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COLLECTION FORUM

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Front Cover Sugar Maple Borer, *Glycobius speciosus* (Say)
(Photograph courtesy of François Génier)

Opinion

Who Are The Bosses?

Natural history collections are integral parts of society. People of any land depend upon plants, animals and minerals for food, clothing and housing. Thus, biological communities were, are, and will be important for the survival of human populations, while the members themselves of the community fight for their own survival. Extinction of animals, plants, and minerals has and will continue as humans require additional land and resources for civilized purposes.

The natural history heritage resources of any land or water consist of *two* things, 1) those living communities that are both normal and/or unique to certain geographical regions of the world and, 2) those plants, fossils and minerals, *i.e.*, heritage archives that exist in museums, universities, colleges and private homes, but which originally came from certain geographical regions of the world.

Certain well-disciplined individuals made extensive collections of animals, plants or minerals which now exist as valuable heritage archives. These specimens were collected with only the best interests at heart. Only secondarily did they become valuable as heritage archives. Heritage archives created the most important and significant museums of the world. The collections were collected by specific individuals but then taken over for management purposes by various political entities.

Today there are a hodgepodge of governing authorities who manage the important natural history heritage archives of the world. I will restrict my examples to Canadian institutions, which I know best, but certainly other countries have similar arrangements. The British Columbia Provincial Museum, which possesses collections of botany and zoology as well as archaeology, ethnology, history and linguistics, is governed by the British Columbia Department of Tourism, Recreation and Culture. The Provincial Museum of Alberta, which possesses collections of botany, geology and zoology, as well as archaeology, art, ethnology, history, folk life materials and Indian materials, is governed by the Alberta Department of Culture and Multiculturalism. The Royal Ontario Museum, which possesses collections of entomology, invertebrate zoology, geology, ichthyology, herpetology, invertebrate palaeontology, mammalogy, mineralogy, ornithology and vertebrate palaeontology as well as collections in art and archaeology is governed by the Ontario Ministry of Citizenship and Culture. The New Brunswick Museum which possesses collections of ornithology, mammalogy, ichthyology and geology as well as extensive collections in art and history is governed by the New Brunswick Department of Tourism, Recreation and Heritage. The Nova Scotia Museum, which possesses collections of geology, botany and zoology as well as collections in history, is governed by the Nova Scotia Department of Education. In Ottawa, Ontario, the National Museum of Natural Sciences, which possesses collections of invertebrate zoology, ichthyology, herpetology, mammalogy, mineralogy, ornithology and vertebrate paleontology, is governed by the Department of Communications while the Department of Agriculture possesses collections of entomology, arachnology and nematology, and the Department of Energy, Mines and Resources possesses collections of invertebrate palaeontology.

Is it no wonder our collections are in financial difficulty? The vast scientific collections are governed, mainly, by departments of culture.

D.J.F.

Research

Microfil™ Injections of Small Vertebrates: An Adjunct to Clearing and Staining

By Anthony P. Russell, Aaron M. Bauer[1] and Richard L. Walker

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Russell, A.P., A.M. Bauer and R.L. Walker 1987 Microfil™ injections of small vertebrates: an adjunct to clearing and staining. *Collection Forum* 3 (1 and 2): 3-5

The practice of clearing and staining small vertebrates is widespread in the study of morphology and systematics. Such techniques are generally employed in the evaluation of skeletal characteristics but, if fresh material is available, they can be augmented by the treatment of certain soft anatomical systems. The injection of the circulatory system with Microfil™ and the subsequent examination of the topography of the component vessels, either by way of clearing and staining or by radiography is one approach. We outline the method by which such injections are achieved and provide details of the visualization of the circulatory system and its relationship to skeletal elements and nerves. The method can be applied to specimens of a relatively small size. Once injected and cured the medium is stable and specimens may be stored in alcohol for extended periods and need not be cleared immediately.

INTRODUCTION

The visualization of vascular architecture by way of silicone rubber injection media has long been used in comparative anatomical studies, but has largely been restricted to the level of gross dissection and to the study of circulatory vessels of relatively wide bore. The recent development of similar media with lower viscosity and smaller particle size now enables the examination of finer anatomical detail and the application of injection techniques to smaller specimens. The practice of clearing and staining vertebrates is applicable only to whole animals of small to moderate size. Newly developed injection media, such as Microfil™, now permit such specimens to be fully injected, and thereby enables clearing and staining of entire specimens to be combined with an *in situ* visualization of the circulatory system.

While the microvasculature of mammals has been extensively studied in medical and veterinary contexts employing injection and clearing and/or corrosion techniques, the application of such investigative techniques to non-mammalian vertebrates has been somewhat more limited (Hentschel 1977, Russell 1981a, b), especially where smaller species are concerned. The information to be gained from the investigation of vascular architecture is potentially extensive, especially in such areas as descriptive and functional morphology (O'Donoghue 1920, Haider and Sathyanesan 1974, Russell 1981b), physiology (Gannon *et al.* 1982, Horiguchi and Watanabe 1984), and systematics (Zug 1971, Duda 1974).

We here outline a rapid, simple and inexpensive technique for obtaining complete vascular filling in vertebrates of relatively small body size, using lizards as the investigative example. This technique results in minimal disruption of body structure (Russell, Walker and Bauer, in-press).

METHODS AND TECHNIQUES

The injection technique described herein employs Microfil™ (available from: Canton Biomedical Products, Box 2017, Boulder, CO 80302) as the injection medium and avoids the difficulties encountered in cannulating the systemic trunk of such small animals (Russell 1981a) by employing bi-directional injection of the dorsal aorta. This bi-directional injection also has the added advantage of maintaining adequate injection pressure throughout the vascular system.

The method was developed for small lizards, specifically geckos with a snout-vent length of between 100 and 140 mm. Details of anaesthesia and surgical procedure may be adjusted to suit the particular species and size of animal. The procedure employed is as follows:

1. Anaesthetize animal with ether in a closed chamber,

2. Administer orally a small dosage of T-61 euthanasia solution (available from: Hoechst Pharmaceuticals, Montrêal P.Q),

3. Secure specimen to a cork board, ventral side uppermost and make a mid-ventral incision through the abdominal wall,

4. Reflect the abdominal wall on one side by making cuts perpendicular to the initial incision,

5. Retract the viscera to expose the dorsal aorta,

6. Ligate the dorsal aorta with suture silk at about the mid-point of its exposed length,

7. Make incisions in the dorsal aorta slightly cephalic and slightly caudal to the ligature and insert a polyethylene cannula(P.E. 50)(available from: Intramedic, Clay Adams, Parsippany, NJ) into each and secure in place with suture silk. Note, prior to insertion each cannula is

connected, by way of a 23 gage hypodermic needle, to a 3 ml syringe containing heparinized saline, and all residual air is driven from each cannula,

8. Make a small puncture in the pericardium and ventricular wall to permit escape of fluid,

9. Flush the circulatory system with heparinized saline, employing the two cannulae simultaneously. Pressurization is achieved by mounting the two syringes in parallel onto the holder of an electric syringe pump (Fig.1). (For details of the procedures see: Russell, Walker and Bauer, in-press),

10. When flushing is complete, exchange the syringes containing saline for those containing the Microfil™ injection medium. Note that a period of 15 minutes is available before curing begins and that about 3 ml of injection medium per 10 g of body weight is sufficient,

11. Allow perfusion to continue until the syringes are empty. Mop excess injection medium from the pleuroperitoneal cavity as it emerges from the punctured ventricle,

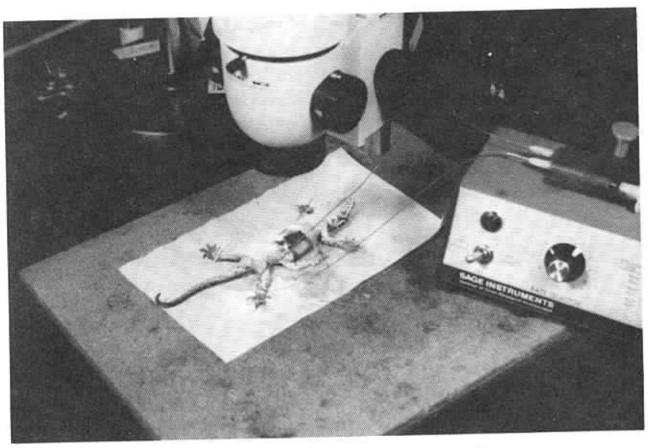

Figure 1 – The injection aparatus in operation.

Figure 2 – Radiograph of the head and anterior extremities of *Rhacodactylus auriculatus* (Reptilia: Gekkonidae), showing the radio-opacity of the injection mass.

12. When the injection is complete, cut the cannulae near the point of their insertion into the dorsal aorta. Position the animal on paper towels in a fixing tray, dorsal side uppermost, and leave at room temperature for three hours while the injection medium cures,

13. Fix the specimen in 10% neutral buttered formalin, and then,

14. Transfer the specimen to alcohol for long term storage or clear and stain after a short period of immersion in alcohol (70% ethanol). No special preparation, fixatives or storage media are required for Microfil™ injected specimens.

RESULTS

The versatility of Microfil™ is evident not only in its ease of injection and preservation, but also in its radio-opacity (Fig. 2). It is flexible and amenable to dissection and may be easily sectioned in histological procedures. It is not affected by the chemicals employed in normal clearing and staining techniques and thus whole body clearing and treatment with stains for skeletal elements (Wassersug 1976) (Fig. 3) and nerves (Filipski and Wilson 1984) (Fig. 4) is possible.

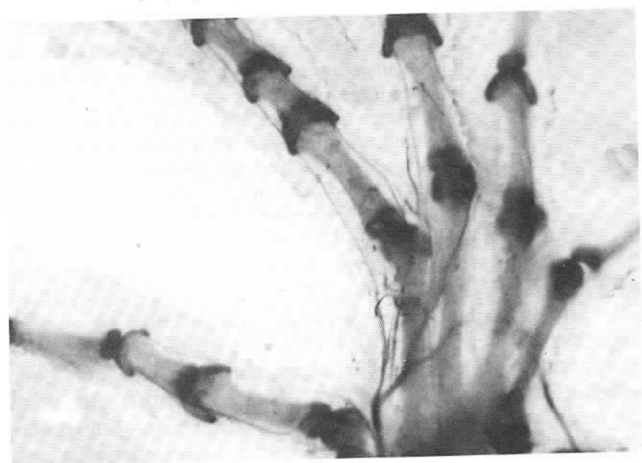

Figure 3 – Cleared and stained left manus of *Rhacodactylus auriculatus* showing the relationship of the arteries to the metacarpals and phalanges.

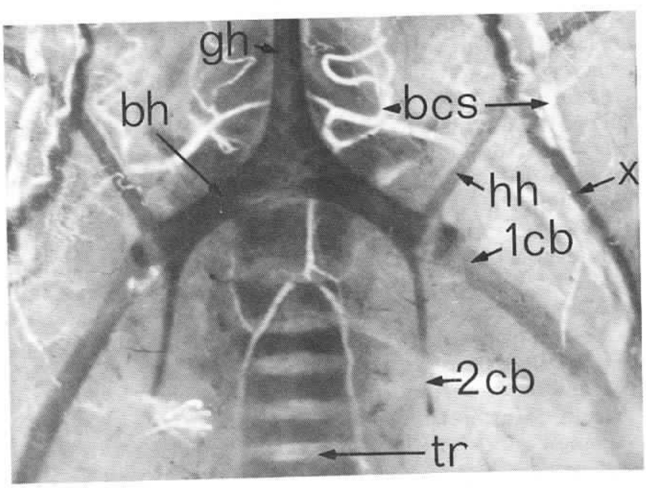

Figure 4 – The hyoid region of a cleared and stained specimen of *Rhacodactylus auriculatus*. The bone is stained with Alizarin red-S, the cartiliage with Alcian blue, and the nerves with Sudan black-B. Abbreviations: **bcs** - branches of the carotid system; **bh** - basihyal; **gh** - glossohyal; **hh** - hypohyal; **tr** - trachea; **x** - vagus nerve; **1 cb** - first ceratobranchial; **2 cb** - second ceratobranchial,

APPLICATIONS

Because the method of injection is not disruptive, specimens infiltrated with Microfil™ can be preserved in alcohol in the same way as uninjected specimens and remain essentially as museum specimens. If, however, details of the vasculature are deemed important for investigation, such data may be obtained by way of radiography (Fig. 2). Thus, for rare specimens, where clearing and staining may not be possible, injection with Microfil™ at the time of specimen preparation provides access to otherwise unattainable data.

Fine details of circulatory vessels may be obtained by way of clearing or clearing and staining techniques. The clarity of such preparations (Fig. 5) enables intricacies of circulatory patterns to be elucidated while being examined *in situ* (Russell 1981b). This has implications both for functional studies and for systematics, the latter by being able to reveal branching patterns of vessels and other architectural details. Elucidation of the vascular architecture of individual organs (Fig. 6) may be useful in physiological considerations, and circulatory details of the maternal-fetal interface may prove useful in certain aspects of the study of reproductive biology. And finally, specimens treated in this way make excellent and elegant teaching aids.

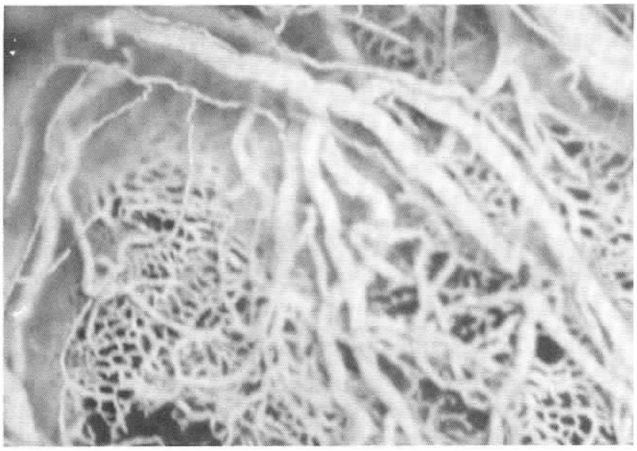

Figure 5 – Fine branching of the vasculature of the ventral surface of the stomach of *Rhacodactylus auriculatus*.

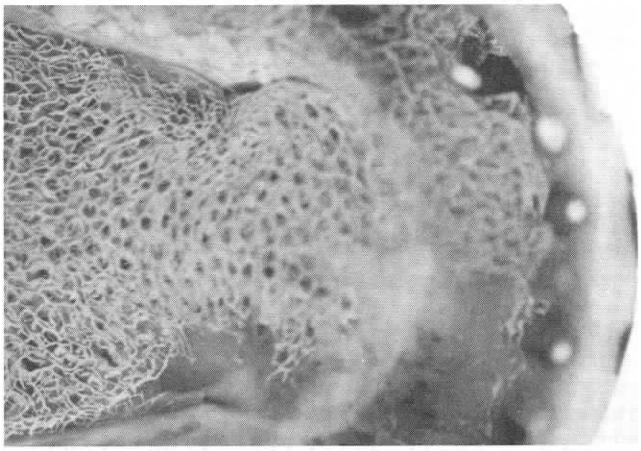

Figure 6 – Vascular network of the primary palate of *Rhacodactylus auriculatus*.

