues but does not break them down. The process is speeded up if specimens are skinned first. The time for simmering depends upon the size and age of specimens; frequent examination during preparation is recommended.

After simmering, the majority of soft tissue can be picked away by hand. Tissue adhering to areas such as the palate is the most difficult to remove. This, as well as soft tissue trapped in awkward places, may be removed by repeated rinsing and brushing with a hard-bristle tooth brush.

Following removal of all external extraneous material, the skeletal components should be set aside for a day or two and allowed to air dry. The brain is much more easily removed from the skull when dry than when wet, as it may be broken up with a probe and the pieces shaken out via the foramen magnum.

The skeletal material may then be bleached in a 5% by volume solution of "20 volume" hydrogen peroxide in water. Full whitening is difficult to attain but is not always required. The time a specimen is allowed to remain in the bleaching solution varies accord-

ing to its size (see Hildebrand, 1968:24 for details). If time and space permit, the material may be left out in the sun to bleach.

Once bleached and dry, the skeletal material may be coated (inside and out in the case of skulls) with Glyptal Cement (General Electric™) diluted 50% with Glyptal Cement Thinner (General Electric™ 3495). Such treatment strengthens the material and provides a surface that may easily be washed clean if it becomes dirty. It also provides a surface that may be written or marked upon for teaching or display purposes. However, it should be warned that an excess coating may obscure muscle scars, sutures, or evidence of pathologies.

Discussion

Such reclaimed skeletal material may be used for quite rigorous treatment and examination, because, if damaged, it may be easily and cheaply replaced. If desired, students may be supplied with discards to prepare for themselves, so that they may use the skeletal material for home study.

We have concentrated on the preparation of skeletal material from cats, as the cat is a commonly used animal in the teaching of vertebrate anatomy. Other species that are widely used and that would be equally applicable for such treatment are the macaque, rat, rabbit, armadillo, opossum, dog, pigeon, caiman, iguana, turtle, bullfrog and garpike. In many instances the skull remains undamaged (unless the brain is examined). Similarly, the only components of the postcranial skeleton that are routinely damaged are the rib cage, sternum (where present) and, in some cases, the ventral components of the pelvic girdle. Here, then, is a source of easily and cheaply produced skeletal material. Slight discoloration of such skeletal material is usually present, due to percolation of the preservative and penetration of the injection medium. This is amply compensated for, however, by cost-effectiveness and the freedom to experiment.

Specimens from biological supply houses generally come in a variety of sizes. Thus, material prepared from them can be utilized to demonstrate a variety of structural features, such as the sequence of the fusion of sutures and the sequence of dental eruption. Such reclaimed material, because of its inexpensive nature, can also be subjected to a variety of novel treatments. Skeletal elements may be disarticulated, or sectioned in various planes using a band saw or an autopsy saw. Such sectioning is best performed before

the preparation procedure is begun, as the soft tissues protect fragile areas from the violent action of the saw.

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Preservation of Douglas fir branches for display purposes

By C. Romero-Sierra and J.C. Webb Department of Anatomy, Queen's University, Kingston Ont. K7L-3N6

C. Romero-Sierra and J.C. Webb. 1986. Preservation of Douglas fir branches for display purposes. *Collection Forum* 2(2):10

A process for preserving Douglas fir branches has been developed. The treatment consists of immersing the branches in a mixture of chemicals for a period up to two weeks. The branches are subsequently rinsed in water and placed in a solution of water and glycerin for another two weeks. Finally, the branches are air dried. This treatment preserves the needles and prevents them from shedding.

In modern museum displays it is desirable that vegetation, which forms a part of the display, be preserved specimens rather than hand-created replicates. There is an urgent need to develop preservative solutions which would retain the original living colours of various trees and plants.

In another paper (Romero-Sierra and Webb, in press) a general method for preserving the structure and chlorophyll pigment of botanical specimens was described. The preservative formula, which was developed, was based on the results of our experiments with a broad variety of botanical specimens. Once confident that the method produced satisfactory and repeatable results with species used in our experiments, we tested it with other species, some with success and some without success.

We report here on the problems we encountered and those we solved in the preservation of Douglas fir branches. Initially we treated them with the general formula. However, we found that it caused the needles of Douglas fir branches to shed easily, and we undertook experiments to improve the composition. This paper describes our method and the composition of a preservative formula which was successful with Douglas fir branches.

Materials and Methods

This method consists of two basic steps, namely, (1) immersion in a bath of chemicals (preservative formula) followed by rinsing in water and then (2) immersion in a second bath of chemicals (holding formula). The preserving formula was a mixture of distilled water and chemicals that fix and preserve the structure and pigments of Douglas fir branches. The duration of immersion in this mixture was generally two weeks. If the mixture had previously been used heavily for treatment of a large amount of specimens, or if it was old, immersion required up to four weeks. The holding formula was a glycerol and water solution that influenced the water affinity of the specimens and caused them to retain their flexibility. Two weeks was normally required for this step, although specimens could be left for extended periods of time, until needed.

In searching for the most efficient formulation of preservatives to prevent the needles from shedding we identified two beneficial factors, i.e., (1) the fixative formaldehyde and (2) polyhydric alcohols (glycols). Our next objective was to determine the ideal concentration levels of these chemicals. In this phase of the experimentation we also found it necessary to increase the concentration of cupric sulphate in order for the needles to retain their colour.

We adhered to regulatory safety precautions in the laboratory when handling formaldehyde, ethylene, glycol, propionic acid, cupric sulphate and ethyl alcohol. We used gloves when handling chemicals.

The preserving bath was kept under a fumehood as is any volatile chemical while not in a closed container. The vat had a lid which was left on at all

times during handling and inspection of specimens. This reduced the escape of fumes and prolonged the usefulness of the mixture.

The rinsing in water of specimens after the preservative treatment removed chemicals that emitted toxic substances in the finished products. Furthermore, it ensured that the water-glycerin bath remained clean.

Once the branches were taken out of the holding solution, they were air dried until there was no trace of fumes. Tests conducted to assess the flammability of treated specimens showed it to be lower than in untreated dried specimens.

Results

The formula presented (Table 1) produced the best colour preservation and resistance of the Douglas fir needles to shed. Table 1 also shows the range of variations that we found effective. The concentration of glycerol in the holding solution was effective at 50% in distilled water.

TABLE 1. Preservative formula used to preserve Douglas fir branches and formula used for general botanical structures

Substance	Quantity	Range of Quantities	Quantity*
Distilled water (ml)	500	300-500	500
Ethyl alcohol (ml)	200	200-300	337
Ethylene glycol (ml)	50	0-75	39
Propionic (ml)	50	50-75	84
Formalin (ml)	100	100-150	--
Propylene glycol (ml)	100	50-175	--
Citric acid (g)	50	40-75	63
Cupric sulphate (g)	20	15-25	1.5
Magnesium sulphate (g)	3	1-7	4.2
Sodium sulphite (g)	7	5-10	8.4
Glycerol (ml)	--	--	50

*Preservative formula used for general botanical structures, taken from Romero-Sierra and Webb (in press).

Discussion

The problem with shedding that we encountered in the treatment of Douglas fir appeared to be due not only to the structural attachment of the needles to the branch but also the lack of resins in the preserved needles which made them susceptible to dehydration in the presence of the monohydric alcohol. Thus the needles shrunk away from the abscission periderm layer, which forms a well defined region between the needle itself and the branch. This left only the central vascular bundle, continuous with the branch, to support the weight of the needle. The vascular bundle is relatively brittle and was easily broken, causing the needle to shed. No information pertaining to the preservation of Douglas fir was found in the literature.