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Biomass Loss in Wet-preserved Reference Collections

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Ellis, D.V. 1987 Biomass loss in wet-preserved reference collections
Collection Forum 3 (1 and 2): 6-8

Specimens of invertebrate and vertebrate animals held in liquid preservatives present a subtle problem for future use in ecological research. Where there is possibility that such future use will involve weighing specimens for estimates of biomass and ecosystem indices, certain procedures would increase the value of the reference collections. The problem arises from the rate of leaching of materials from the specimens, hence loss of weight, which is usually a function of type of preservative and duration of storage. Specimens commonly are fixed in neutralized formalin and transferred after a few days to alcohol of various concentrations. Quality controlling this leaching effect is so inadequate at the moment that biomass productivity estimators generally will not accept values derived from preserved specimens. Adoption of standardized procedures for quality control would increase the value of wet-preserved specimens for long term retroactive analysis of ecosystem productivity changes based on reference collections in museums. It is suggested that museum records include original (wet weight) biomass values, a record of preservatives, dates and adequate quality control of preservative concentration, for sets of specimens held.

INTRODUCTION

It is occasionally desirable to re-examine specimens in natural history collections for purposes which may have been unpredictable when the specimens were stored. An example is an analysis of museum tuna and swordfish, which showed that mercury had not increased in their tissues in recent years (Miller *et al.* 1972) in spite of concerns about anthropogenic dispersal of the pollutant. The oldest tunas had been collected in 1878, almost 100 years before the re-examination.

There can be problems in re-examining specimens for unusual purposes, and this paper is an examination of some problems for one such purpose. Can voucher specimens from ecological-environmental surveys be used to calculate biomasses, and important derived statistics such as productivity levels, from the past? This paper explores the severity of the weight-loss problem on wet storage of samples and provides suggestions for procedures for re-examining samples for biomass determinations.

A SELECTED SURVEY OF THE LITERATURE

Extent of Biomass Losses

Mills et al. (1982) showed that many marine benthic invertebrate forms lost biomass when preserved in alcohol, but in formalin some lost and some gained weight. There were complex changes in water and tissue content, some occurring very rapidly (within a few minutes), others taking a month or more before final stabilization. Some annelids in isopropanol lost 50% biomass within a week, and then stabilized after a month at 60% loss. Annelids could gain 30% weight initially in formalin, but then lose weight to a final gain of only 10%. Bivalves and crustaceans lost 20% of their weight after several months stabilization, but amphipods initially gained 20% in both formalin and alcohol.

Howmiller (1972) reported biomass losses between 20% and 70% in freshwater benthos in various common preservatives. Day (1985) quotes other studies of losses in preservative by freshwater benthos (Wiederholm and Eriksson 1977; Lappalainen and Kangas 1975) and zooplankton (Williams and Robins 1982; Morris 1972; Beers 1976). She concluded that biomasses actually present in the living ecosystem (which after all is what these measures are intended to represent) could not be obtained accurately from the two sets of annual samples in storage available to her.

Confounding Effects of Significant Figures

It is extraordinary but several of the widely used operational guides to benthic methods do not consider the problem of deciding the level of significant figures to use when weighing specimens, i.e. do you read the scale to 1 g, 0.1 g or even 0.00001 g? In part, both wet and dry weight measures need a significance level determined by the nature of the derived estimates, e.g., whether a productivity statement will be in grams per square metre or tonnes per hectare. Dry-weight measures can be to almost any desired level of significant figures since drying can be completely achieved. With wet-weight measures there is a unique and major source of inaccuracy and imprecision. It is the amount to which free water can be removed by so-called damp drying. This variability is highest in species the largest individuals of which are big enough that their body cavities can be opened and drained, as with bivalves, echinoderms and fish. Generally each investigator decides how big is big enough.

I happen to know that a standard-setting investigator of the 1930s-60s, Gunnar Thorson of the University of Copenhagen used 0.1 g as his level of figure significance, since I was his student for a time (but I do not recall to what size he opened bivalves for draining). Many other levels than 0.1 g have been used, including 0.00001 g at Island Copper Mine, and 1 and 0.1 mg in some of the benthic biomass-loss studies referenced. In these loss studies the significant figure levels could be accurately achieved in some cases since the investigators centrifuged their wet specimens. For conventionally damp-dried specimens measured to 0.00001 g, the figure is variably inaccurate since the scale reading can on occasions be seen dropping as it is read, presumably as preservative evaporates. The Thorson level of 0.1 g is convenient. It can be routinely achieved, apparently accurately, and allows bulking of small species so that their counts can be converted to weights without weighing, e.g., 10 *Axinopsida* weigh 0.1 g.

Other factors determine levels of significance to use for biomass determinations. Biomass losses in preservative can reach 50% or greater according to the loss-studies referenced. Hence weights for the smallest specimens will drop in preservative below the significance level used, i.e., become zero. The value can of course be rounded up to the minimum recordable. Bulking specimens to a minimum of twice the lowest value recordable also avoids this problem but loses species information. Bulking means that some selection has been made about which species to weigh separately and which to bulk. This type of decision is similar to deciding which species to cut and drain, and for what size of specimens of that species to do so. Specimens weighing only 0.1 g are too small for draining. Accordingly there is merit in weighing to a significance level of 1 or even 10 g, 10-g specimens can be drained if necessary. At this level though the loss of potential information may reduce the biomass measure to demonstrating only major order-of-magnitude changes for a few species. This of course may still be useful information since sudden order-of-magnitude changes in biomass may be a pollution index.

Finally in this context, the demands of statistical procedures claim that the significance level should be determined by the range of values obtainable, with the number of unit steps to be between 30 and 300 (Sokal and Rohlf 1969). A 1-g significance level would meet this requirement for many infaunal studies. However, this requirement is undoubtedly complicated by biomass measures not being normally distributed (in a statistical sense).

PROBLEMS WITH EXISTING BIOMASS PROCEDURES AND VOUCHER COLLECTIONS

I am presently involved with two projects which measure stocks of infaunal (soft-bottom) benthos on the sea bed and their changes over time. One of these draws on a prior survey 50 years before. This was in East Sound near Friday Harbor Marine Station of the University of Washington (Shelford et al. 1935). Although no collections could be found, the published results allowed a uniquely designed resurvey 50 years later (Day 1985). Day took over the project after 2 years of an intended 5 years' resurvey; she thus had two sets of recently stored samples. The other project is a monitoring programme at a mine (Island Copper) in British Columbia, which discharges its tailings to the sea. The benthic monitoring is part of a comprehensive environmental quality control programme started in 1970 with the intent of detecting changes over time, i.e., year by year (Pelletier 1982).

Both projects recorded species identifications and counts per sample as basic data. The East Sound project recorded no biomass (weight) data for reasons to be explained, but the mine project did for a number of years. The mine has also recorded some size data for some types of organisms.

Species counts measure numbers of animals. When expressed per unit area, these become estimates of abundance (a better term than density, which in marine biology can be confused with sea-water density). Numbers also inevitably provide presence-absence data, which demonstrate species distributions, and when distributions are related to counts, whether species are dispersed in clusters, randomly or evenly (McIntyre et al. 1984).

These behavioural properties have effects on the precision of the species abundance estimates. The number of species is an additional parameter. It is a simple measure of diversity within a sample set. It can be input into various more or less complicated formulae for diversity indices incorporating species abundance and their inequitability. Certain such indices permit comparisons of species diversity between sets of samples (Washington 1984). Counts per sample thus provide a great deal of ecological information.

Weight and size measures are also desirable in an ecological project, since they permit estimates of biological growth and productivity. Size measures, for example, can demonstrate the rate at which specimens grow in length, height or width or all three, and can lead to conclusions about productivity (Jones and Ellis 1976). Often ages can be calculated from modes in growth statistics or by other measurement techniques, and ages are useful for productivity estimates.

Biomass encompasses water, inorganic and organic materials, and assimilating these has different metabolic costs. It may be desirable in a project to know their relative proportions. Biomasses are first estimated from a set of wet weights. These are generally from specimens damp-dried on paper towels or a fine screen. Then biomasses can be converted to dry weights by drying (which destroys specimens) or by conversion using formulae for different species obtained by drying representative samples (Thorson 1957). Weights can also be converted to carbon or energy values or to values of any element or compound of importance to a particular study, provided appropriate conversion procedures or formulae are available.

A further utility of biomass values is that they can be converted to an estimate of biological production over a unit of time. This can be done simply by multiplying biomass by turnover, i.e., average number of times that the organisms breed. Generally the time period is a year and so a species which breeds twice a year has an annual productivity twice the biomass at any one time. This estimate does not allow for changes arising from seasonal or irregular phenomena. These need more detailed sampling and calculations: catching flushes of settling larvae, feeding frenzies of transient predator packs, environmental catastrophes, etc.

The point of all this is that a set of samples from an ecological project can be a data bank permitting comparisons with new samples, possibly many years later. The samples may have been held for routine processing, or have been formally presented into a natural history collection with no such re-examination intended (such as the dried tunas and swordfish).

There are of course problems for re-examination of specimens. Size-measures for example can in general only be made on hard-shelled animals which do not shrink in prolonged preservation. It is too much to hope that soft-bodied specimens meticulously narcotized, hence uncontracted, will occur in ecological samples. Ordinarily the whole lot is put into preservative as soon as possible.

Weight-measures also present problems. So much so that the relevant chapter on procedures (Crisp 1984) in a widely used text on benthic methods states that weight should be taken before preservation (fixing?) of specimens. This is not always practical nor is it the alternative to chemical preservation or freezing. So, many ecological studies preserve samples on site, and then weigh specimens afterwards. The standard preservation procedure for marine benthic studies is to leave specimens for three days in buffered seawater formalin, then transfer to 40-70% alcohol (as we did in East Sound in 1978 and 1979). Species weights are then obtained as specimens are identified and counted, weeks, months or even years later. An overall sample weight, however, may be obtained before specimen identification, as at Island Copper where weights were obtained for polychaetes, molluscs and other groups. This extra handling can break delicate specimens, especially small fragile polychaetes and crustaceans, reducing the accuracy of the more important identifications and counts.

SUGGESTIONS TO IMPROVE BIOMASS PROCEDURES AND VOUCHER COLLECTIONS

1. Organisms should be identified and counted, not weighed or sized for an infaunal benthic survey in a new area. Voucher specimens from surveys should be deposited into permanent museum collections for later taxonomic verification.

2. The very first (pilot) survey should be used to define biomass sampling and the processing procedures for species and size ranges selected. An appropriate level of significant figures should be included, if biomass (or size) measures are an important statistic at the time or in the future. This could be 1 g or 10 g if wet weights are adequate measures, but may be as fine as 0.00001 g if dry weights are required to reflect properties of the ecosystem. Weights should be taken before fixing the specimens. If this is not practical, a representative sample of important species should be wet-weighed before fixing for development of a back-calculating formula for live biomass from the preserved weights later. The samples should then be stored until biomass losses have stabilized (several months at least).

3. Samples for biomass determinations should be stored together as sets, so they can be retrieved as sets for re-examination. The recorded pre-preservation data should be properly stored and readily retrievable.

CONCLUDING COMMENTS

It is difficult to predict what ecological measures may become important in the future, as with the museum fishes and their use for mercury determinations. Since we now know that trace metal analyses, biomass measures, etc., from old specimens can be useful, we should be taking steps to ensure that some natural history collections provide opportunities for such measures. This can be done by storing collections with thought to their eventual processing. Hopefully, we can leave to our successors collections usable for unpredictable purposes, like the tunas and swordfish.

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Improvements in the Construction of Plastic Display Jars for Museums

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Due to increased cost of materials over the last few years it has become increasingly more important to develop methods of constructing museum jars and displaying anatomical materials in an inexpensive manner. A method of constructing plastic display jars from transparent plexiglass is described. The design and construction of a simple bending jig containing a solid rod heating bar has simplified this task. The resulting product offers versatility in size and function. This may be accomplished at low cost from readily available materials.

INTRODUCTION

Because it has become more and more expensive for museums to purchase glass or plastic display jars, new and less expensive methods of fabrication have become essential. Because of surface irregularities, inexpensive glass jars tend to distort the appearance of specimens, which is not the case with plastic jars. Apart from offering this advantage, plastic jars can be covered in a variety of ways. The method of construction described here allows one to produce jars of varying sizes from plexiglass[1] sheets.

MATERIALS

The following materials and supplies were used in the construction of plastic display jars.

a) Various sizes and thickness of sheet and rod Plexiglas™ G (transparent methyl methacrylate) (manufactured by Rhom & Haas Company, Philadelphia, PA, available in Canada from Rhom & Haas Canada, Inc., West Hill, ON).

b) A solid core heater bar of variable length manufactured from low resistance steel alloy (available from Nedco Canada Ltd., Kingston, ON). A bar 60 cm long by 5 cm wide and firmly mounted into a bending jig was used for the jar described in this paper.

c) A bending jig constructed of 12 mm thick plywood.

d) A 110-115 volt AC power source with a switch and attached to heater bar.

e) An adjustable retort stand specially adapted with 12 mm adjustable platform for holding plastic during bending.

f) A T-bar holding device with adjustable arm for securing plastic during cooling.

g) Chloroform (threshold limit value: 10 ppm).

h) Ancillary equipment: C-clamps, furniture clamps, masking tape, lead weights, electric drill, table or radial arm saw.

1. Plexiglas™ is used when referring to the specific product by its trade name but plexiglass is used when referring to the generic product.

METHODS

The method outlined here allows versatility in jar size. The production of a jar 25 cm long, 15 cm high and 10 cm wide will be described. When using this method, it is important to remove the protective brown paper from plexiglass surfaces to be glued which prevents the glue from reacting with the paper and staining the plexiglass.

Step I: Using a piece of 3 mm (approximately 1/8 in.) plexiglass, the dimensions of the sides of the jars were laid out as shown in Figure 1a. Pieces of plexiglass slightly larger than the top and bottom of the jar were also laid out.

Step II: The plexiglass was placed on the heater bar at bending line #1 with the free end supported using a specially adapted adjustable retort stand (Fig. 3a). The heater was turned on and the plastic was left until pliable (80 to 100C). Care was taken to prevent overheating which caused the protective paper to stick at the bending joint.

Bends had to be made approximately 15 to 30 seconds after the plexiglass had been removed from the heater bar. For each of the three bends of the jar, the jig (Fig. 2) was used as a moulding device. The heated plexiglass was pressed to form a 90 degree angle against the inside corner of the jig and left to cool secured in place with a T-bar holding device and lead weights (Figure 3b). It was important that the plexiglass be held tightly and supported properly to make certain that everything was square and the jar stood correctly.

Step III: Waste pieces of plastic (10 g) were placed in chloroform (50 ml) and allowed to dissolve to form a glue. It was spread on the free edge of side #1, which was then positioned to meet the final cutting line at side #4 (Fig. 1b) and secured with clamps. The glue was then allowed to dry (approximately 8 hours). Subsequently, the waste area was carefully cut off as close as possible to the side of the jar.

Step IV: The glue was applied to the bottom edge of the jar which was then placed on the plastic base. Weights were placed on top of the jar and the glue was allowed to dry. At this point the remaining protective paper could be removed from the jar and the jar could be tested for water tightness. Any leaks were rectified by the application of small amounts of chloroform at the leak sites.

Step V: Any excess plastic on glued edges of the sides or bottom was removed using a fine toothed file and ascending grades of sandpaper (100-600 grit). During sanding and filing care was taken to avoid scratching jar surfaces. The sanded edges were then ready to be polished on a buffing wheel using jeweller's rouge.

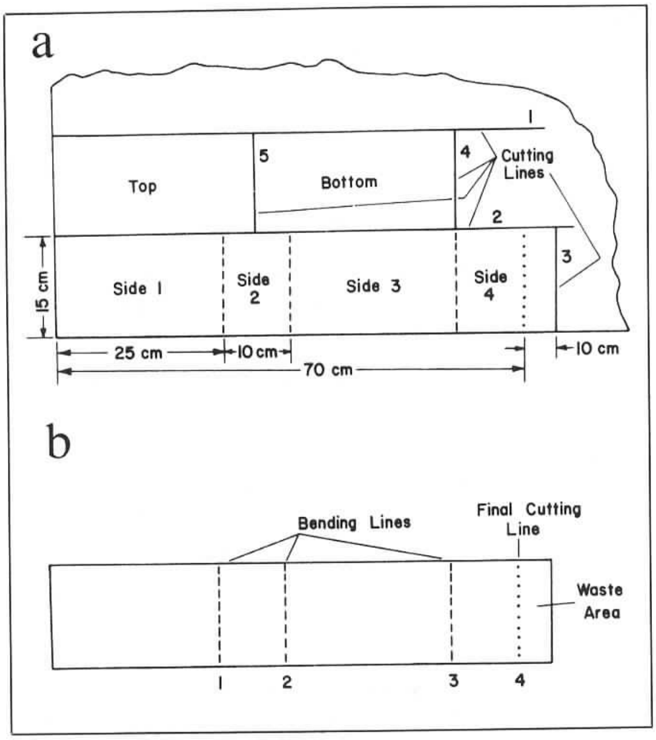

Figure 1 – (a) Jar layout on 3mm plexiglass.
(b) Jar layout showing bending lines.

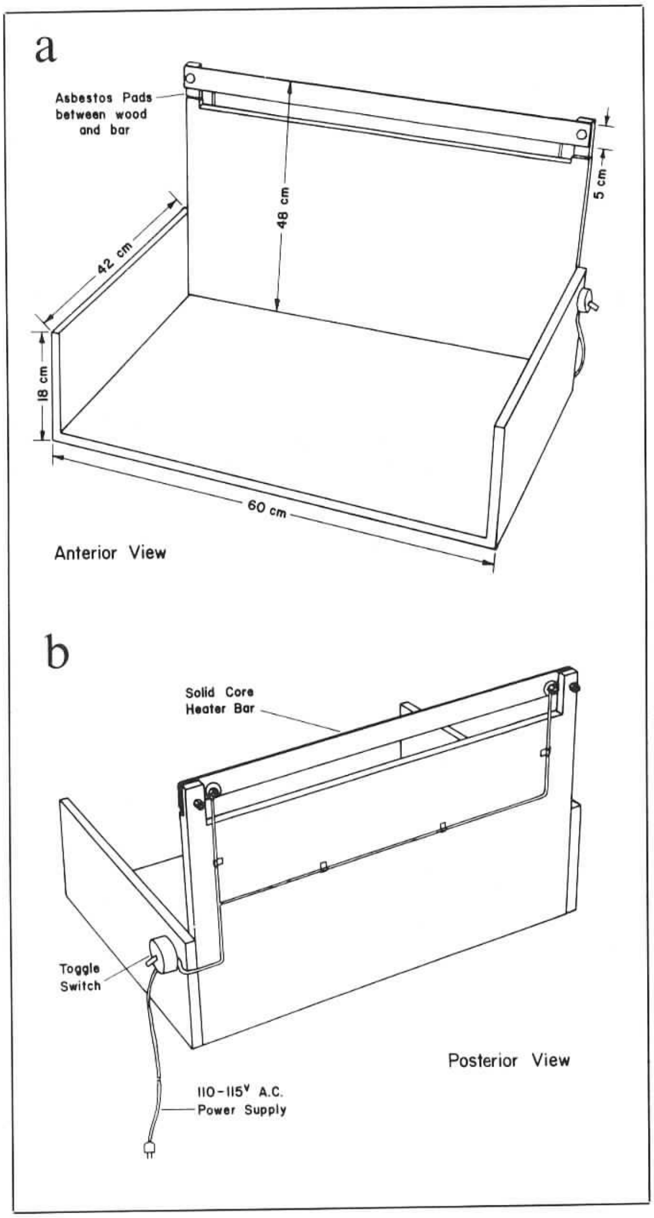

Figure 2 – (a) Bending jig with heater bar attached.
(b) Bending jig showing power source attached.

Four methods of lid construction are described here:

a) Inside Fitting Lid (Fig. 4a):

A strip of plexiglass 12 mm (approximately 1/2 in) wide and the length of the inside top of the jar was cut and bent to fit. The bent strip was glued to the plexiglass top piece and, with weights in place, it was left to dry. The top piece was trimmed to match the outside of the jar.

b) Outside Fitting Lid (Fig. 4b):

The same procedure as outlined in a, above, was followed except that the plexiglass strip was bent to fit the outside edge of the jar. The top piece was trimmed to fit the outside edge.

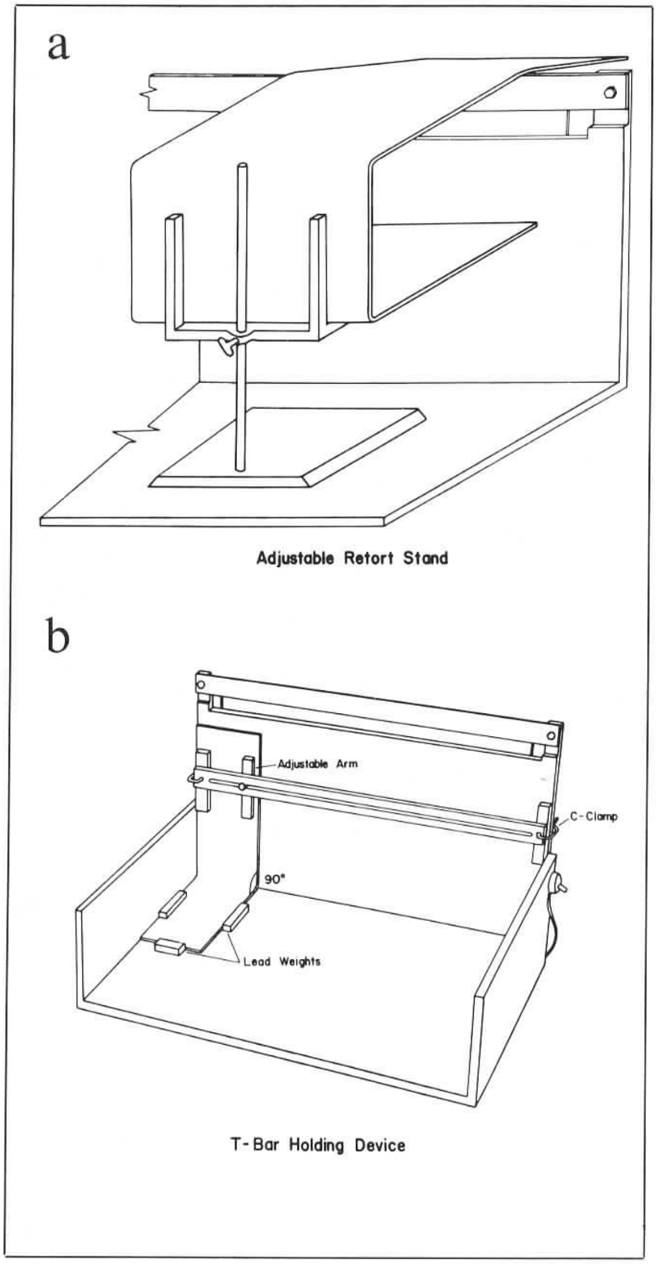

Figure 3 – (a) Adjustable retort stand with plexiglass in place during heating.
(b) T-bar holding device securing plexiglas after bending jig.

c) Plexiglass Permanent Cover

A specimen was placed in a completed jar partially filled with fixative (5% formalin). A piece of plexiglass was cut to fit the jar top and glued permanently in place. After drying, the edges were trimmed and polished. A small hole was drilled in the jar top to allow complete filling with formalin. The hole was sealed with plastic glue.

d) Removable Glass Lid (Fig. 5):

Using a cover of this nature requires a change in procedure of construction. The upper edge of the jar must be rabbeted prior to bending (Thompsett 1970a). Only plexiglass thicker than 6 mm is suitable for this purpose. Plastic was rabbeted approximately 3 mm deep and wide. Glass was cut to fit inside the rabbeted edge of the completed jar.

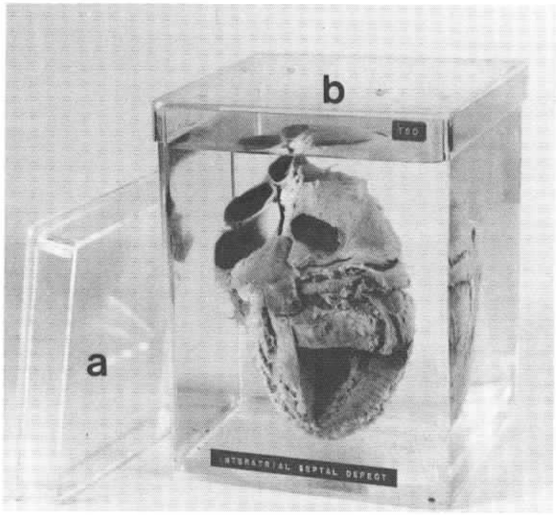

Figure 4 – (a) Jar showing internal fitting lid.
(b) Jar showing external fitting lid.

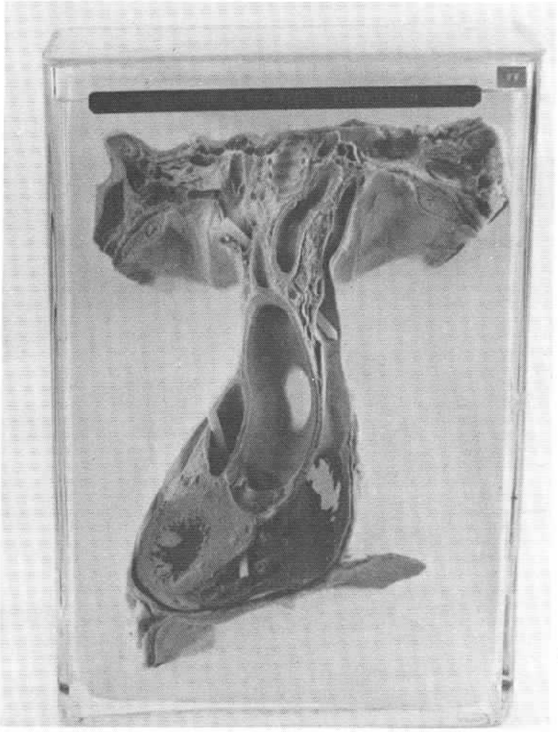

Figure 5 – Specimen attached to plastic backpiece.

Following construction of the jar, provisions are made for mounting the specimen. Four methods are outlined here:

a) Specimen Secured to Backpiece

Nylon fishing line is used to secure the specimen to a plexiglass backpiece whose dimensions are slightly smaller than the height and width of the jar (Fig. 5).

b) Plexiglass Mount

The specimen is placed on a moulded or straight piece of plexiglass as shown in Figure 6.

c) Plastic Rod Mounting Rack

A mounting rack constructed from rod and sheet plastic is used to support the specimen as shown in Figure 7.

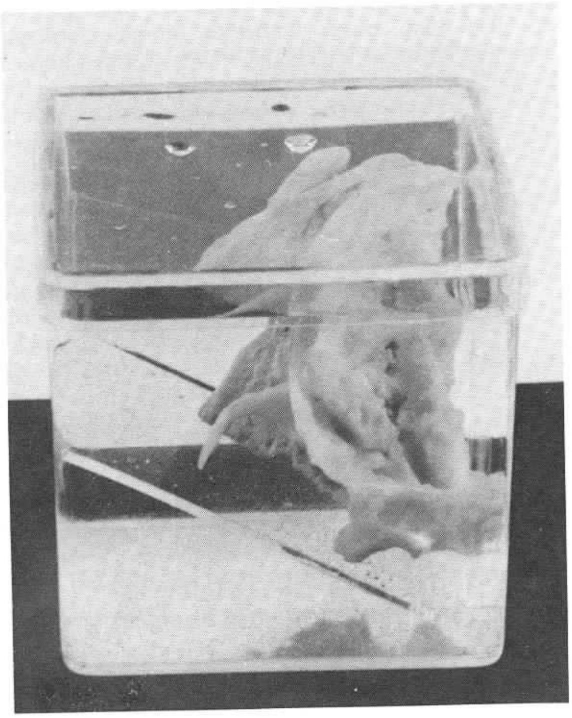

Figure 6 – Specimen on moulded plastic mount.

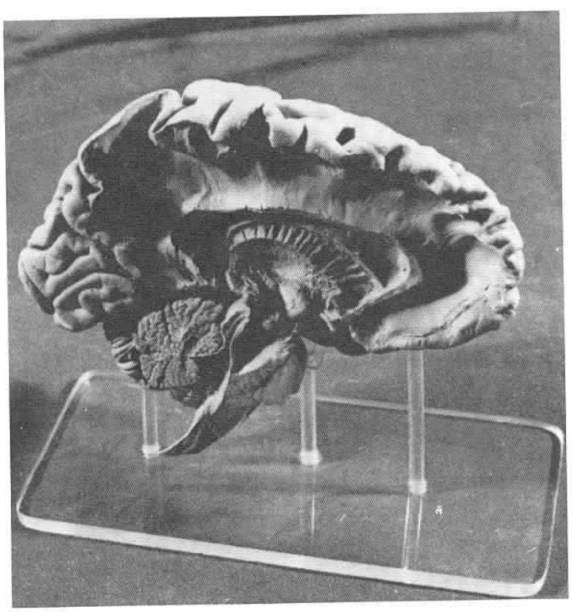

Figure 7 – Specimen on plastic rod mounting rack.

d) Appropriately Sized Jars

Specimens are displayed in jars slightly larger than their size. This utilizes the sides of the jar as support for the specimen (Farmer 1951).

DISCUSSION

As noted in previous publications (e.g., Edwards 1959, Audette 1965), transparent plastic jars are superior to glass jars for displaying specimens. They provide minimal distortion and are less expensive to construct.