Reference

Romero-Sierra, C. and J. C. Webb. Chemical method of preserving green plant structures. Royal Ontario Museum Life Sciences Miscellaneous Publications, (in press).

Preparation of freeze-dried hearts for use as teaching aids.

By C. Romero-Sierra, J.C. Webb,² G.W. Lyons, J.K. Desmarteau¹ and K.C. Carlson¹ 1986.

Department of Anatomy, Queen's University, Kingston, Ontario K7L 3N6

C. Romero-Sierra, J.C. Webb, G.W. Lyons, J.K. Desmarteau and K.C. Carlson. 1986.
Preparation of freeze-dried hearts for use as teaching aids. *Collection Forum*
2(2):11-13

Freeze-dried hearts are well suited for teaching aids. They last for a decade and longer, occupy little storage space and emit little odour. This study describes how to prepare these teaching aids by freeze-drying. Also, instructions are given on how to mount hearts on plastic bases for display purposes.

INTRODUCTION

Soft anatomical specimens are traditionally displayed in transparent holding tanks of glass or plastic with 10% formaldehyde, sometimes in combination with other chemicals. While this method imparts longevity to the immersed specimens, it also has a number of unpleasant drawbacks.

This report describes an improved method of preservation and presentation of anatomical specimens with particular reference to hearts. It consists of freeze-drying, sometimes preceded by injection with red and blue latex in coronary vessels to emphasize the arterial and venous systems. Preliminary procedures, such as relaxation of tissue, removal of fat, and freezing, are also described.

METHOD AND PROCEDURES

Freeze-drying is well suited for the preservation of biological specimens (Hower, 1967, Romero-Sierra et al., 1983). For use as teaching aids in anatomy courses two embalmed human cadaver hearts were freeze-dried in a Virtis Freeze-MobileTM equipped with a bulk drying chamber. Given the scarcity of human hearts, 10 fresh beef hearts, which resemble human hearts in gross and microscopic structure, were also freeze-dried.

Preparation of Specimens

One beef heart was freeze-dried in 11 days to a constant weight. A transverse incision was then made below the tricuspid valve to best display internal structures of the heart. Both ventricles remained in a natural state of contraction, i.e., in systole. Normally, the heart in diastole is more instructive for teaching purposes and therefore subsequent hearts were first relaxed.

Relaxation of Tissues

To relax fresh hearts prior to freeze-drying, they were placed in cold running water for 3 days. Intermittently, they were massaged and cleaned of any congealed water-blood mixture (Fig. 1) to prevent putrefaction.

In another attempt to relax the hearts, they were cleaned of blood, frozen solid and then let to thaw, rather than placing them in running water.



Fig. 1. A heart showing the left ventricle in a state of relaxation.

Injection of Vessels

In some hearts, following relaxation and prior to freeze-drying, the coronary vessels were injected with 150-200 ml red latex³ for the arterial system and 100-150 ml blue latex for the venous system. Three catheters were inserted into and tied in place with suture material passed along with a curved hemostat into the right coronary artery, the left coronary artery and the coronary sinus. Via a 50 ml syringe filled with latex and attached to the catheter, the latex was then injected. To prevent leakage and improve injection pressure, we used FolleyTM urinary catheters, size #16, expanding the water bulb to create a positive seal. A 50% solution of acetic acid was used to cure the latex and prevent leakage. Finally, the heart was submerged in 10% acetic acid for 24 hours.

Shaping Prior to Freeze-Drying

In fresh hearts systemic and pulmonary vessels are flaccid. To hold them in any desired position, water-soaked cotton was lodged inside the heart prior to freeze-drying.

To better show their vessels, the abundant surrounding fat deposits (Fig. 2a) were removed by curettage, leaving didactically superior specimen (Fig. 2b). A procedure to clean mammalian hearts chemically for display purposes has recently been reported (Romero-Sierra et al., 1986) and may be used instead of curettage.

1 formerly affiliated with Department of Anatomy.

2 formerly affiliated with Department of Biology.

3 manufactured by General Latex and Chemicals (Canada) Ltd., Brampton, Ontario

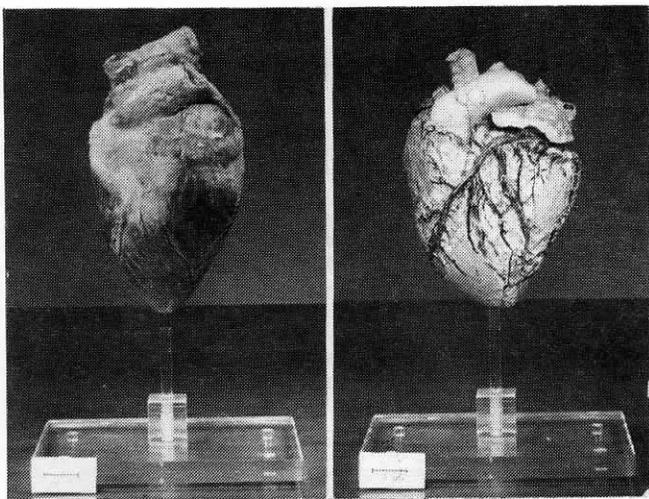


Fig. 2A. A heart with no outside fat removal.

Fig. 2B. A heart showing the outside fat removal.

Freezing

Specimens were placed in a freezer at -7°C for 24 hours. Because of ice crystal formation, this procedure is suitable only for gross anatomical and not ultrastructural purposes.

The hearts were carefully suspended in a three point system on hooks. However, these hooks easily became embedded in the tissue, often leaving marks or tears on the specimens when removed. In a better method we used differential freezing points of a solvent and a solvent-solute solution. Submerged in tap water in a thin plastic sac, a heart was suspended in a tank containing 10% aqueous sodium chloride solution and placed in the freezer until solid. Allowed to thaw out of the freezer, the heart was easy to remove and retained its shape.

Freeze-Drying

During freeze-drying, records were kept on weight loss versus process time. The chamber was opened not more than once every 24 hours and at no time for more than 15 minutes.

Operations Following Freeze-Drying

The tissues of a freeze-dried heart resembled soft wood, allowing cuts to be made to reveal desired features. Figure 3 shows a heart with atria, auricles and the great vessels removed, demonstrating the cardiac valves sutured as described.

In a special preparation the heart was cross-sectioned between the atria and ventricles. The incision was fitted with a hinge so that the top could be tilted open to allow inspection of internal structures.

Mounting for Display

For a small (calf) heart specimen, a 6 mm diameter acrylic rod was mounted in a 10.2 cm x 15.9 cm x 1.3 cm acrylic base. Edges were sanded with emery paper and carborundum cloth for a clear finish. For a large (adult) beef heart a 1.6 cm diameter tubing of glass was used in the 13.2 cm x 22 cm x 1.9 cm base. The hearts were drilled at the base to a depth of about 1.5 cm and the supporting piece was attached with white glue.

Protective Coating

Calf hearts were coated with a mixture of acrylic plastic and chloroform in a proportion that allowed it to be applied by brush. Adult beef hearts were thinly brush-coated with Bio-PlasticTM. The protective coats were applied to ready the hearts for normal handling during instructional use.