Owing to the use of a solid core heater bar as opposed to a heating element (Hangay 1985) or a heating coil (Audette 1965), discolouration and distortion of the plexiglass is almost completely eliminated. The glue, i.e., plastic dissolved in chloroform, creates strong bonding at the sealed edges, preventing cracking and leaking (Kennedy 1952).

Chloroform is a very hazardous substance and must be carefully handled. When handling chloroform, it must be certain that there is no open flame nearby (e.g., from welding equipment, etc.). Prolonged inhalation of chloroform fumes must be cautioned against. It is advisable to store unused glue in a well stoppered container.

Moulded tops provide tightly fitting removeable lids, thus minimizing evaporation of fluids in the jars. Permanent plexiglass covers prevent further evaporation of fluids.

It should be noted that the storage fluid in plastic display jars should be restricted to non-solvent media, like formaldehyde (e.g., 37-40% assay containing 12.1% CH_3OH preservative). Solvents or solvent-containing solutions (e.g. 2% ethanol) cause the plastic to etch and crack after prolonged exposure.

In light of the growing concern regarding the hazards of using formaldehyde for preservation purposes, it is advisable to use containers which can be sealed as tightly as possible. Because of the superior properties of formaldehyde fixatives it is nevertheless highly recommended for use as a storage fluid. Minimization of shrinkage in comparison to alcohol favours its use. Low percentage solutions (1 to 3%) are preferred.

After several years of use in the Department of Anatomy, Queen's University, this method of jar construction has been found to be perfectly suitable for specimen display in our teaching museum.

ACKNOWLEDGEMENTS

For his advice and encouragement during the preparation of this manuscript I thank Dr. C. Romero-Sierra. I am also grateful to Mr. Jim Driscoll for his expert technical assistance.

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"Cased" Bird Skins – An Alternate Opening Incision

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Halford, S.A. 1987 "Cased" bird skins – an alternate opening incision. *Collection Forum 3* (1 and 2):13

In the preparation of ornithological study skins, an opening incision running from each thigh to the vent – similar to that used to prepare a 'cased' mammal skin – is useful. This method can reduce the risk of stretching, possible tearing of the skin, and restoring the lay of breast feathers. This method will be particularly useful for pattern-breasted and long-legged specimens.

INTRODUCTION

The "classic" procedure for preparing ornithological specimens involves an initial, ventral, midline incision. Most authorities however, recognize the advantages of varying the location of this initial incision in special cases (Anderson 1965, Wagstaffe and Fidler 1968).

My original concern was with the disturbance of feathers on pattern-breasted specimens and the extra effort required to recreate these patterns after preparing the skin in the conventional manner. Harrison and Cowles (1970) suggest using a lateral incision on such specimens, but they also point out some of the disadvantages of this method. Having been pleased with the results of using a "cased skin" or "trapper's" opening cut (Anderson 1965) on mammal specimens, it occurred to me that a similar incision on birds would overcome the problems of both the mid-ventral and lateral techniques.

METHODS

After the desired measurements have been taken, the specimen is laid on its back and the opening incision is made in two semicircular cuts dorsal to and parallel to the abdominal pterylae. These cuts run from the inner margin of each thigh and meet just anterior to the vent (Fig. 1). The skin of the thigh itself is not cut. The flap of skin thus produced is worked free of the abdomen as is the skin surrounding each thigh. Femora may be cut at any convenient point between hip and knee, the location varying for different species. Further skinning and stuffing may proceed in the normal manner.

In sewing up it is most convenient to use two threads and sew each incision separately, beginning at the anterior ends of the incisions and tying the loose ends of thread together where they meet at the vent. If the stick on which the body has been formed extends beyond the vent, the threads should be bound firmly to it. Should any evidence of the incision remain after sewing up, the legs of most species may be conveniently arranged to conceal these irregularities.

DISCUSSION

I have found this method of opening a specimen superior to more conventional techniques on all specimens I have attempted it on, 15 specimens of 9 different species. Since breast feathers are barely disturbed, feather patterns are restored with little effort and the danger of soiling the breast is minimized.

Several other advantages to the technique have become apparent with use: 1) The proximity of the incision to the thighs makes dealing with the legs easier, particularly in long-legged hawks where the leg is more readily cut at the hip than at the knee, 2) the breadth of the incision close to the vent allows skin to be worked free of the rump with much less stretching and little risk of tearing, 3) the size and shape of the incision as a whole reduces stretching and tearing when the skin is brought forward over the body, and 4) placing the incision in the narrow apteria between axillar and abdominal feather tracts minimizes distortion due to drying and shrinking of the edges of the incision prior to sewing up.

The only significant disadvantage to the technique that I have found is the potential weakening of the attachment of leg to body due to the proximity of the incision to the leg. However, where the legs are routinely tied to the body stick this weakness should be of little concern.

ACKNOWLEDGEMENTS

I thank Nico Verbeek of this Department for his advice in the preparation of this paper.

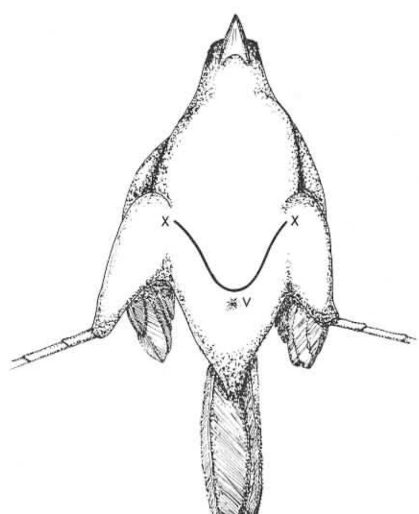

Figure 1 – Ventral view of fox sparrow, *Passerella iliaca* (plumage reduced) showing location of incision (X – X). V: vent.

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Features

The Lyman Entomological Museum and Research Laboratory

An enviable insect collection

By D. Keith, McE. Kevan and P.M. Sanborne

The Lyman Museum had very modest beginnings – five mahogany cabinets, which are still preserved, containing about 20,000 insects and 78 entomological volumes. These were bequeathed in 1914 to McGill University by the late Henry Herbert Lyman: McGill graduate, Montréal businessman, well-known public figure, amateur entomologist, and general naturalist. He and his wife were tragically drowned when the *Empress of Ireland* foundered in the Gulf of St. Lawrence on the night of 28-29 May, 1914. For the upkeep and augmentation of the collections, a bequest included a handsome endowment, though income from this today is now sufficient only for a few limited purposes.

The collections, both insects and books, were at first accommodated in "The Lyman Room" which contained about 80 square metres of floor space, with a high ceiling in the Peter Redpath Museum on the Montréal campus of McGill University. There they remained for 47 years under the stewardship of two devoted amateur entomologists: A.F. Winn (from 1914-31) and G.F. Moore (from 1931-61), who had also been secretary of the administering body, ie., the Lyman Entomological Committee. By 1961, it was estimated that the collections had expanded to include about 200,000 insects of all orders and from many countries and some 2,750 entomological volumes. They were now too large and diverse to be adequately cared for by a single, part-time, non-professional of Mr. Moore's very advanced years, though at the age of 80 he was still scrambling up the high stack-ladder like a monkey!

The Lyman Museum on the Macdonald College Campus

Without lengthy explanation, the Lyman collections were moved from Montréal to the Macdonald College Campus at Ste-Anne de Bellevue at the end of 1961, where the university's staff entomologists had always been located. This disposed of an anomaly that had existed for almost half a century. Until then, the collections had never been used to best advantage, because very little entomological research was ever undertaken on the Montréal campus.

Over the next few years the Lyman collections were integrated with those of a rather different nature already at Macdonald College, creating a new and enlarged "Lyman Entomological Museum" and "Lyman Collection" of entomological literature. The latter was, thereafter, supervised and housed by the Macdonald College Library and has become one of the best entomological libraries in North America. To look after the insect collections, an academically qualified Curator, V.R. Vickery, was appointed in 1961 to the Department of Entomology, rather than to the Lyman Museum, which, at the time, had only honorary or voluntary assistance and no university budget.

The Lyman Museum flourished with new and more adequate quarters of about 465 square metres of floor space, which were rather fragmented with low ceilings in the converted "attics" of the Macdonald College Biology Building. At last the collections of the Museum became well used, quite well known, and began to play a vigorous research role in close association with the Department of Entomology. Its subsequent increase in international stature was recognized and as a result in the mid-1960s, a sum for new cabinets and then a modest annual budget from general university funds were provided to supplement Lyman's inadequate endowment income. The former enabled the Museum to initiate conversion to modern, steel cabinets, uniformly-sized drawers, and an up-to-date "unit-tray" system of curation. The annual budget made it possible to employ non-academic staff – initially a secretary, but later, technical and managerial assistance. Currently there is a single incumbent in each category. Summer assistants, unfortunately, were sacrificed as times of financial stringency over-took the Museum.

There remains the anomaly that academic staff are paid from the budget of the Department of Entomology, Faculty of Agriculture. The Museum, however, is not an administrative part of any Faculty, but departmental teaching and other duties are expected of its staff. Courses and graduate students in the Museum are the responsibility of the Department, not of the Museum *per se*. On the other hand, the Museum has its own Research Associates and receives independent capital equipment grants and research funds. In teaching, research and social matters the two units act as one; in matters of administration, public relations, and reporting to higher authority they go their separate ways. This seemingly illogical situation, which has a legal basis, actually works to mutual advantage!

In 1971 the Lyman Entomological Committee, which is ultimately responsible for Museum policy, concluded that it was time for more formal recognition of the Museum's enhanced status. It requested the appointment of a Director from within the university to administer the unit and the words "and Research Laboratory" added to the Museum's official name – to reflect its true functions. Both requests were implemented in 1972. The first author was appointed its Director, but remained a professor in the department of Entomology with normal duties therein.

During the 1970s Macdonald College and those units sharing its campus went through certain traumatic experiences. One was that the Lyman Museum was moved again in mid-1978 to excellent accommodations in the new Macdonald-Stewart Building with the Department of Entomology immediately above it. Lack of sufficient space for the expanding collections had, once more, become a problem, so that 688 square metres of floor space, including offices, allocated to the Museum was minimal, but, under the circumstances, fairly generous. The space was fully utilized and there was some room for normal growth though certain facilities were cramped.

Creation Of A Major Insect Collection

Collectors working with the Lyman insect collection have always had a bias towards eastern Canada and adjacent regions. This was especially so in earlier times as various members of the Montréal Branch of the Entomological Society of Ontario (later, Québec) affectionately regarded it almost as the branch's own. Nevertheless, the acquisitions have always been rich and of varied origins so that the collection is cosmopolitan, being represented by all orders of insects and various other terrestrial arthropods from many lands.

Because of its wide representation and size, Pechuman of Cornell University placed the Lyman Museum among the very few university institutions in North America – and the only one in Canada – possessing first-rank insect collections. By the mid-1970s the collection was estimated to have passed one million specimens. It has long been the largest and most diverse collection in Canada after the Canadian National Collection of Insects in custody of Agriculture Canada in Ottawa; in certain groups it is even stronger. Indeed, it has been part of the Committee's declared policy for many years that the Lyman Museum should try to complement the National Collection wherever feasible. For example, its exotic collections in several orders are richer and its world representation of orthopteroid insects is more comprehensive. The orthopteroid "reprint" collection, as an example, is one of the best in the world.

Currently there are about 2 million specimens belonging to at least 50,000 species of insects and other terrestrial arthropods. However, with the exception of soil mites and Collembola, groups comprising minute species, particularly those preserved on slides or in fluid are less well represented. The larger orders of insects include the most specimens and of these, Coleoptera and Lepidoptera are particularly well represented. The latter are especially so, partly because of the founder's preference, and partly because of the recent acquisition of the large A.C. Sheppard collection. They and the orthopteroid orders have received the greatest attention in modern times. Mr. Sheppard passed away recently but he had been associated with the collections since 1918. When he retired from business in 1968, he was officially appointed honorary curator of Lepidoptera in which capacity he functioned for many years. Just recently the museum, with financial help from the Maclean Foundation and private donations, was able to purchase the Jean-Charles Aubé collection of Coleoptera which contains approximately 200,000 specimens. This collection has now been integrated into the main collection.

The Lyman Museum is not an exhibition though it has recently acquired a small display area in the main concourse of the Macdonald-Stewart Building, where it has mounted a succession of eye-catching exhibits. Temporary displays are also prepared from time to time by the staff for use elsewhere such as, at "Expo '67" and "Terre des Hommes" exposition in Montréal. The Museum is not open to the public or to casual student "drop-ins" but any *bona fide* visitor may view the collections by appointment. Small supervised parties can also be accommodated with prior notice. A substantial amount of the time of the Museum's staff is devoted to answering all manner of enquiries from the general public about all manner of insects and insect problems. As one would expect, these vary from the serious and sensible to the nuisance and crack-pot! Once – and only once – was there an entertaining visit by an entomophobic striptease artiste!

The Museum is, despite its other roles, primarily a biosystematics research unit. It is well equipped for the purpose having its own research vehicle, rearing rooms, photographic facilities, *etc.*, in addition to the pinned, fluid, and slide collections. Loans and exhanges with other institutions throughout the world are arranged and welcome.

The Museum accommodates visiting scientists and/or graduate students for short or protracted periods. Well over 80 McGill entomology graduate students have used the Museum's facilities in the course of their research. The Museum also accommodates small classes of students and provides teaching material for others. It also publishes larger works (a *Memoir* series) and shorter papers (*Notes*) at irregular but frequent intervals.

In 1986 both the Director and the Curator retired. A new Director, Dr. J.E. McFarlane, Chairman, Department of Entomology, was appointed and a new Curator, Dr. P.M. Sanborne, was hired. Dr. Sanborne's interests are with parasitic Hymenoptera further expanding the scope of research conducted at the museum. Unfortunately, since Dr. Sanborne is the museum's only full-time taxonomist, he will shoulder an increased burden. The Director's position has been filled by an insect biotechnologist.

1988 will be another traumatic year for the museum for it is moving again; this time to the basement of the Centennial Centre on the Macdonald College Campus. The strong protests from staff of the Department of Entomology, the Lyman Museum Committee and numerous entomologists across Canada were not enough to prevent this uprooting. However, the museum will nearly double its floor size and receive new systems, including a halon gas fire prevention unit, a walk-in fumigation unit, a dehumidification unit, a separate air-conditioning system, and an advanced security system. One room will be re-modelled and furnished to re-create as closely as possible the original Lyman Entomology Room, circa 1918. Lepidopterist Research Associate, Dr. E.G. Munro worked in the old Redpath Museum's "Lyman Room" in the late 1930s as an under-graduate and remains the museum's last link to the past.

In the coming years the Museum will strive to strengthen its public role and its role as a centre for taxonomic training and research in Québec. The greatest problems facing the museum are a lack of funds to obtain additional storage cabinets for specimens and of course a lack of staff. An organization the size of the Lyman Museum should have, at least, three full-time research scientists and two technicians. Ideally, one scientist should be a full-time curator. The present Curator must fit teaching, research, committees and curating into his schedule, as well as plan for the safe and rapid move of the museum to its new quarters. Renovations in the basement should be complete by the spring of 1988. No move of any part of the collection will take place until renovations are complete.

The Lyman Museum looks to the future with guarded optimism.

Keith Kevan is former Director of the Lyman Entomological Museum and Research Lab which is located on McGill's Macdonald College Campus in Ste. Anne de Bellevue, Québec. He is a specialist in orthopteran insects. Mike Sanborne is Curator of the Lyman Entomological Museum; he is a specialist in parasitic hymenopteran insects.

Zoological Collection Incunabula: *The Wied Brazilian Collection*

By Marie A. Lawrence

In the late 1860s a group of wealthy New York bankers and merchants began to organize a museum of natural history for their city. Their motivation and intent is best given in their own words:

Whereas, nearly all the capitals of Europe and more important cities in our own land, including Boston, Philadelphia, Washington and Chicago, possess instructive and valuable Museums of Natural History, while New York, notwithstanding its metropolitan position, is still destitute of such an institution. Resolved: that recognizing the necessity of such an institution as a means of recreation and education and desiring its establishment upon a scale comensurate with the wealth and importance of our great city, we have heard with satisfaction that the opportunity is now presented of securing by purchase in Europe, the largest most valuable collection of Natural History objects which has been offered for sale in many years. Resolved: that immediate action should be taken to secure this or some other collection as a nucleus of a great museum. (Kennedy, 1964, p. 42.)

The "largest most valuable collection" referred to was that of Prince Maximilian Wied, whose heirs offered his collection for sale after his death in 1867.

Maximilian Wied's Travels

Maximilian Wied was born in 1782 into a family of the lesser German nobility. Raised in a spirit of late 18th Century classicism, he attended Gottingen University where he was attracted to the study of natural history. After meeting Alexander von Humboldt, he became interested in the New World and particularly in South America (Wied, 1952).

Wied was among the earliest European naturalists to visit Brazil after the colony was opened to non-Portuguese in 1808. The colony had been closed to all but the Portuguese for almost 200 years in order to control its mineral wealth (Avila-Pires, 1965). Wied arrived in Rio de Janeiro in August 1815. He traveled about the state of Rio, then progressed to Espirito Santo and Bahia. He explored inland and southwest through the forest to the frontiers of Minas Gerais and later moved north over the Conquista range, across the Rio Contas. Finally he trekked east to the Atlantic coast, returning to Europe in 1817 (do Amaral, 1931). Throughout his travels he collected mammal, bird, fish and botanical specimens. He also learned the languages and customs of the native Americans he encountered.

Maximilian Wied's Collections

The animal specimens were described by the leading naturalists of the day: Schinz in Berlin, Geoffroy in Paris, Kuhl at Frankfort, and Temminck at Leiden. Wied himself published descriptions and plates of some of the new material (Avila-Pires, 1965). Some of the specimens described by others remained at the institutions of the describers. Others were returned to him and retained in his private collection. As was customary at the time, Wied's private collection was available to scholars during his life.

The American Museum of Natural History – Early Stages

It was this private collection, offered for sale at Wied's death, that the Trustees of the nascent American Museum of Natural History purchased for approximately $7,500 (Annual Report, 1870). The collection consisted of 4,000 mounted birds, 600 mounted mammals, and about 2,000 fishes and reptiles, mounted and in alcohol (American Museum Accession Records). It "contained a large number of types, the result of the Prince's explorations in South America...." A "full and complete catalog" was furnished with the collection (Blodgett Report to the Board, 1871).

The entire collection was placed on exhibit when the museum opened to the public in 1870. The same year the following statement appeared,

We have now reached a point when it would be questionable policy to purchase any large collections of mammals or birds entire as a great portion of such a purchase would only furnish us with duplicates. (Annual Report, 1870.)

From 1870 to 1883 while following an active program of acquisition through gift and purchase, all duplicate specimens were exchanged with other institutions. According to notes in the collection catalog, some of the Maximilian specimens were discarded at the time of accession. Most of these seem to have been duplicates of specimens in the Verreaux, Vardy or Ward collection also obtained in 1869.

The founders regarded the museum as: "a source of instruction for the artisan and laboring classes of our citizens, and the pupils of our public schools, whom it is our special desire to benefit." (Annual Report, 1880.)

They thought research should "*be left to the Europeans*" (Kennedy, 1968). They were businessmen who considered natural history a cultural adornment. They understood applied science but not the concept of basic research. However, the "*artisan and laboring classes of our citizens*" were not attracted to the museum as the founders had hoped.

Morris Jesup, a member of the committee that studied the problem, offered a plan for improving the institution. He was promptly made president and he set about a broad program of revitalizing the museum. While preparing his report, Jesup had visited museums in the United States and abroad and had absorbed the current ideas about exhibition and research. His program included improvements in the exhibitions and the development of research.

Jesup tried to make the exhibits more attractive and toward that end had all the mounted specimens remounted on uniform cherry wood bases. When the Maximilian specimens were transferred to the new stands, the original labels were not retained. Where labels had been present, the information on them was transcribed into the museum collection catalog. Not all Maximilian mounts had original labels, and locality data for some was transcribed from the original Mazimilian catalog. The museum collection catalog bears only the notation "No label" for many of the Maximilian specimens.

Jesup promoted scientific research. J. A. Allen, a former student of Agassiz, was appointed Curator of Mammals and Ornithology in 1884 with the understanding that he develop research (Sloan, 1980), which he did. Care of the collections also developed.

Allen's first Annual Report in 1885 notes that the mounted skins and skeletons "*were free of insect pests and neatly mounted*" and that "*all of the Maximilian specimens had been remounted on cherry stands.*" Fifteen years later Allen's Annual Report observes, "*While taxidermy is good, specimens have become greatly faded from long exposure to light. This is true of nearly all the specimens purchased in 1869. Some were mounted long before 1869 and the additional exposure to strong light has...greatly affected their original color.*" He continues fatalistically that "*these conditions were inevitable as the specimens must be shown notwithstanding the deterioration.*"

In 1910, he refused to have a sea otter skin mounted for exhibition, for he was, "*reluctant to have unique specimens mounted for exhibition, for the reason that they become practically valueless for scientific investigation, and quickly deteriorate under the bleaching effect of the strong light they are subjected to in the exhibition cases*"

(Archives, 13 October, 1910)

About the same time, the fall of 1910, we find in the Archives the first expression of regular concern about fumigation. Allen reported to the Acting Director that the large skins in the study collection have been inspected and given a treatment of bisulphide of carbonate (carbon disulphide). He adds that in order to secure their safety in future, it seems necessary that a careful examination of specimens be made once a month (Archives of Mammal Department).

In 1912, a request for bisulphide of carbonate "or some insecticide for poisoning some of the specimens on exhibition and also those upstairs" appears in the correspondence from J. A. Allen to the Director. Budget requests for bisulphide of carbonate appear regularly for the next 5 years. Napthaline, as well as bisulphide of carbonate, appears for the first time in 1917.

Requests for metal storage cases started in 1915 and continued until 1917. The earlier requests merely observe that such cases are necessary for safeguarding specimens. The 1917 request is explicit.

We have already had rare and expensive specimens...destroyed or badly damaged in these cases despite careful attention and placement of insecticides.

(Allen to Lucas, 20 April 1917 Museum Archives)

The request for metal, insect-proof cases was granted in 1917. Notations in the collection catalog dated March 1916 indicate that 18 Maximilian specimens were discarded on this date. I have not been able to determine whether they were discarded because of insect damage or exhibition deterioration. Insect-proof metal cases continued to be installed until the Depression.

Henry F. Osborn had succeeded Jesup in 1908 as President. His tenure was characterized by nationally publicized expeditions that appealed both to the general public and the wealthy donor (Kennedy, 1968). Until 1933, when Osborn retired, money was also made available for care of the collections.

The American Museum of Natural History – Since the Great Depression.

The museum's income dropped sharply during the Depression. The philosophy of Osborn's successor, Roy C. Andrews, was that with dwindling resources the Trustees must choose between supporting scientific research or aiding public education in the form of exhibits (Kennedy, 1968). He recommended early retirement of scientific staff, salary cuts and curtailment of scientific publications. The Trustees followed this policy from 1933 until 1940. During this period the emphasis was on new exhibitions. An administrative note dated June, 1937, to Harold Anthony, who had become chairman of the Mammal Department in 1921, recommended that the department dispose of mounted mammal specimens "*as expeditiously as possible by sale, gift or otherwise.*" From the late 1930s into the 1940s, specimens were offered to and accepted by colleges and small museums. Notes in the collection catalog indicate that Wied specimens went to Dartmouth, Barnard and the Irvington Children's Museum in March 1941.

The Brazilian mammalogists, Fernando de Avila-Pires, published a paper in 1965 reporting his search for the Maximilian Brazilian Type Specimens. He found or designated 7 Types in the American Museum collection in a total of 38 skins and 16 skulls. Twenty years later, I found a total of 361 Maximilian specimens listed in the museum collection catalog. Six hundred mammal specimens had been accessioned. Only 29 specimens of the total Maximilian collection are annotated as discarded and 16 as given away. This leaves a total of 245 specimens, or 41% of the original collection unaccounted for.

The collection catalog lists Brazil as the locality for only 37 specimens. Two of the 37 are listed as discarded and 3 listed as given away, leaving a catalog count of 32 Brazilian specimens in the collection. I was able to find only 21 of these. This includes the 7 Type Specimens listed by Avila-Pires and 14 specimens in the general research collection. It is clear that not all discards and gifts were noted in the collection catalog. Dartmouth College acknowledged the gift of 1941 by returning a listing of material they had received (Archives of Mammal Department). Two of these specimens had not been listed in the catalog as gifts.

The original mammal catalog made by Prince Maximilian, and cited in the collection catalog, is also missing. I have not been able to locate this catalog and no one currently on staff remembers ever having seen or heard of it. The Herpetology Department has the Maximilian Wied catalog of reptiles,and his original catalog of the birds is housed in the Rare Book Room of the American Museum library. There does not seem to have been a catalog of fishes.

One hundred and seventy years after the end of Maximilian Wied's trip to Brazil and 118 years after the collection arrived at the American Museum of Natural History, 56% of the Brazilian mammal specimens remain in the collection. Twenty-one of the 37 mammals originally catalogued from Brazil can be found in the collection. Seven of the 21 are Type Specimens. The mounted skins are bleached, faded and in fair to poor condition. The bats have suffered the most damage and are fragile in the extreme. Most were originally mounted with wings at full extension and were particularly vulnerable.

Zoological Incunabula

"Incunabula" usually prompts images of the works of Gutenberg and Schoeffer or vellum manuscripts with handsome illuminations. *Webster's New International* defines "incunabula" as (1) "a cradle period or state of beginnings" and as (2) "works of human industry of an early epoch". The 19th Century was certainly the state of beginnings for the research museum. Collections such as the Wied Brazilian collection which document geographic exploration, new species, the founding of a museum and even 19th Century taxidermy are records of human industry in biological science. These specimens are zoological incunabula. Though we can not undo what has happened to these collections, we must find ways to prevent further destruction to them and to other collections. Make no mistake, the same errors are being made today.

Natural History Collections Are Still in Trouble

A recent survey found that 38% of the collections in systematics have no fire protection, 42% no water damage protection, 17% no protection against pests, 50% no temperature control, 64% no humidity control, and 22% no protection against theft or vandalism.

(Chairman's Report
House of Representatives Committee
on Science and Technology
December 1986)

No present-day policy-maker would suggest that research is best carried out in Europe. Many *do* think that research is done only with a centrifuge or a computer. Policy-makers still ask, what is the point of research collections? With changes in the economy, redirection of priorities in university and government programs, many small collections are imperilled.

Research collections, such as exist in museums, contain the only record readily available for study of life on earth before, during, and after events such as the industrialization of society. The specimens found in a museum collection provide the opportunity to refer back to a time and place in history. One cannot predict which specimen will ultimately be needed and when, but if preserved, they will be available when needed. Museums are the keepers of knowledge about the biota. They contain the biological inventories and the baseline ecological, historical and evolutionary information on which future studies must be based.

(Chairman's Report
House of Representatives Committee
on Science and Technology
December 1986)

To condense and paraphrase Representative Fuqua cited above *Early collections contain the biological inventories and baseline data on which future studies must be based and require special protection against natural and special hazards. Collections of any kind require special protection against natural hazards and the special hazards that can lead to destruction of a collection.*

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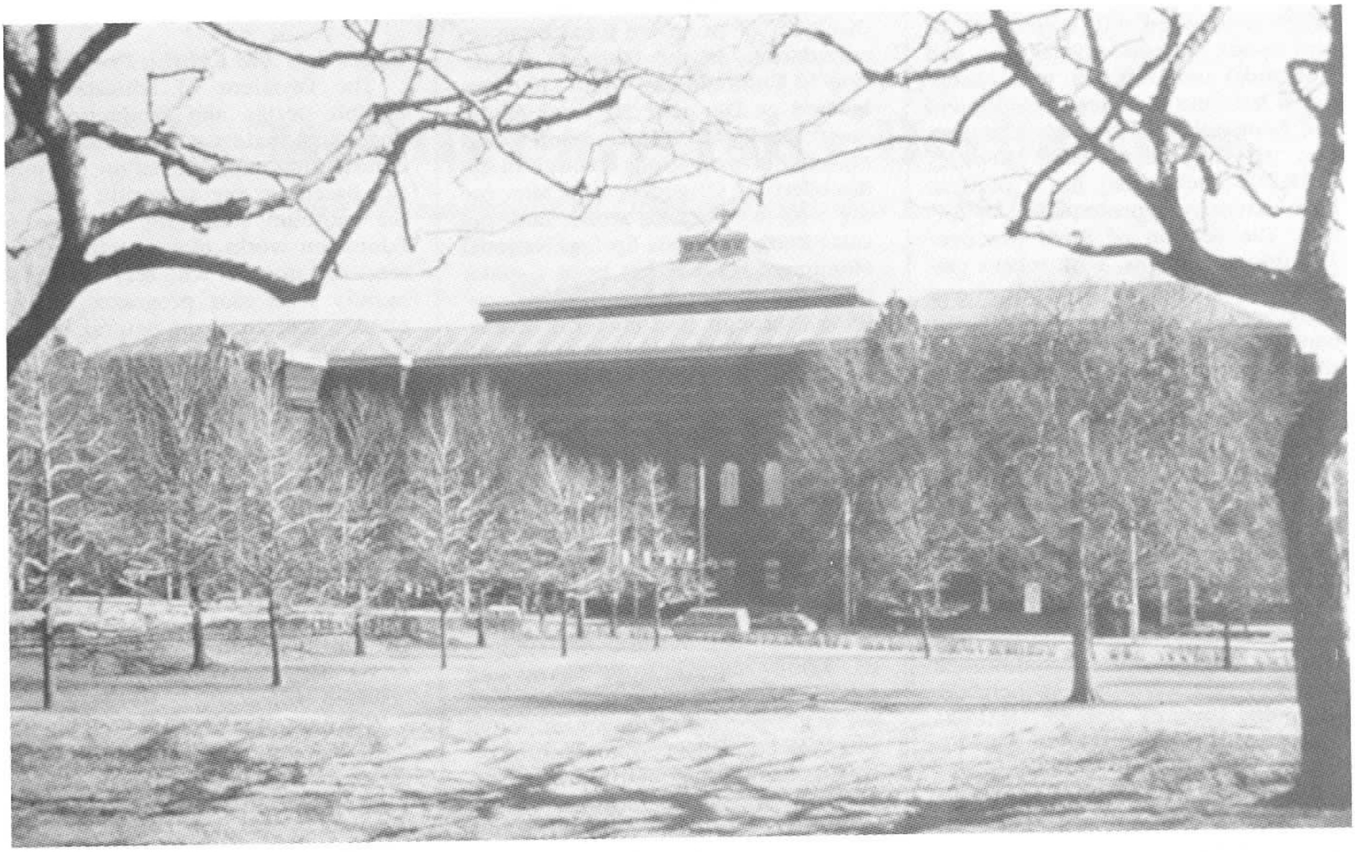
The Natural History Museum of the Carnegie