RESULTS

Having lost in excess of 2/3 of their original weight, all hearts stabilized within 11 days of freeze-dry treatment. The finished hearts were reduced to 85% of original size but surface features were well retained.

After freeze-drying the great vessels of calf and beef hearts turned off-white and the cardiac musculature medium-light brown. Conversely human cadaver hearts retained their colours.

Ten years after treatment, these hearts still retain the properties they possessed when first prepared.

DISCUSSION

Liquid preservatives such as formaldehyde and alcohol prevent deterioration by fixation of the tissues. They also serve as a physical barrier to organisms that could cause decay. A disadvantage with all such fluids is that specimens must be placed in cumbersome and impractical holding tanks. Also, solutions must be maintained at proper strength and volume; they must be watched, as they tend to become cloudy.

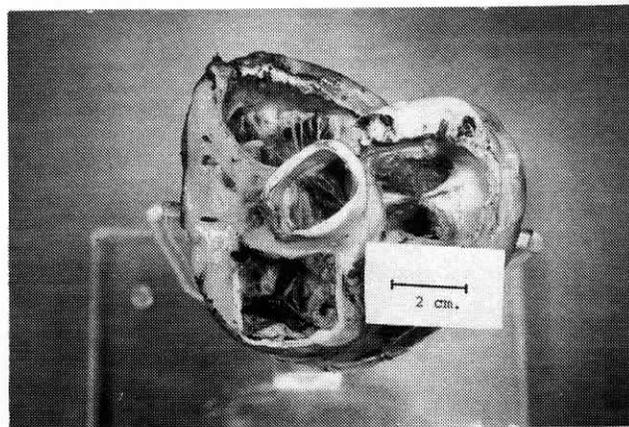


Fig. 3. A dissected heart showing the cardiac valves.

Moreover, specimens immersed in fluids are difficult to view. They may be taken out for observation, but handling is disagreeable because of the malodorous fumes of formaldehyde. Also, in exposure to air, such specimens quickly lose colour and their surface features progressively deteriorate.

Our freeze-dried specimens, used in anatomy courses at Queen's University for the last ten years, occupy little space and emit virtually no odour. Students have found them to be powerful visual aids, far superior to heart specimens immersed in fluid. A limitation of this methodology, however, is the rigidity of preserved specimens which preclude a detailed study of their tissues.

4 manufactured by Ward's Natural Science Establishment, Inc., Rochester, N.Y.

ACKNOWLEDGMENT

This program has been supported by the National Research Council of Canada.

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- Romero-Sierra, C., J.C. Webb, P. Lane and W. Lyons. 1983. Preservation of biological specimens by freeze-drying techniques, Proceedings of a 1981 Workshop on Care and Maintenance of Natural History Collections, (D.J. Faber, editor) Syllogeus No. 44:57-63.
- Romero-Sierra, C., J.K. Desmarteau and K.C. Carlson. 1986. Cleaning a mammalian heart for display purposes, Collection Forum 2(1):10-11.

1986 Meeting Abstracts

The following are abstracts for the presentations given at the 1986 Annual Meeting of the Society for the Preservation of Natural History Collections in Washington D.C., 8-10 June, 1986, Fred Collier, Host.

The Problem of Mazon Creek Type Specimens in Private Collections

Mary Carman, Field Museum of Natural History, Chicago.

The fossils of the Mazon Creek, Illinois, area represent an exceptionally well-preserved biota composed of about 500 species from the lower Pennsylvanian Period. In a review of 100 scientific papers on Mazon Creek published between 1886 and 1986, 300 type, illustrated, and referred specimens were cited as being in 62 private collections. This is compared to all other published Mazon Creek material in 18 recognized institutions. The recommendations of the International Codes of Botanical and Zoological Nomenclatures that all type and illustrated specimens be preserved in permanent institutions are not always followed, especially in the case of Mazon Creek. There are no guidelines for maintenance of referred specimens. Mazon Creek is a prime example of a situation where scientific artifacts have been lost or their whereabouts unknown because specimens were in private collections. Preservers of natural history collections can and should play a role in locating these privately held scientific specimens. Valuable scientific material, such as cited fossil specimens, *should* be preserved in established institutions.

Bird Egg Collections in North America

Lloyd Kiff, Western Foundation of Vertebrate Zoology

Bird egg collecting was a common and traditional hobby in North America from about 1850 to 1940. Although large private and institutional collections were amassed, relatively little scientific use of such specimens was made during the period of intense collecting. Although most major natural history museums housed egg collections by the 1950's, few would accept additional specimens. The Western Foundation of Vertebrate Zoology was formed in 1956 by a group of prominent amateur naturalists partly to serve as a depository for then unwanted egg collections. Subsequently, 250 collections have been brought together from around the world by the WFVZ.

The discovery in 1967 that DDE, a metabolite of the ubiquitous pesticide, DDT, causes eggshell thinning in many species of upper tropic level birds focused attention on long-ignored egg collections, since the specimens, mostly taken before the advent of synthetic chemicals, provide a baseline for presumably normal eggshell quality.

There are presently about 100 egg collections in North America containing at least 200 sets, and total nearly 500,000 sets. Almost all are in public institutions. There are a few other large collections elsewhere in the world, especially those at the British Museum, University of Helsinki, and the Leiden Museum.

A Preliminary Inventory of Botanical, Mineralogical and Zoological Species Occurring in Canada

Daniel J. Faber and Karen Strong, National Museum of Natural Sciences, Ottawa.

Canada has a diverse fauna and flora lived and living within its 10 million sq. km. Almost 200,000 botanical, mineralogical and zoological species are known from Temperate and Arctic regions of Canada. This study was a literature survey in an attempt to document which groups of natural history species are least known. These data will provide information about which natural history groups need further research.

Conservation of Natural History Collections, I. Assessing Problems

Catharine A. Hawks, Carnegie Museum of Natural History, Pittsburgh.

Natural science collections contain a wide variety of organic and inorganic materials subject to deterioration from physical, chemical and biological causes. Both the scientific value and the long term preservation of specimens may be compromised by problems inherent in the original materials, by unrecorded preparation techniques, by subsequent treatments, and by storage methods and materials. Examples of common problems will be used to illustrate various sources of deterioration.

Conservation of Natural History Collections, II. Suggestions for Future Directions

Carolyn L. Rose, U.S. National Museum of Natural History, Washington, DC.

Although the concerns of fine arts have dominated conservation studies for a number of years, recent attention has been directed to problems associated with the preservation of large and multicomponent collections, such as anthropological, historical and archival ones. Many of these findings can be applied to problems extant in natural science collections. In addition, some studies are being conducted on special problems of natural history materials, such as pyrite inclusions in mineral specimens. In order to better address the overall needs of natural history collections, applicable conservation studies and information must be readily available to those responsible for the preservation of these materials. Moreover, the special requirements of natural science collections must be communicated to those who can undertake needed research and experimental studies. Suggestions for pursuing both these avenues will be discussed.

Preservation of Douglas Fir for Museum Display

C. Romero-Sierra and J. C. Webb, Queen's University, Kingston.

A formula and process for preserving Douglas Fir branches has been developed. The treatment consists of immersion of the branches in a mixture of chemical preservatives for a period up to two weeks. The branches are subsequently rinsed in water and placed in a holding solution of water and glycerin for an addi-

tional two weeks or longer. Finally, the branches are air dried. The treatment preserves the needles and prevents them from shedding. This treatment was unsuccessful with specimens of Sitka Spruce but new treatment formulas have been developed.