An American institution holding impressive natural history collections



By John E. Rawlins, Duane A. Schlitter and Stephen L. Williams

The Carnegie Museum of Natural History (CMNH) is but one of five components of The Carnegie, a private, non-profit, educational institution in Pittsburgh, Pennsylvania. The Carnegie opened to the public in 1896 through the philanthropy of Andrew Carnegie, the Pittsburgh steel magnate. In addition to the Natural History Museum, The Carnegie includes the Museum of Art, the Carnegie Library of Pittsburgh, the Music Hall, and the recently acquired Buhl Science Center and Planetarium. Most of The Carnegie is situated between the campus of the University of Pittsburgh and that of Carnegie Mellon University in Oakland, about three miles east of downtown Pittsburgh. The Carnegie is dedicated to the understanding and enjoyment of literature, art, science and music. The Carnegie collects, preserves, interprets and exhibits objects from our natural history and cultural heritage, and tries to make its collections and resources available to the widest possible audience. It is committed to providing public programs that educate, excite, entertain and inspire. As one of America's great cultural centers, The Carnegie serves all the residents of its region as well as national and international audiences.

Facilities of the Carnegie

The staff of The Carnegie Museum of Natural History includes 75 full-time members, 45 part-time workers, and over 300 volunteers and Research Associates. Public exhibit and education programs at CMNH serve about 595,000 visitors each year. In addition to a main museum building in Oakland, CMNH includes the CMNH Annex and Powdermill Nature Reserve. The Annex, located two miles northeast of the main building, houses the mammalogy and anthropology collections. Powdermill Nature Reserve is located near Ligonier in the Allegheny Mountains about 50 miles southeast of Pittsburgh. The 2,085-acre research facility includes various natural and disturbed habitats as well as buildings for meetings, research activities, and staff housing. One of the larger bird banding operations on the Eastern Flyway is located there.

Scientific Programs and Collections

Scientific programs at CMNH belong to three Divisions: Life Sciences, Earth Sciences, and Man. The Division of Life Sciences contains five Sections: Botany, Invertebrate Zoology, Amphibians and Reptiles, Birds, and Mammals. The Division of Earth Sciences includes the Sections of Mineralogy, Invertebrate Fossils, Paleobotany, and Vertebrate Fossils. The Division of Man contains the Section of Anthropology with a strong program in conservation.

The five research collections in the Division of Life Sciences are among the largest in North America. All of these collections are of regional, national, and international importance due to their diverse taxonomic representation and worldwide geographic coverage. All serve as repositories for valuable type specimens. In addition to major holdings from the Nearctic Region, most of these collections have excellent representation from the Neotropical and Ethiopian regions.

The Section of Botany includes 550,000 herbarium sheets with emphasis on local and Holarctic floras. The Section of Invertebrate Zoology contains almost eight million specimens, subdivided into collections of Arthropoda (insects, crustaceans, and arachnids) and Mollusca, with exceptional holdings in African Lepidoptera and Neotropical gastropods. The Section of Amphibians and Reptiles (158,000 specimens) has a particularly extensive representation of turtles. The Section of Birds has over 180,000 specimens, with recent emphasis on anatomical specimens and skeletons. The Section of Mammals contains 96,000 specimens, and has an active program in specimen conservation.

The Division of Earth Sciences includes the systematic collections for Mineralogy, Paleobotany, Invertebrate Paleontology, and Vertebrate Paleontology. Each of these collections is significant in its own way, with histories dating to the turn of the century. The mineral collection was initially started in 1899, and during the past two decades acquired additional materials that were used to help develop the recently installed Hillman Hall of Minerals and Gems. The paleobotany collection has also grown sporadically from field work and various acquisitions, and in recent years has developed a special interest in palynology. The collection of fossil invertebrates began in 1903 when the Bayet Collection of North American and European fossils was acquired. The collection has continued to grow by acquiring other equally important material.

Growth and development of the collection of fossil vertebrates was initiated through the personal involvement of Andrew Carnegie. He was particularly interested in dinosaurs and was primarily responsible for the early work in Wyoming, Colorado, and Utah. This work resulted in discovery of extensive fossil bone accumulations in the Morrison Formation in Colorado and Utah, later designated as Dinosaur National Monument. During the same period, fossil mammal investigations resulted in the discovery of Oligocene and Miocene deposits in Nebraska, which later became known as Agate Springs National Monument. CMNH has been a major influence in North American paleontology through its long-term investigations, particularly in the Appalachians, Utah, Wyoming, and the Canadian tundra.

The Section of Anthropology includes specialized collections for archeology, ethnography, and historic items. The archeological collections were started in 1896 with the first of many excavations from the Upper Ohio Valley which have resulted in the accumulation of over five million specimens. This material, in additon to 4,000 objects from Egypt and 6,000 objects from Costa Rica, forms the major portion of the anthropological collection. The ethnographic collection contains about 100,000 items, primarily from the Southwest, Plains, and Northwest Coast regions of the United States, the Pacific region, and Africa. The historic collection consists of 125,000 objects including coins, stamps, dolls, watches, costumes, guns, and transportation items. Much of the current acquisition to these collections result from research and excavations at historic sites in downtown Pittsburgh and at archeological sites in western Pennsylvania, Martha's Vineyard, and the Caribbean. The activities of this division also include care of special objects conducted by the Conservation Department's laboratory.

Education and Exhibit Programs

The Divisions of Education and Exhibit Design and Production produce and maintain educational and entertaining experiences for the public, based on the scientific work of the museum staff. The Division of Education works closely with volunteers and docents who serve the community with tour programs, special classes, and loans of natural history materials from the teaching collection. The Division of Exhibits is responsible for planning, development, and maintenance of permanent and temporary exhibits. The staff is experienced in exhibit construction, audiovisuals, taxidermy, photography, graphics, art work, and other specialized activities. The most recently completed exhibits, such as the Hillman Hall of Minerals and Gems and the Polar World: Wyckoff Hall of Arctic Life, display many objects from research collections.

In addition to the research, education, and exhibit programs of CMNH, there are a variety of other resources and opportunities. For instance the CMNH maintains its own library that complements the holdings of The Carnegie Library and libraries of local universities, but emphasizes natural history publications. The CMNH also conducts an international program that supports museum specialists from other countries that have an interest in working at CMNH to enhance their professional stature. These are only some of the other features of the CMNH.

John Rawlins is Chairman of the Division of Life Sciences of the Carnegie Museum of Natural History. Duane Schlitter is Curator of mammals and Steve Williams is Collection Manager of the collection of mammals.

The McGill University Herbarium

The development of Québec's eminent herbarium

By Marcia J. Waterway

Houses, stores, office buildings, and more than two million people occupy the Island of Montréal. It is very difficult to imagine what it must have been like before urban development. Thanks to the efforts of a Montréal physician in the 1820s and the curators of McGill's Herbarium since that time, we can reconstruct the scene quite well. Dr. Andrew F. Holmes (1797-1860), first Dean of McGill's Medical Faculty and one of the founders of the Montréal Natural History Society botanized the Montréal area intensively from 1820 1825. His collection from Montréal of more than 500 species remains in good condition in the McGill University Herbarium today. Holmes' specimen labels include such localities as Mount Royal, Papineau woods, a "swamp" on St. Denis St., Cote St. Paul, Boucherville Island, Nun's Island, Cote St. Henri, Grey Nun's Court, Rivière St. Pierre, and Savanne, St. Michel. Many of these habitats have changed completely and many of the plant species no longer grow in Montréal. "Savanne", a Québecois term for swamp, was actually a rich peatland area in the northeast part of the island from which Holmes gathered several ericaceous shrubs including rhododendron and cranberries, the insectivorous pitcher plant, and 4 species of bog orchids, including the very rare ram's head orchid, *Cypripedium arietinum* . Holmes also collected several other species now on the rare plant list for Québec including *Armoracia aquatica* (an aquatic relative of horseradish) from Gregory's Creek and both *Panax quinquefolium* (ginseng) and *Taenidia integerrima* (yellow pimpernel) from Mt. Royal.

The Beginnings

The McGill College Herbarium was founded in 1856 with the gift of the Holmes collection and that part of Sir William Dawson's private herbarium not destroyed in the Burnside Hall fire of 1856. James Barnston who curated the newly established herbarium from 1857 until his untimely death in 1858 catalogued the Holmes specimens, noting that *the present collection also derives additional interest from the circumstance that it affords many localities of species which have become locally extinct, owing to the progress of cultivation and the extension of the city* (Barnston 1859). This was written less than 40 years after the plants were collected and it is certainly true today.

From its founding until about 1912, the herbarium was very active. Under the directorship of Principal Dawson and later under D.P. Penhallow who replaced Dawson in the Chair of Botany in 1883, many specimens were added through active collecting, research, and exchange programs with other institutions. Collections added during this time reflect the history of exploration both in Canada and worldwide. An important set, about 3600 sheets, is that of John Macoun, Chief Botanist with the Geological Survey, who collected plants on his many expeditions across Canada. Other 19th Century collections at McGill include those of T.J.W. Burgess (5500 sheets, eastern Canada), Rev. Robert Campbell (3000 sheets, Canada-wide), H.H. Lyman (1000 sheets, Canada-wide), George Barnston (720 sheets, northern Rocky Mountains), A.A. Heller (1200 sheets, Hawaii), and C.G. Pringle (2100 sheets, Mexico and Pacific Northwest). Women were also botanizing the frontiers at this time. Marion Moodie's collection of 750 plants from the Calgary area in 1892 gives us an idea of the native prairie plants that once grew in areas now intensively cultivated. A collection of 700 specimens from Labrador was made by a Miss Brodie in 1863 while Mrs. Crawford collected several plants from Ungava in 1875-76. How these collections came to MTMG is not known.

The earliest Arctic collections in the herbarium are those collected by James Anderson in the Northwest Territories. Although not finding many traces of Franklin's ships, H.M.S. *Erebus* and H.M.S. *Terror*, Anderson did make notes about the plants that he saw and pressed some of them into his field notebook while searching for relics of the ill-fated Franklin expedition of 1845. About 115 of his collections from the Great Fish River (Back River) on this 1855 expedition and from a previous trip on the Mackenzie River in 1852 are now at McGill. This is not the herbarium's only connection with the *Erebus* and *Terror*. These chips were chosen for Franklin's 1845 Arctic voyage because of their excellent performance in icy seas during Captain James Ross' expedition to Antarctica (1839-43). Dr. David Lyall collected natural history specimens on Ross' journey and eventually duplicates of 60 of his botanical specimens from such places as Fiji and the Falkland Islands found their way to the McGill Herbarium, probably on exchange during the Penhallow period.

When F.E. Lloyd took over the Chair of Botany in 1912, the scientific emphasis in the department shifted and the herbarium remained relatively inactive until the 1950s. It was moved from the Redpath Museum to the new Biology building in 1922. The valuable collection of the Montréal Natural History Society was added to the herbarium about 1925. This collection of 8000 sheets contained many interesting 19th Century specimens and was one of three herbaria used by John Macoun in compiling his 1883-1902 *Catalogue of Canadian Plants*. Others were in his personal collection, now at the National Museum of Natural Sciences in Ottawa and the McGill College Herbarium. Unfortunately, many of these, along with several other unmounted collections, were damaged because the herbarium was not properly curated during this time. Specimens were stored in boxes under the conservatory and many were destroyed by water or mold.

A New Beginning

The McGill Herbarium became active again in the early 1950s under Muriel Roscoe and David Erskine. During the curatorship of Paul Maycock from 1957-1968, the size of the herbarium doubled as he and his graduate students in plant ecology deposited vouchers from their research work. The staff of the herbarium was increased during this time to clean, remount and catalogue the specimens that had accumulated during the years of neglect. Shortly after the resignation of Maycock, the herbarium was moved to the Macdonald Campus to be combined with the herbarium there.

The Macdonald College Herbarium had been established in 1907 as a teaching collection with the purchase of 1000 John Macoun specimens from the Ottawa District. Many Québec specimens were added during the 1930s as vouchers for a pasture survey carried out by the Agronomy Deparment. Dr. Dorothy Swales participated in this project and co-authored several papers on plant distributions in relation to soil types as well as a very useful guide to identifying grasses by their vegetative characteristics (Nowosad *et al.* 1936).

Emphasis On Arctic Regions

Dr. Swales returned to the herbarium as Curator some years later and became interested in Arctic plants. Her yearly journeys to the Arctic to study pollination and collect specimens resulted in a growing Arctic collection and provided numerous duplicate specimens for exchange. She began exchange programs with the Komarov Herbarium in Leningrad, the Botanical Museum in Copenhagen, and the Natural History Museum in Sweden. As a result, the herbarium developed good representations from Siberia, Lapland, and Greenland as well as the Canadian Arctic. A particularly interesting set of 49 sheets collected from the Russian Arctic islands, Novaya Zemlya, in 1891 and 1895 was given in return for a collection of Arctic lichens sent by Dr. Swales. The note arriving with these specimens indicated that these islands are now closed to all except Russian bomb-testing personnel. Over the past 20 years many researchers, including those studying birds, mammals, and insects, were encouraged to bring back plants. Also, priests, nurses and other service personnel in the North were persuaded by Dr. Swales to collect plants for the herbarium. As a result, McGill probably has the only available specimens from some of the smaller Arctic islands, such as the Albert Islands, Prince Albert Sound, and Digges Islands off the Ungava coast.

The amalgamation of the two herbaria in 1972 resulted in a very strong collection of arctic and subarctic plants by combining those recently amassed by Swales with the historical 19th Century collections and the numerous sets of voucher specimens from northern sites collected by members of McGill's Departments of Biology, Geography, and Renewable Resources during the course of their studies in the North. The current arctic and subarctic collection is filed separately within the herbarium and remains a valuable reference for confirming identification of northern plants.

Other research programs are also vouchered by specimens in McGill's Herbarium. Dr. W.H. Brittain studied the systematics of birches across Canada, collecting over 1000 sheets that are now filed in the herbarium. This collection is important for many of the specimens are also represented in the living collection of birches growing in the Morgan Arboretum at Ste. Ann de Bellevue. Other groups which are well-represented in the herbarium because McGill researchers have studied them, include *Carex*, *Centaurea*, *Euphrasia*, *Lotus*, and *Urtica*. Voucher specimens from breeding programs in barley, forages, and high-bush blueberries have also been deposited at McGill. Staff and students in the Department of Renewable Resources have studied the food plants of various insects and mammals. Many students have also made floristic studies locally and at McGill's field stations in Schefferville, Mont St. Hilaire, and Barbados in the Caribbean.

The Herbarium Of Today

The McGill University Herbarium today has over 130,000 specimens and an active program of research and exchange. The holdings document past and present research at McGill and in turn provide the raw materials for research in plant systematics and floristics. Over the past ten years, about 100 loans have been sent out to specialists in Canada, the United States, and Europe. In some cases, the specimens have been used for mapping plant distributions and compiling floras, particularly for Arctic regions. They have also been used for preparing rare plant lists for Ontario and Québec and for studying changes in the distributions of both rare and weedy species. The majority of the specimens, however, have been loaned for monographic and revisionary studies of about 40 different genera. Researchers at McGill have also borrowed specimens from other institutions for their work in plant systematics, cytogenetics, morphology, ecology and weed biology. Over the past 10 years 125 loans have been processed through the herbarium and 65 are presently being used by McGill researchers in conjunction with cytogenetic and chemotaxonomic investigations. Although modern systematists use a variety of techniques for assessing evolutionary relationships, the results of this research must still be related to the patterns of variation found in nature. Pressed specimens, accumulated over the past 200 years, remain the most readily available source of information on structural variation and geographic distribution. The McGill Herbarium is being actively used and is expected to grow as vouchers are deposited not only from systematic and ecological research, but also to document source material in physiological and molecular studies.

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Marcia Waterway is Curator of the McGill University Herbarium which is located on McGill's Macdonald College campus. The Macdonald College campus is a short 30 minute drive from the downtown Montréal campus of McGill University.

Mont St. Hilaire Montreal's Scientific Reserve

A mountain for scientific research

By Martin J. Lechowicz

In 1609 when Samuel de Champlain sailed up the Richelieu River past Mont St. Hilaire, he noted that the area was entirely forested and devoid of settlement because the river had long been a transportation corridor used by warring Indian tribes. It was only in 1665 with the arrival of the Carignan-Salieres regiment that European settlement of the Richelieu Valley began and even then Mont St. Hilaire remained little exploited because of its rugged topography. Mont St. Hilaire, like Mont Royal, is one of the eight Monteregian Hills that rise so strikingly from the floor of the St. Lawrence valley in the vicinity of Montréal. Mont St. Hilaire originated some 100 million years ago as a series of three igneous intrusions into the Lower Paleozoic sedimentary bedrock of the St. Lawrence Lowlands. Subsequent glacial cycles and erosion have left the relatively resistant essexites and nepheline syenites that form the core of the mountain standing some 250 meters above the Pleistocene sediments of the present valley floor. Wave-cut terraces on the outer slopes of the mountain originated during the most recent deglaciation when Mont St. Hilaire was briefly an island in the Champlain Sea. Today the mountain remains almost entirely covered by old-growth forest, undoubtedly the best preserved remnant of native vegetation in the Montréal region. Twenty-five species of rare and endangered vascular plants grow on Mont St. Hilaire, including the only Québec site for the showy milkweed, *Asclepias exaltata*.

Ownership of Mont St. Hilaire

From 1694 until 1844 the mountain was held by the Hertel family, and then passed into the hands of the Campbell family. During the latter half of the 19th Century, the mountain was a rather famous tourist attraction known for its unspoiled landscape and magnificent view of Montréal. Brigadier Andrew Hamilton Gault acquired the mountain in 1913 and used it as a summer retreat for the next 45 years. He especially valued its wild beauty and, with the exception of some selective cutting to raise funds for his Princess Patricia regiment in the First World War, he continued to preserve the mountain in its near pristine condition. It was good fortune that on the death of Brigadier Gault in 1958, the stewardship of the mountain passed to McGill University. His bequest called for the continued preservation of the mountain *...as a great heritage for the benefit and enjoyment of the youth of Canada*. The university has subsequently maintained the Gault Estate Reserve at Mont St. Hilaire essentially as an outdoor museum, a nature reserve dedicated to scientific research and public education. In 1978 the mountain also became the first UNESCO Biosphere Reserve in Canada, a clear mark of its international scientific significance.

Scientific Surveys

Because of its distinctive characteristics and proximity to Montréal, Mont St. Hilaire has long been a focal point of scientific interest. As early as 1860, Sterry Hunt published a treatise on the geology of the mountain in the *American Journal of Science*. Sir William Dawson, McGill's first principal and founder of the Redpath Museum, published on the singular geology of the mountain and it was the site of an excursion from the 1913 International Geological Congress. The early botanical interests of Frere Marie Victorin, author of *Flore Laurentienne* and founder of the Jardin Botanique de Montréal, were formed on the mountain and he always maintained a special appreciation for its distinctive flora (Marie Victorin 1913). There was an excursion to the mountain by attendees of the International Botanical Congress which was held in Montréal in 1959.

Immediately after the university acquired Mont St. Hilaire, a survey was initiated that resulted in a series of publications describing the flora and fauna of the mountain. Maycock (1961) gives not only a flora for the mountain but also a description of its vegetation, geology and physical characteristics. Ouellet and LeBlanc (1967) list 248 bryophytes growing on the mountain and discuss their ecological distribution. Denmann and Lapper (1964) describe the herps and Mackay (1969) the aquatic insects found on the mountain. Daily climatological records were kept on the mountain during this period as well (Baird 1967).

Because of the long and active tradition of geological research, the mountain is well known to geologists and mineralogists. Over 130 minerals have been collected at Mont St. Hilaire, especially from the small quarry on its eastern flank (Sabina 1983); the mountain is recognized as one of the world's ten most mineral rich sites. Since the acquisition of the mountain by the university, dozens of papers and many theses on its geology and mineralogy have been written through the Departments of Geology and Mining and Metallurgical Engineering. In addition, an Institute of Mineral Industry Research was established on the mountain in 1968 and maintained an active research program through the early 1980s.

The other main stream of research on the mountain during the past 25 years has originated in what are now the Departments of Geography and Biology. These studies range from long term records of population dynamics in small mammals to similar records for understory plants, and from descriptions of forest microclimate to analysis of the relation between microclimate and vegetation. The large number and diversity of such investigations preclude their summary here, but Levy and Lechowicz (1987) provide an annotated bibliography of all publications based on research at Mont St. Hilaire.

Future Outlook

Currently the prospects for continued research use of the mountain look promising. The old Institute of Mineral Research has been partially renovated to serve as the Mont St. Hilaire Research Centre. The Centre houses laboratory, offices, and some accommodations for those doing research on the mountain. In the past year there were in excess of two dozen professors, students, and research assistants engaged in research on the mountain. Irrigated experimental gardens, a screened exclosure for growing plants in the absence of pollinators, and a tree nursery have been established adjacent to the Research Centre. The university's commitments to stewardship of the mountain remain firm, and new land along the perimeter of the property continues to be acquired. The use of the mountain as a research site by investigators outside McGill is being actively encouraged, and an opportunity exists for collaborative research with Chinese scientists under the UNESCO MAB program. This current activity, the essential responsibility of universities to help preserve remnants of our natural ecosystems for scientific study and the increasing importance of research reserves and field laboratories for biological research all justify the university's continued commitments to this "outdoor museum".

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The Morgan Arboretum and Woodlands

An important living collection of trees and plants

By A.R.C. Jones

The Morgan Arboretum occupies a 240-hectare tract of forested land forming the northern portion of the Macdonald campus at Ste. Anne de Bellevue, Québec. The property is administered by the Faculty of Agriculture of Macdonald College of McGill University and operated by the non-profit Morgan Arboretum and Woodland Development Association. While the Arboretum remains the property of McGill University, nearly 100% of its operating budget comes from non-university sources, in particular, membership fees of the Morgan Arboretum Association and from sales of various products and services.

The Arboretum is in the Great Lakes-St. Lawrence Forest Region, thus its natural forest associations are dominated by tolerant hardwoods, such as maple, beech, red oak, ash, eastern hemlock and white pine. Soils are mainly alluvial with, in places, quantities of glacial drift or sand. There are wide variations in soils and vegetation. Besides use as an outdoor teaching laboratory, opportunities for research activities are provided by a variety of natural forest ecosystems, a number of planted stands of both coniferous and deciduous tree species, a collection of native Canadian trees, a Canada-wide group of white birches, and local flora and fauna. A unique aspect of the Morgan Arboretum is the presence of such a variety of natural and artificial forest ecosystems within 40 km of the centre of a large city – Montréal.

Uses Of The Arboretum

The principal users are staff and students of the Faculty of Agriculture, McGill University, and John Abbott College, C.E.G.E.P. (College Enseignement General et Professionnel) staff and students in Forestry Technology, Biology and Outdoor Education. Others from Québec universities use it for specific projects. The arboretum is always available for use by *bona fide* researchers.

Much of the natural forest, which represents an unusually rich forest flora, has never been cleared for agriculture. It is the only arboretum which contains all the native trees of Canada. Research, teaching and demonstrations relating to many aspects of forest conservation occur concurrently with rational exploitation and intensive educational and recreational use. Despite having to finance its own activities, the facility is probably the most complete example of multiple-use forestry in North America. In 1986 the arboretum received the Ministére de l'Energie et des Ressources gold medal, category "Très Grande Mérite". Since the late 1940s it has been developed as a model of practical management methods for private forests and farm woodlots that includes both timber and maple syrup production. An active group of volunteer workers assist with the production and sale of products, educational tours, patrol and maintenance, fund raising, and staffing the Visitor Centre.

Arch Jones is a member of the Department of Renewable Resources at Macdonald College, located in Ste. Anne de Bellevue, Québec, a short 30 minute drive west of Montréal. There he teaches Forestry and Environmental Interpretation and is also a member of the Board of Directors of the Morgan Arboretum Association.

Teaching with Natural History Specimens

Experimenting with "hands on" teaching

By Mary Anne Dancey and Joanne G. Faber

An important advance in science education at the elementary and high school levels has been to design science *curricula* to expose students to "Hands-on science experiences". This method is designed to lower the proportion of students who drop science options because they are (a) too difficult and abstract and (b) considered irrelevant to an individual's everyday existence. Handling natural history specimens makes it easier to demonstrate relevance, interest and appreciation for the biological world around us. For example, it is hard to ignore the problems of acid rain and the resulting deformed animals. These "unseen" problems become very real to students when they realize that they are also being exposed to the same toxic dangers. Specimens which students can see, feel and examine closely have an impact that the printed word does not. One of the great rewards of educators is to observe students taking an active interest in the lesson at hand and coming to a realization that knowledge of science is important to one's well-being and survival. Science is no longer irrelevant for these students.

Acquiring Specimens

Certain specimens may be obtained from supply houses but purchasing them is very expensive. Educators must learn to be creative, foolish, and even ghoulish in the search for badly needed specimens. Cajoling and sweet talk also work; for example, our education programme at the National Museum of Natural Sciences was given a large piece of very poorly tanned moose hide from the neck and chest area over ten years ago. It is the inherent stiffness and not the constant handling for 10 years that has caused the fur to disappear along the fold lines. A new moose skin, or part hereof, has been requested for several years, but this year we finally obtained one thanks to a hunter and the Ontario Ministry of Natural Resources.

Even road-kills are a natural resource for us. Museum volunteers have responded to our cries of help by bringing in road-kills, for example, birds that fly into windows, bones (boiled and bleached) from Thanksgiving turkeys, and moles and voles that cats have caught.

Maintaining Specimens

Specimens for teaching cannot be left behind in classrooms. This practice results in constant handling and transporting from place to place. Handling of specimens by teachers and students in the classroom causes deterioration and breakage. As a result, a polar bear has false teeth, a grey squirrel has repaired ears, and a beaver has several false claws. It is interesting to note, however, that most young children handle specimens with great care and respect. Our caribou skin has survived ten years with at least thirty thousand children running their fingers through its dense fur. That skin is still very useful.

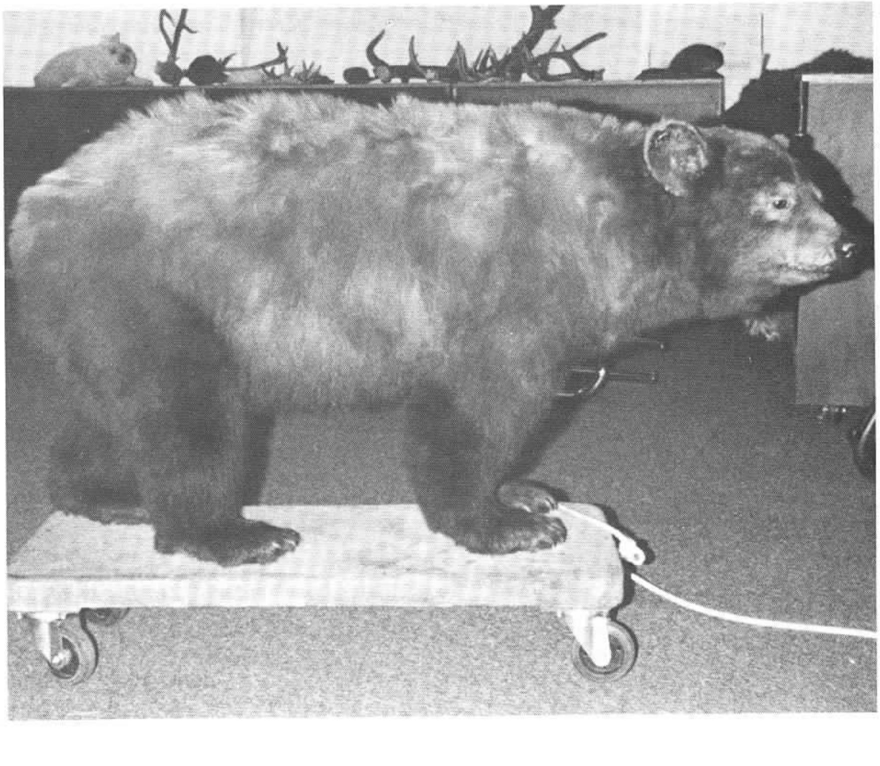
Replacing Specimens

It is inevitable that certain specimens will eventually need to be replaced. This presents a problem for those of us who are charged with finding replacements, for example, mammal pelts that have become embarrassingly bald, or bird mounts which can no longer be held together by glue and wire. We have been greeted by a certain lack of enthusiasm for our cause when a curator or a collection manager is asked for a specimen from the systematic collections. The mere thought of exposing a catalogued specimen to thousands of little hands must be enough to fill a research scientist with dread.