Improvements in the Construction of Plastic Display Jars for Museums

G. W. Lyons, Queen's University, Kingston.

Due to the increased cost of materials over the last few years, it has become increasingly important to develop methods of constructing museum jars and displaying anatomical material in an inexpensive manner. Described is a method of constructing plastic display jars from transparent plexiglass. The design and construction of a simple bending jig containing a solid heating bar has simplified this task. The re-

sulting product offers the user the advantages of versatility in size, display function and superior quality at low cost from readily available materials.

The Atlantic Geoscience Centre

I. A. Hardy, Atlantic Geoscience Centre, Halifax.

The Atlantic Geoscience Centre (AGC) is a Division of the Geological Survey of Canada, Department of Energy, Mines and Resources. AGC is responsible for conducting long-term basic research and surveys, and short-term mission-oriented programmes along Canada's offshore regions in both the Atlantic and high Arctic. To support this research extensive use has been made of computers to acquire, process, manipulate, manage and display site-specific information for the more than 150,000 geological marine samples comprising the AGC's inventory of collections.

News and Reviews

Meetings

WORKSHOP ON COLLECTION MANAGEMENT OF MAMMAL COLLECTIONS

During August, 1985, a workshop was held at the Fourth International Theriological Congress in Edmonton, Alberta. This congress included posters and presentations, all of which are scheduled to be published as the Transactions of the First Conference of the International Commission for Mammalogical Collections, edited by Hugh H. Genoways, Clyde Jones, and Olga L. Rossolimo. These papers are scheduled to be published in *Museology*, a publication of The Museum, Texas Tech University, Lubbock, TX. Titles of the 17 papers to be published include the following:

- The value and future of systematic collections of mammals.
- Using mammal museum specimens as bioindicators of environmental disturbance.
- Criteria for selecting a computer system for collection data management.
- Automated data processing procedures at the U.S. National Museum of Natural History.
- Collection database management at The Field Museum of Natural History.
- Computer management of mammal collections at the Royal Ontario Museum.
- Computerizing specimen data: a hybrid system (microcomputer/mainframe) in use at Texas A & M University.
- A collection information consortium: the next step in computerization.
- The computer as a collection management tool.
- History of the materials used in the preparation of recent mammal specimens.
- Fluid preservation of mammalian specimens: history, current practices, and future needs.
- Historical aspects of collection conservation: an Australian perspective.
- Older mammalogical specimens in the Hungarian Natural History Museum: hopes and fears.
- Considerations about the old mammal specimens in the Museo Nacional de Ciencias Naturales, Spain.
- Problems of maintaining collections of mammals in developing nations: India.
- Maintaining mammal collections in Latin America: problems and solutions.

International Commission for Mammalogical Collections.

Steve Williams
Carnegie Museum of Natural History

CONFERENCE ON THE CONSERVATION OF GEOLOGICAL MATERIALS

A conference on the Conservation of Geological Materials was held January 23-24, 1986 at the British Museum (Natural History). The conference was organized by the Geological Curators' Group (GCG) in association with the BM(NH) and sponsored by ICCROM and the Geological Society; it attracted over 80 registrants from Britain, Europe, Canada and the U.S.A.

The GCG was founded 12 years ago by a group of curators from museums outside London who were concerned about the lack of facilities and expertise for preservation of geological collections. The objectives of the GCG are as follows: 1. to hold meetings for exchange of information, 2. to provide information and advice on all matters concerning geology in museums, 3. to prepare a code of practice for geologists in museums, 4. to promote documentation of the conservation of geological sites through the National Scheme for Geological Site Documentation, and 5. to conduct a survey of geological collections throughout the U.K. and advise on their care and maintenance.

At the London Conference talks were grouped according to subject matter and covered health and safety considerations, documentation, problems of adequate staffing, environmental control and practical application of conservation techniques to a wide variety of geological materials.

Conservation, as a discipline, is not widely practised in the earth sciences; it is more readily associated with art and archaeology museums. Fortunately much ethnographic and archaeological conservation involves many of the same materials (bone, wood and stone) as are found in geological collections and the bank of knowledge assembled by conservators in the humanities can be used in the treatment of fossils and minerals. To this end the organizers invited four speakers from archaeological museums to share their knowledge. J. Ashley-Smith presented a common sense approach to environmental control in museums. S. Keene gave an overview of consolidants used in archaeological conservation, including discussion of the different properties of consolidants and adhesives, criteria to use in choosing the appropriate material, and the characteristics and uses of a variety of different products. S. Bradley spoke on the use of

silanes in the conservation of stone. R. Jaeschke outlined materials and methods used for cleaning, consolidating, and repairing stone artifacts. A full afternoon was dedicated to the conservation of fossil and sub-fossil bone. M. Walders described methods for impregnating bone by immersion in polyethylene glycol or water soluble epoxy resin. A. Doyle described a method of impregnating bone with polyvinyl acetate. M. Collinson presented a brief survey of different types of preservation encountered in palaeobotanical material. The treatment of decaying pyritiferous specimens has been the subject of research at the BM(NH). L. Cornish reviewed treatments used in the past and outlined the recent use of ethanolamine thioglycollate to arrest and reverse the decay process. W. Lindsay outlined acid preparation of vertebrate fossils. J. Wilson outlined various methods for preparing calcareous fossils from a calcareous matrix.

The conference offered far more than a catalogue of preparation techniques. I came away with the feeling that geological conservation is an active interdisciplinary concern. We must cross time-honoured boundaries and learn from our colleagues in the fields of art and archaeology. The proceedings of the conference will be published in a future issue of the *Geological Curator*.

Janet Waddington
Royal Ontario Museum

Miscellany

NATURAL HISTORY GROUP OF ICOM COMMITTEE FOR CONSERVATION STARTS NEWSLETTER

In April, 1986, the Natural History Group of the ICOM Committee for Conservation issued their first newsletter. This first issue discussed objectives of the Natural History Group, concepts of conservation, research activities at various institutions, a list of similar interest groups, recent publications, professional meetings, and ended with a questionnaire for professionals in the field. This effort is a positive contribution toward opening communication between institutions and professionals involved with natural history. The preamble printed in Issue No. 1, April, 1986 is reprinted here.

Dear Colleagues,

"This newsletter is a new venture for the Natural History Working Group and is aimed at those with any interest in the preservation of natural science material in museum collections. Our colleagues on the ICOM International Committee of Natural History Museums and colleagues in the various national flora and fauna preservation groups throughout the world have quite rightly taken up the cause of the conservation of natural resources represented by living populations of animals and plants.

"The perilous state of the enormous holdings as specimens of extant and extinct life-forms and earth science material has however gone largely unnoticed. Recent surveys carried out by curatorial groups indicate the size of the problem in the United Kingdom. Out of the total estimated 100 plus million specimens in UK collections upwards of 25 million are at risk or are deteriorating today. Taken as an indication of the situation worldwide as many as 500 million natural science specimens could be in jeopardy.

"With spending on natural history collection conservation probably running at less than 1% of the sum spent on arts conservation the outlook appears bleak indeed.

"If you are concerned enough to want to alter this state of affairs please join the working group. Conservation in the fine arts and antiquities fields

has a long history. Relative newcomers to the discipline include stone-work and ethnography both these groups now have active worldwide support for the conservation of their charges. Natural history has misused out for too long. It must benefit soon - hopefully before it is too late and extinction of species catches up with the decay of specimens in museum collections.

For further information contact F. W. Howie, British Museum (Natural History), Cromwell Road, London SW7 5BD, U.K.; or C. V. Horie, Manchester Museum, The University, Manchester M13 9PL, U.K.

Steve Williams
Carnegie Museum of Natural History

CM INVESTIGATES THE CARE AND DOCUMENTATION OF TYPE SPECIMENS

The Carnegie Museum of Natural History is completing a project on the care and documentation of pre-1900 type specimens of Recent mammals, and will be conducting similar studies of post-1900 types. To determine common factors of deterioration, these projects will determine the conditions of 3,000 objects maintained at eight important collections, these studies also are investigating collection conditions that may threaten the long-term preservation of these specimens. Subjects of particular interest include the effects of dichlorvos (DDVP) fumigation on museum materials, and on the effects of paradichlorobenzene (PDB) fumigation. The eight collections include The Carnegie Museum of Natural History, U.S. National Museum, American Museum of Natural History, Field Museum of Natural History, The Philadelphia Academy of Natural History, Museum of Comparative Zoology (Harvard University), University of Michigan, and University of Illinois.

Steve Williams
Carnegie Museum of Natural History

NEW NATURAL HISTORY ORGANIZATION IN NORWAY

A new natural history museum organization was established last year in Norway. It is entitled Norske Naturhistoriske Museers Landsforbund (Norwegian Museums of Natural History). The NNML joins together all the Norwegian Natural History Museums. We have our first newsletter (in Norwegian) and we meet together once each year. Presently, we have 26 institutional members and 150 individual members.

Ben Schei, President
Norske Naturhistoriske Museers Landsforbund
c/o Tromsø Museum
Tromsø N-9000, Norway

A NATIONAL PLANT CONSERVATION PROGRAMME FOR CANADIAN BOTANIC GARDENS

During the fall of 1984, the Devonian Botanic Garden assumed the responsibility for the organization and definition of the Canadian Plant Conservation Programme.

It was proposed that a Canadian Programme would fill three important needs of Canadian Gardens. First, an information network among Canadian Botanic Gardens would be an effective development in relating individual efforts to local, national, and international groups, including those with scientific and commercial interests as well as non-professional bodies such as horticultural and natural history societies. Second, a Canadian Programme would complement,

and be complemented by, other plant conservation programmes such as the American Centre for Plant Conservation, the National Council for the Conservation of Plants and Gardens (Britain), and the Botanic Gardens Conservation Coordinating Committee of the IUCN Conservation Monitoring Centre. Third, a Canadian programme would fill an acute need for the provision of a national and professional avenue of communication among Botanic Garden staff and students about conservation programmes involving plants in cultivations, gardens, and plants and their natural habitats in Canada.

Seven specific objectives of the Programme were outlined:

1. To promote research into the propagation and maintenance in cultivation of genotypes considered rare, threatened or endangered.
2. To organize a central secretariat (Canadian Centre for Plant Conservation) which would coordinate a national inventory of specialized collections maintained at Canadian Botanic Gardens. This might also be extended to the identification and listing of rare and threatened plants in private gardens.
3. To produce and circulate a newsletter to contributing institutions and individuals. Topics would include items of professional interest to conservationists and keen amateur plantmen.
4. To provide an advisory service to individuals (professional or amateur, academic or commercial) which would locate materials (i.e. specific genotypes for research, propagation, distribution or reintroduction).
5. To assist in, and/or provide political and/or logistic support for, the conservation of valuable plant collections and/or species in danger of being destroyed.
6. To sponsor a programme ensuring uniform signage system to identify (to the public) participating gardens and their specific major collections. (This would inform the public of the program and help them understand its objectives).
7. To encourage systematic maintenance of various plant groups at their most appropriate geographic centres.

Randy S. Currah
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ORPHANED COLLECTIONS

In October, 1984 the Stamford Museum and Nature Center, Stamford, Connecticut, transferred their mollusk collection to the Delaware Museum of Natural History. The collection, known in Stamford as the "Hubbell Collection", consists of approximately 16,000 lots or about 90,000 specimens. The Stamford Museum, lacking a malacologist and having limited room, wanted to relocate the collection to a museum with a commitment to malacological collections. The shells represent marine, land and fresh-water mollusks from around the world. The land and fresh-water specimens are especially notable because many came from areas no longer accessible or areas where the environment has changed and the shells are no longer available.

As a result of this growing concern for endangered natural history collections, the Association of Science Museum Directors has created a Task Force to investigate the depth of the problem and potentially organize one or more conferences to thoroughly explore it and perhaps come up with some guidelines and recommendations on what should be done in the future. The members of the Task Force in the MAAM region are: Dr. Robert West, Director, Carnegie Museum of Natural His-

tory; Dr. Barbara H. Butler, Director, Delaware Museum of Natural History; Dr. Robert S. Hoffman, Director-elect, National Museum of Natural History; and Dr. Harold D. Mahan, President, Roger Tory Peterson Institute. Please contact these Task Force members to make suggestions and to help them locate endangered collections which are in need of encouragement.

Mid Atlantic Association of Museums Courier
6(2):4, March/April 1986
Sent by Shirley Albright
New Jersey State Museum

A NEW NATURAL HISTORY MUSEUM GROUP

The Natural History Affinity Group of the Mountain-Plains Museum Association was formed in 1985 to act as a medium of communication for natural history museum professionals. Participants of the first meeting in Salt Lake City, Utah, as well as respondents to a questionnaire sent out in 1985, reconfirmed the need for a central forum for discussion of both philosophies and operations of natural history museums. One of the major functions of the group is to provide the stimulus for panels at future meetings and encourage communication of research findings and/or new projects in appropriate publications.

Approximately 100 questionnaires were sent out in 1985 to individuals located primarily in the 10 state Mountain-Plains Region of AAM. At least 75% of the 52 responses showed strong interest in the following topics: conservation of specimens, storage and maintenance of specimens, co-operation between museums for exhibit production, computerized collection management programs, outreach interpretive programs, production of traveling exhibits, programs for adults, training of volunteers for collection work, and finally research of new conservation techniques.

The Natural History Affinity Group will meet each year during the Mountain-Plains Museums Association annual meeting (generally in October). The 1986 meeting is Friday, October 24, in Abilene, Kansas. Discussion will include short presentations concerning points to consider when looking for a conservator of natural history materials, and information about New Mexico's new Museum of Natural History. The 1986 MPMA meeting also includes two sessions of particular interest to natural history museum professionals. Conservation of Natural History Materials includes 3 speakers who will address such topics as: the preservation of osseous materials and testing of specimens for arsenic and other toxic compounds. Legal issues will be discussed in a second session with a representative of the US Fish and Wildlife Service.

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Texas A. M. University
College Station, TX 77843

ASSOCIATION OF SYSTEMATICS COLLECTIONS COUNCIL ON COLLECTIONS - MEMBERSHIP LIST

1. Collections Associated with Long-term Ecological Research, Environmental Assessment, etc.
Dr. Nancy L. Stanton
University of Wyoming, Laramie, WY
2. Tissue Collections
Dr. Hubert C. Dessauer
Louisiana State University Medical Centre,
New Orleans, LA
3. Living Collections (except culture collections)
Dr. Donald N. Duvick
Pioneer Hi-Bred International, Johnston, IA

4. Orphaned Collections
Dr. Robert M. West
Carnegie Museum of Natural Hist., Pittsburgh, PA
5. USNM Collections Activities Pertinent to the Collections Community
Ms. R. Janet Gomon
U.S. National Museum of Natural History,
Washington, D.C.
6. Voucher Specimens
Dr. Robert A. Wharton
Texas A&M University, College Station, TX
7. Directory of Resources
Dr. J. Richard Schrock
Association of Systematics Collections,
Lawrence KS
8. Culture Collections, Microbiology, and Biotechnology
Dr. R. E. Stephenson
American Type Culture Collection, Rockville, MD
9. Worms
Dr. Virginia R. Ferris
Purdue University, West Lafayette, IN
10. Molluscs
Dr. Fred G. Thompson
University of Florida, Gainesville, FL
11. Insects
Dr. Wallace A. Steffan
Idaho Museum of Natural History, Pocatello, ID
12. Mites
Dr. Valerie Behan-Pelletier
Research Branch, Agriculture Canada, Ottawa, ON
13. Other Invertebrates
Dr. Welton Lee
California Academy of Sci., San Francisco, CA
14. Vertebrates
Dr. Robert M. Timm
Field Museum of Natural History, Chicago, IL
15. Algae, Fungi, and Lower Plants
Dr. Amy Y. Rossman
Agricultural Research Service, USDA,
Beltsville, MD
16. Higher Plants
Dr. Thomas Duncan
University of California, Berkeley, CA
17. Chairman
Dr. Lloyd Knutson
Agriculture Research Service, Beltsville, MD

Lloyd Knutson
Agriculture Research Service, U.S.D.A.
Beltsville, MD.

THE TRAINING OF NATURAL HISTORY CURATORS AT THE UNIVERSITY OF LEICESTER

The training of natural history curators has traditionally been accomplished through apprenticeships or internships in natural history museums. The desirability of a university course in Museum Studies was advocated by the British Museums Association in the 1930's. One of the first university courses in Museum Studies was set up in Baroda in 1952 and the University of Leicester course followed in 1966. There is now a great proliferation of university courses, but

few give attention to the special needs of natural history curators.

The post-graduate course in Museum Studies at the University of Leicester was set up in close collaboration and with the support of the British Museums Association. The Association had long felt the need for a university based course which would provide the opportunity for a more thorough study than was possible in the short diploma courses provided by the Association.

Students entering the course are required to select one of a number of options for special study, these options being Local History, Archaeology, Geology and the History of Technology. The fifth option of Natural History was offered from the second year.

To be accepted for the natural history option, students are required to have a first degree in an appropriate subject, usually botany, zoology or geology or a combination of these. They must also show some evidence of motivation towards museum work, usually by having undertaken a period of voluntary work in a museum. Teaching is accomplished through formal lectures, seminars, discussions, practical demonstrations, visits to museums, project work, and periods of museum attachment. Students for the natural history option have been drawn from Sudan, Uganda, South Africa and Australia in addition to the United Kingdom. On leaving the course, twenty-two students either returned to or took up full-time museum employment, and at the present time, twenty are in full-time and two in part-time employment.

The syllabus for the course follows the traditional pattern of history, philosophy and purpose of museums, the administration of museums, the management of collections including the formation of collecting policies, documentation and preparation techniques, and the use of the collections for research and education. Particular emphasis is given to the changing role of natural history museums.

We depend heavily on the good-will of our museum colleagues who accept students for periods of practical experience. To date, we have found no difficulty in persuading them to take our students and indeed, many of them now approach us each year having found that the students are able to make a valuable contribution to the work of the museum during their attachment.

Since 1975, a Master's degree has been offered by the Department in addition to the Graduate Certificate originally offered; Master's students take the same taught course, but are also required to prepare a dissertation and to complete a six month period of employment in a museum in the year following the taught course. In 1976, regulations for the award of M. Phil. and Ph.D degrees in Museum Studies were approved and there are now both full-time and part-time research students. Some of these students assist with teaching, and through their research provide important new material.

We are conscious of our shortcomings and would welcome an exchange of experience with other courses and comments from our colleagues in natural history museums.

Geoffrey Stansfield
Department of Museum Studies
University of Leicester
Leicester, England LE1 7QA

TRAINING PROGRAM FOR COLLECTIONS CARE

The Natural History Museum of Los Angeles County is offering a workshop on the care and preservation of Natural History Collections from 22 February to 13 March 1987 in Los Angeles. The workshop has been funded by a grant from the Bay Foundation, and is sponsored by the National Institute for the Conservation of Cultural Property, the American Association of

Museums, and the American Association for State and Local History. The curriculum has been developed by the collections care staff of the Natural History Museum of Los Angeles County in conjunction with several consultants who are recognized experts in conservation science and the preservation of natural history collections. They are:

Carolyn Rose, Conservation Laboratory, U.S. National Museum of Natural History, Washington DC

Robert Waller, Mineral Sciences Division, National Museum of Natural Sciences, Ottawa

Mary Lou Florian, Conservation Division, British Columbia Provincial Museum, Victoria

Catharine Hawks, Research Associate, Carnegie Museum of Natural History, Pittsburgh

Stephen L. Williams, Section of Mammals, Carnegie Museum of Natural History, Pittsburgh

Benita Johnson, Training Coordinator, Getty Conservation Institute, Los Angeles

Most of these consultants will be involved in the actual training session as well. Limited to fifteen students; stipends will be available to defray expenses, including housing and travel costs. For further information please contact:

Kimball L. Garrett or Lyn J. Barkley
Collections Care Pilot Training Program
Los Angeles County Museum of Natural History
Los Angeles, CA 90007

The Biodeterioration Society

The Biodeterioration Society was formed after the 1st International Biodeterioration Symposium at Southampton, England, in 1968. The aims of the Society are to promote the science and technology of biodeterioration and its prevention and biodegradation of economic importance.

The Seventh International Biodeterioration Symposium will be held on 6-11 Sept. 1987 at Emmanuel College, Cambridge, England. For information write:

Mrs. Christine Gaylarde
Local Organising Committee
Dept. of Biological Sciences
City of London Polytechnic
London, E1 7NT, U.K.

The Pan American Biodeterioration Society was established within the last year or so as a North American group. The first Annual Meeting of the Society was held in Wash. D.C. during 17-19 July, 1986. For information about the Society write:

Co-chairman
Dr. Charles O'Rear
Department of Forensic Sciences
George Washington University
Washington D.C. 20052
or
Dr. Gerald C. Llewellyn
Bureau of Toxic Substances
Virginia Department of Health
Richmond VA 23219

Daniel J. Faber
National Museum of Natural Sciences

Reviews

Biological Museum Methods. By G. Hangay and M. Dingley. Academic Press, Australia, 1985. Two volumes, illus., bibliography, index, hard cover, Vol. 1:379 pages, \$95 U.S., Vol. 2:323 pages, \$72 U.S.

The main subject of these two volumes is museum preparation techniques of biological specimens. This broad topic is handled very well by the authors within the scope and aims outlined in their Preface. While basic methods needed by preparators for purposes of collections and displays are well covered, the main thrust in elaborations lies in methodologies for museum displays. In keeping with tradition, the authors stress the side of taxidermy that is based on artistic ability and pragmatic technical experience.

The book is organized into chapters with literature references and a good list of up-to-date source material at the end of each chapter. There are 356 black and white drawings or photographs of high quality reproduction. The index has over 1500 entries, which is more than many books offer but still insufficient for this extensive field, especially with a lack of cross-indexing.

In the first volume the lengthiest chapters are: Fishes (45 pages); Birds (69 pages), Mammals (115 pages) and Skeletal preparation (40 pages). The most extensive information is in the area of taxidermy. Good descriptions of techniques for making models or copies of specimens with moulds, casts or mannikins, incorporating the expertise of other leading taxidermists in the field, are found throughout this volume.

The second volume directs its focus on various topics unevenly. Twenty-nine pages on the manufacture of plastic display boxes contrasts with fifteen pages dedicated to the entire plant kingdom. On pages 153-159 one finds a very handy synopsis of treatment for each insect order reproduced from the book of Courtenay Smithers, "Handbook of Insect Collecting" (1981).

Only a very few books have been written to cover the subject as thoroughly as this one, e.g., the two volumes of R. Wagstaffe and J. H. Fidler, "The Preservation of Natural History Specimens", Volume I (1955, reprinted several times) and Volume II (1968). Their work, more scientifically oriented and written, has not been edited since its respective publication dates. The two volumes of Rudolf Piechocki, "Makroskopische Präparationstechnik", Volume I (3rd edition, 1979); Volume II (2nd edition, 1975) are not translated from German.

These two volumes by Hangay and Dingley cover a gap in the literature and undoubtedly will be a valuable asset for preparators and taxidermists working in natural history museums. The high standards of publication of Academic Press are again in evidence in these handsome books.

C. Romero-Sierra
Queen's University

Supplies and Equipment

MUSEUM SUPPLIER PROBLEMS

A sample of information requests received by the Centre from museum professionals, exhibition organizers, or those designing new museums shows that the same questions keep coming up:

"Is there such a thing as a catalogue of museum suppliers (of all kinds) covering various countries... I should like to obtain catalogues for all kinds of equipment-photographic material, showcases, plexiglass pedestals, alarm systems, climate control systems,

etc. It takes ages trying to get such information and being so far away doesn't make things any easier. If no such catalogue exists, it would be a good idea to make one. It would be a big help for people working in developing countries and who are responsible for drawing up requests for funding from the UNDP, for example!"

"Could you send me a list of specialists in lighting equipment? We have to plan the lighting systems of our future music museum as soon as possible."

"Where can we find mannequins for displaying the costumes in our temporary exhibition on women's clothing which we are organizing next summer?"

What Can We Answer?

For several years now the Centre has maintained a file on suppliers of museographical material and equipment. Arranged by subject and by country, it lists the major suppliers of equipment connected with climate control, lighting, packing and transportation of art objects, showcases, panels, storage and archive units, etc. The major sources of information for this file are museological periodicals which regularly

carry advertising - Museums Journal (UK), Museum News (USA), Museumkunde (Fed. Rep. of Germany), Musées et collections publiques de France (France), etc.

In addition to the above, the Centre systematically collects sales catalogues and publicity leaflets which it solicits from suppliers and manufacturers.

To be able to respond efficiently to the needs of the profession, it is however essential that the Centre's information be as up to date as possible.

A few national museum associations, more particularly those in Canada, France, United Kingdom and the United States, have already published directories of museum suppliers. It is hoped that other associations might follow this example and make available lists of "recognized" addresses, not only to their own members but to the international community as well. In its turn, the Unesco-ICOM Documentation Center would be in a position to offer a supplementary, and much demanded service.

ICOM News, 1986, Vol. 39(2):24
Unesco-ICOM Documentation Centre
Sent by, Daniel J. Faber

Society Business

Letters

MESSAGE FROM THE PRESIDENT

The Society for the Preservation of Natural History Collections continues to progress. I personally welcome all new members and encourage each of you to pick up your pens right now and communicate your information to a committee chairman.

The meeting in Washington D.C. was successful and we held our first business meeting at that time. I am already looking forward to our next meeting (1-3 June, 1987) in Montreal. The Conference Committee is actively planning a busy programme which will have something for everyone.

I have established a number of committees which are actively planning activities for our Society. The following committees and their chairmen are now established:

1. Annual Conference Committee
Cesar Romero-Sierra
Queen's University
2. Bibliographic Committee
Sonja Teraguchi
Cleveland Museum of Natural History
3. Bylaws Committee
Cesar Romero-Sierra
Queen's University
4. Colleges and Universities Committee
Wynn Watson
Wilfrid Laurier University
and
Paisley Cato
Texas A and M University
5. Conservation Committee
Carolyn Rose
U.S. National Museum of Natural History
6. Liaison Committee
Julia Golden
University of Iowa

7. Membership and Directory Committee
Shirley Albright
New Jersey State Museum
8. Publications Committee
Dan Faber
National Museum of Natural Sciences
9. Supplies and Equipment Committee
Len Marhue
National Museum of Natural Sciences

The bylaws of our Society are presently being fine-tuned by the Bylaws Committee and they should be ready for approval soon. Our bylaws allow for six Members-at-large which form a part of the Executive Council; but we will only elect four Members-at-large this year. This election will take place during the winter and they will be installed in Montreal in the spring.

I wish to acknowledge a special THANK YOU to several members for their hard work and assistance during the last six months. Fred Collier for organizing the 1986 annual meeting; Shirley Albright for answering our correspondence, receiving applications, and establishing a membership directory; Ingrid Birker and Delise Alison for organizing the next annual meeting; Cesar Romero-Sierra for creating our bylaws and for support in various other ways; Joanne Faber for acting as Treasurer and helping with administrative matters (our new Treasurer will be Mike Rankin); Bill Arrott, Spacesaver Corporation, Chicago, for funding the reception and dinner in Washington D.C.; and Ken Edmonds, Rousseau Metal, Inc., Mont Joli, Quebec, and Ottawa, Ontario, for funding the Icebreaker in Washington D.C. Rousseau Metal sells and designs special storage products for the museum community. Ken can be contacted at (613) 226-3687 or Box 5254, Station F, Ottawa, ON. K2C 3H5. Finally, I wish to acknowledge the financial assistance and time that I received from the National Museum of Natural Sciences. All these efforts have been put forth in order to establish an organization having to do with natural history collections.

Daniel J. Faber
National Museum of Natural Sciences

PRAISE FOR OUR WASHINGTON MEETING

I thoroughly enjoyed the meeting in Washington, DC., the papers given, and the workshops. I wish to express my appreciation to all those who arranged the meeting and especially the Museum staff who did all of the extra things that made the meeting so pleasant to attend.

When I returned to University, I explained to George Stanley, our Invertebrate Paleontologist, some of the material that I had. He immediately suggested that we write a grant proposal which would upgrade our facilities and would increase our usable storage space for specimens. This could be accomplished by installing a compaction system. We also included putting all our collection data on computer. Our Dean has promised that we could have an extra graduate assistant to help us with collection data.

The Department Chairman and staff are very enthusiastic about the information I received from your meeting and its possibilities. I have had to look at all present collection space and its use and to summarize data in the specimen catalogs and provide some future projections. The proposal will be submitted for consideration in August and if its receipt is favorable, we could start our plans as early as November. If nothing else is accomplished, we will at least have a long range plan for utilization of space and more efficient storage. This plan will be in writing and a quantum leap in availability of cataloged information for research, teaching, and general use.

As far as I am concerned, I feel that this is one of the most successful meetings I have ever attended.

Sincerely,

William G. Melton Jr.
Curator
University of Montana

SPNHC MEETS IN WASHINGTON, D. C.

The SPNHC held its first annual meeting in Washington, D. C. on 8-10 June 1986. These meetings were hosted by the U. S. National Museum of Natural History with Frederick Collier serving as head of the Local Committee. Forty-four individuals from 18 states and three countries registered for sessions featuring formal presentations and workshops.

Titles of presentations were: Faunal Collections - Maintenance and Documentation (L. Marhue), Natural History Resources in the United Kingdom (P. Morgan), Preliminary Inventory of Botanical, Mineralogical, and Zoological Species Occurring in Canada (D. J. Faber and K. Strong), The Atlantic Geoscience Center Sample Collection (I. A. Hardy), High Density Mobile Storage Systems in Use for the Storage of Natural History Collections (D. B. Fenner), Bird Egg Collections in North America (L. Kiff), The Museum Reference Center - Smithsonian Institution (E. Johnson), Preservation of Douglas Fir for Museum Display with Comments on Treatment of Sitka Spruce (C. Romero-Sierra and J. C. Webb), Improvements in the Construction of Plastic Display Jars for Museums (W. Lyons), and Conservation of Natural History Collections, Part 1 - Assessing Problems (C. A. Hawks), and Part 2 - Suggestions for Future Directions (C. L. Rose). Demonstrations included: Computer Applications for Collection Management, (J. Gamon). Clearing and Staining Small Vertebrates (R. P. Vari), and Wet Preservation of Organisms, (C. A. Child).

The program ended with a business meeting which resulted in the election of the organization's first officers: Daniel Faber, President; Cesar Romero-Sierra, President-Elect; and Shirley Albright, Secretary. The SPNHC is grateful for the financial support

of Spacesaver Corporation for the banquet and refreshments and of Rousseau Steel, Mont Joli, Quebec, for refreshments at the Icebreaker.

Steve Williams
Carnegie Museum of Natural History

1987 Meeting in Montreal

The 1987 Annual Meeting of the Society for the Preservation of Natural Collections is going to be hosted by the Redpath Museum in Montreal, Quebec, May 31-June 3, 1987. Presentations, "hands-on" workshops, and field trips will be organized.

First circular replies are due by 10 December, deadline for abstracts is 20 February, and posters should be mailed before 15 April. For more information contact Ingrid Birker, Redpath Museum, McGill University, 859 Sherbrooke Street West, Montreal, PQ, H3A 2K6, telephone (514) 392-5997. (See inside front cover for other information).

APPLICATION FORM TO BECOME A REGULAR MEMBER OF THE SOCIETY FOR THE
PRESERVATION OF NATURAL HISTORY COLLECTIONS

Send this form along with a check or money order(\$15.00 Canadian or \$12.00
U.S.) to: S.P.N.H.C.

Box 6520, Station J,
Ottawa, Ontario
K2Y 3Y6 Canada

1987

Make out check to: Society for the Preservation of N.H.C.

1988

(May be in either U.S. or Canadian currency)

1989

(Information below to be included in the Society's membership Directory)

NAME

First name and middle initials: _____

Last or Family Name : _____

POSITION OR TITLE: _____

INSTITUTIONAL AFFILIATION (if applicable)

Line 1: _____

Line 2: _____

DEPARTMENT, DIVISION OR SECTION: _____

MAILING ADDRESS (street address)

Line 1: _____

Line 2: _____

CITY : _____ STATE OR PROVINCE: _____

COUNTRY: _____ POSTAL OR ZIPCODE: _____

BUSINESS TELEPHONE: _____

PROFESSIONAL MEMBERSHIPS OR AFFILIATIONS:(Print each one fully)

INTERESTS: RESEARCH, COLLECTION MANAGEMENT, ETC.(Maximum 150 characters)

Please attach a selected list of your published papers, if you would be
willing to assist Society in reviewing papers for Collection Forum.

Information and Instructions for Authors

Collection Forum publishes general information articles and short articles of scientific research having to do with collecting, preparing, preserving, managing, and storing natural history collections.

Research articles are normally sent to two qualified persons for peer review. Authors are encouraged to suggest names of suitable referees but the final decision lies with the Editor. Reviewers are asked to give general appraisal of manuscripts along with specific comments and constructive recommendations. The Editor makes the final decision on whether a manuscript is acceptable for publication.

Publication is facilitated if authors check very carefully for accuracy, consistency, and readability. Also check symbols, abbreviations, and technical terms used, and ensure, before they are submitted, that manuscripts and illustrations meet the requirements outlined below. Particular attention should be paid to the proper format and details of references. Although due care is taken, neither the Editor nor the Society accepts responsibility for lost manuscripts or illustrations; they are submitted at the owner's risk.

Send an original copy and two duplicates to Dr. Daniel J. Faber, Editor, *Collection Forum*, National Museum of Natural Sciences, Ottawa, ON K1A 0M8.

MANUSCRIPT

General- All parts of the manuscript, including footnotes, tables, and captions for illustrations should be typewritten, double-spaced, on paper 8½ by 11 in. (21.6 by 27.9 cm), with margins of 1-1½ in. (2.5-3.8cm). Each page of the manuscript should be numbered. The first page should have only the title, byline, and author's affiliation, and any necessary footnotes. Captions for illustrations should be on one page and be placed after the references. The length of research articles can be no longer than 3 printed pages. *Webster's Third New International Dictionary* should be consulted for acceptable spellings. Symbols, units and nomenclature should conform to international usage and be the same in the text and figures. For all numerical data, the metric system should be used or metric equivalents given. An original copy and duplicates are required.

Abstract- An abstract of not more than 200 words is required for research articles. Keep the abstract simple and direct.

References- These should be checked with the original articles and each one referred to in the text by the author and date, in parentheses. They should be listed at the end of the paper in alphabetical order.

In the reference section, each paper should be listed as follows: author(s), year of publication, title of paper, and where it was published.

In reference to papers in periodicals, complete titles and inclusive page numbers are required. The names of serials are not abbreviated but each word is spelled out at length.

Tables- Tables should be numbered with arabic numerals, have a brief title, and be referred to in the text. Column headings and descriptive matter in tables should be brief. Vertical rules should not be used. Each table should be on one page and be placed after the references.

ILLUSTRATIONS

General- Originals should not be more than three times the size of the final reproduction. Each figure or group of them should be planned to fit, after reduction, into one column of the text, or two. The figures (including those for plates) are numbered consecutively in arabic numerals, and each one must be referred to in the text. Each illustration should be identified by the authors' names and title of paper, preferably written below the illustration, at the left or on the back.

Line Drawings- The original drawing or a photograph and two sets of clear copies are required. Drawings should be made with India ink on plain or blue-lined white paper or other suitable material. Any coordinate lines to appear should be ruled in. All lines must be sufficiently thick to reproduce well, and decimal points, periods, dots, etc. must be large enough to allow for any necessary reduction. Letters and numerals should be made neatly with a printing device (not a typewriter) and be of such size that the smallest character will not be less than 1mm high when reduced.

Photographs- Three sets of all photographs are required (1) one set mounted, ready for reproduction, (2) another two sets, equally good, but mounted or unmounted. Prints must be of high quality, made on glossy paper, with strong contrasts. The copies for reproduction should be trimmed to show only essential features and mounted on white cardboard. Each photo should be identified by the author's names and title of paper, preferably written on the back and on the mounting cardboard. Coloured photos cannot be accepted at this time.