Storage of Specimens

Teaching collections must be onsite and readily available to classrooms. The specimens must be transported from one room to another, yet they must have a secure storage area. Specimens can not be left on open shelves in classrooms. This often requires giving up needed space for storage purposes. And finally the cost of shelving and cupboards in which to store and secure specimens is important to consider.

Mary Anne Dancey is the volunteer coordinator at the National Museum of Natural Sciences. Joanne Faber teaches natural history.



1987 Meeting Abstracts

The following are abstracts from oral and poster presentations at the 1987 Annual Meeting of the Society for the Preservation of Natural History Collections in Montréal, Québec, 31 May – 3 June, 1987.

Bone Cleaning by Burial

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A method for cleaning bones by burial has been used at the Redpath Museum, McGill University, for the past two years. The first experiment in cleaning with fossorial terrestrial vertebrates was a cervical vertebra of *Loxodonta africana*. There followed the skull of a rhinoceros (*Diceros bicornis*) and a gavial (*Gavialis gangeticus*). Small specimens, such as mice, were placed in plastic (yogourt) cups with lids and holes punched in the bottoms. Depth of burial depends on the size of the specimen to be buried. Another method, using terrestrial isopods, is also illustrated.

Training in the Care of Natural History Collections: Report on the Collections Care Pilot Training Program at the Natural History Museum of Los Angeles County

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The natural sciences lag far behind other disciplines in organizing formal training in the care of natural history collections with the goal of preserving each specimen's integrity for as long as possible. Recognizing this need, the Bay Foundation has funded a series of pilot training programs administered 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 Natural History Museum of Los Angeles County hosted the first program concerning the needs of natural history collections in a three week session early this year with a follow up in May. We present a brief history of this program, followed by an in-depth look at the curriculum and didactic techniques. Finally, based on strengths and weaknesses of this first program as discerned by the participants and consultants, we suggest directions for future training of natural history collections care professionals.

What is a Discovery Room

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Neither museum, nor library, nor laboratory, but rather a fusion of all three: a discovery room enables its users to learn about a given scientific, artistic or cultural field through the use of pedagogical materials which encourage active participation (examining, touching, handling). This particular project was inspired by several already existing rooms in North America: the Discovery Room ROM in Toronto, the Discovery Room of the Museum of Natural Sciences in New York, the "Herb Lab" in the Washington Zoo, *etc.* These rooms all have the common feature of providing an infrastructure favouring a dynamic approach to learning which calls for observation and experimentation.

The Insectarium of Montreal: A New Museum Devoted Entirely to Insects!

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The Montreal Botanical Garden is planning a new centre of attraction, to be located near its present headquarters buildings and greenhouses. In addition to displays of colourful and dramatic tropical insects, both living, pinned and in dioramas, there will be displays devoted to the insects of Québec. A section will be designed especially for children to allow them to handle and examine living specimens. Each display will be built around a theme – mimicry and protective coloration, for example. Visitors to the Insectarium are to discover the attractive rather than the repulsive aspects of insects. Ultimately, public awareness of the need for conservation of habitat, not only in Québec but everywhere, is the Insectariums ultimate aim. Few other Canadian museums have even moderate holdings of tropical insects, particularly the showy species that are attractive to the public, and hardly any are on display. The Insectarium will serve as a centre for their acquisition, preservation, as well as propagation.

Intrinsic Materials Which Accompany Natural History Collections

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Accessory materials often accompany acquisitions into natural history collections and may constitute scientifically or historically valuable portions of those collections. Intrinsic materials such as field notes, maps, diagrams, sketches, photographs, slides, correspondence, legal documents, bills of sale, customs receipts, and reprints have all been deposited along with natural history specimens and artifacts. Some of these accessory materials, such as specimens and artifacts of an accession, need to be culled and maintained for their scientific and/or historic value. Field notebooks should be treated as one-of-a-kind reference textbooks and kept in a restricted library. Field notes, maps, legal documents, correspondence, site diagrams and other sheet items can be protected by encapsu-

lating in clear plastic and placed in acid-free boxes or specially built cabinets. Also submitted as field notes are tape recordings and, more recently, computer discs. A workable documented cross reference system of these various accessory materials with their respective specimens and artifacts will insure their usefulness. Investigation photographs and illustrations may contribute as clues in future scientific discoveries. Reproductions can be made for research use, while originals stay stored in climate controled, archival areas. Occasionally, unusual packing materials and containers are found with specimens. Although of no scientific value, old newspapers and tins can be historically revealing.

The Care of Greasy Specimen Tags

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Greasy specimen tags are persistent and complicated problems with prepared mammal study skins. The breakdown and migration of residual organic compounds to the tag can cause irreparable damage to the paper and make data unrecoverable from the tag. Extraction of the organic compounds from the paper tags is one procedure that has been examined. Five standard museum specimen tags, 100% rag partially prestamped with printer's ink, were tied to a freshly skinned guinea pig (*Cavia porcellus*). The tags were tied from November 1986 through April 1987. Five organic solvents were tested for effectiveness and efficiency in the removal of the organic compounds from the tags. Tests were run before and after chemical extraction to determine how much of the organic compounds was removed and if the paper composition was altered. Additional research with other chemicals and also non-chemical methods needs to be examined to help control the greasy tag problem.

Review of Organizations and Resources that Serve the Needs of Natural History Collections

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Collection management practices have traditionally been learned and transmitted by on-the-job training and oral instruction. However, this system leads to a number of problems including repeatedly "reinventing the wheel" and reinforcement of inappropriate, even destructive collection practices. In order to correct this situation, a professional structure must exist for transmitting knowledge, for encouraging the development of new knowledge, and for critically reviewing new information. Such a structure would include professional societies, support organizations, and a body of literature. This paper summarizes a review performed to determine the extent of the professional structure which serves the needs of natural history collections.

The Development of Geological Specimen Conservation in the United Kingdom

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Until 1981 geological conservation in U.K. museums was extremely limited. There was minimal interest in developing the field to standards of conservation science and techniques seen in other fields, especially fine arts and archaeology. In 1981 a major review, the Doughty Report, caused recognition of the desperate need for conservation services. The Geological Curators' Group and other bodies, mainly the Area Museums Services (regional services), are developing policies and standards for the establishment of conservation services and staff recruitment and training. Fulfilment of these aims depends on a reassessment of professional and public attitudes and the establishment of approximate parity of funding with other subject areas such as fine arts.

Mechanisms of Shale Delamination

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Serious conservation problems caused by the delamination and powdering of shale have led to damage and/or destruction of important palaeontological material. Clay minerals previously identified as the cause of delamination were detected from the X-ray diffraction patterns of samples associated with liassic fossil speciments from Barrow-on-Soar, Leicestershire. Previous work investigating both water adsorption onto and intercalation into clay minerals with electric instability is reviewed. It is suggested that these could account for some of the problems encountered. Suggestions are made for the long-term conservation and storage of shale specimens.

The Habitat Groups of William H. Werner: A Significant Historical Collection

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The wildlife collection of William H. Werner must be considered significant because of its content and historical value.

The collection contains over six hundred, primarily avian specimens from the United States, Mexico, and the Bahamas. It was collected and prepared by Werner between the years 1865 and 1910. Werner has been considered to be the first American to produce "habitat groups" of birds or mammals. Most of his exhibits contain male and female specimens with their original nest, eggs, and/or juveniles. Also, they are enhanced by a painted background depicting the habitat in which the specimens were obtained. The value of each exhibit lies not only in its completeness, but also in its specimens. The collection contains extinct and endanged birds such as the Passenger Pigeon, Heath Hen, Carolina Parakeet, Ivory-billed Woodpecker, Red Cockaded Woodpecker, Whooping Crane, and Everglade Kite. X-rays of such specimens reveal much needed skeletal information as well as a possible "hidden" value for the entire collection. Aside from their inherent educational worth and biological data, historical collections such as William Werner's yield insight into preparation techniques of the past. Also because of their age, they serve as the best of all possible models, revealing the effects of time on museum specimens.

A New Look at Old Collections (Moving a Major Collection)

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Fossil specimens are fragile and often irreplaceable. Loss of records can negate their scientific value. Inherent in a major move are the dangers of serious damage to specimens, confusion and loss of specimens and/or information. These risks must be minimized. With relocation of the Tyrrell Museum of Palaeontology from Edmonton to temporary quarters in Drumheller and subsequently to a permanent building, the collection was moved twice in three years. Too little time was available for a complete inventory. However, careful planning, organization, attention to detail and careful supervision during the entire process lessened the longterm negative impact on the collection. The move was broken into five steps: planning, packing, moving, unpacking and relocation. In this way problems, staff needs, materials, *etc.*, could be dealt with separately for each step. Considered in a positive light, the move was an opportunity to reorganize and restructure collections and to allow for major longterm expansion.

The Development of a Low-Risk Storage System for Mollusk Collections

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Mollusk shells appear relatively indestructible but actually are subject to a number of deteriorating processes over time. In addition to mechanical damage, such as crushing, they are subject to chemical breakdown, as in Byne's Disease (a white crystalline overgrowth of a mixed salt of calcium chloride and acetic acid), and other environmentally related problems such as periostracal shrinkage/peeling, fading, dust- accumulating and other forms of specimen loss. In redesigning the storage for the mollusk collections at the Corpus Christi Museum, both recent and fossil (approximately 10,000 and 1,000 lots respectively), these factors were taken into consideration. Also considered were temperature, humidity, pH, vibration, atmospheric pollutants, and, in the case of alcoholic material, dehydration and preservative-related destruction. Since the Museum is located on the Gulf coast where severe hurricanes strike approximately once every three to five years, potential flood damage to collections was included. In addition, the problems of data/specimen separation and archival labeling were examined. Where possible, existing storage facilities were modified in-house to minimize cost, although some new acid-free storage supplies were designed and purchased. The entire storage and work area was rearranged to eliminate excess traffic, which had been both a security risk as well as a potential cause of acceleration of specimen deterioration through handling, light exposure, dust, potential pest introduction and humidity alteration. The process was realtively inexpensive but resulted in a much reduced risk of specimen loss from the collections.

Coordinate-Classification: A New Numbering System for Biological and Paleontological Collections

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The system uses a triple digit coordinate classification where the first number represents the phylum, the second number the class and the third number the order-group. The phylum digits range from 1 (*Archaeobacteria*) to 100 (*Chordata*) with increasing complexity. The number for class and order is variable within each phylum, but never exceeds 99. For example, the coordinate 84,6,1/xx classifies a specimen that belongs to phylum number 84 (*Mollusca*), is in the sixth class of this phylum (*Bivalvia*) and falls within the first order of this class (*Nuculoida*). The symbol "xx" represents the individual number which separates this specimen from all others of the same order. The coordinate-classification system is intended for the undergraduate student and for the general visiting public of natural history museums. It can be used equally well with neontological and paleontological collections. This system is currently used at the University of Québec in Montréal for the undergraduate systematic fossil collection. Students find that the system helps them quickly sort out the taxonomic relationships between numerous specimens and to better understand the different evolutionary lines in nature. The numerical code system is also very useful for ordering natural history data on a computer file as the computer can be easily programmed to organize the list of specimens by taxonomic position.

The Paleontological Section of "The Montréal Mineralogical Club"

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The "Section de Paleontologie du Club de Minéralogie de Montréal" was initiated by a small group of concerned and enthusiastic local amateurs, in the spring of 1983. The common goals are: 1)promote interest in paleontology in the general public, 2) encourage responsible collecting of specimens using scientifically appropriate methods, 3) introduce amateurs to preparation techniques and identification methods, 4) promote research and interest in the protection of fossiliferous sites. Current and future projects of the section include: 1) complete stereo-photographic catalogue of the fossil species found in Québec, 2) data file on the principal fossiliferous localities of the southern region of Québec, 3) plaster casting of local fossils and reconstruction of prehistoric scenes, 4) production of videotape library, 6) publish articles in "Filon", the journal of the club.

Biomass Loss in Wet-preserved Reference Collections

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Natural History Collections of the Canadian Government (Ottawa Area)

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A brief summary of important natural history collections of the Canadian government in the Ottawa, Ontario, area is presented. The collections are divided between three federal government departments, namely, the National Museum Corporation, Agriculture Canada and the Department of Energy, Mines and Resources. The collections included here consist of vertebrate animals, invertebrate animals, botanical specimens and vertebrate and invertebrate fossils.

Use of Natural History Collections in Teaching

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Information on acquiring, maintaining, replacing and storing teaching artifacts in natural history will be discussed. "Teaching by touching" in the classroom and the tools of the trade to make it possible to have the artifacts mobile will also be discussed.

Storage Housing Considerations with High Density Mobile Systems

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The versatility of different types of shelving casework storage racks and customized casework is present with high density mobile storage systems (compactors). A history of mobile storage compactors along with specific design consideration and product improvements will be presented from over 16 years experience in North America. Storage applications for natural history collections will be emphasized.

Ethical Considerations of Moulding and Casting

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Casting objects for museum display and scientific exchange is an established practice and is considered a valid conservation approach. The use of copies increases the potential for use of an object while limiting the potential for damage. However, casting should not be considered to have universal application as the moulding process is not without its hazards, and in some cases damage is done. Separators, moulding compounds and dyke material leave behind residues which may affect specimen stability for future analysis. Breakages when removing the mould may result in varying problems from minor loss of detail to major damage. Curators must be aware of these potential problems in order to make rational decisions as to whether or not objects should be cast.

Effects on Materials of Natural History Specimens by Standard Museum Preparation Methods. Part I. Freeze-drying and Freezing Used in Preservation and Eradication of Insects, Pests and Fungi

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This review paper is one of a series prepared on the effects of standard preparatory methods used for natural history specimens. It is essential to clarify the role of natural history specimens. Are they research or exhibit objects or are they precious natural heritage museum objects? The role of the objects may dictate different attitudes toward preparation methodology. The emphasis will be on material change and longevity which are important in reference to the role of the object. The subject of this first paper is the effect of freezing and freeze-drying on materials. The effects of freezing on dry and wet materials and the effect of freeze-drying and "vacuum and sublimation" of frozen materials will be reviewed. Moisture relationships of materials will be emphasized. The procedures for freeze-drying of living and dead animal tissues will be compared. The effectiveness of freezing and freeze-drying for eradicating insects, pests and micro-organisms will also be reviewed. Also, the importance of the rate of freezing and thawing will be presented.

Preservation Methodologies and Suggestions for Long-Term Storage and Maintenance of Avian Flat Skins

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Bird flat skins, or "pelts", have several advantages for systematic research over traditional "round" study skins. Molt may be quantitatively studied, pterylosis can be investigated, spread wings may be examined, and complete skeletons or fluid-preserved bodies can be saved. On the minus side, standard external measurements are precluded after preparation, and questions remain as to the outlook for long-term preservation of such skins. Flat skins have become a standard preparation technique at the Natural History Museum of Los Angeles County and many other institutions. I report here on techniques for flat skin preparation, storage and handling, and offer suggestions for improvement of these methodologies. I also report on the condition of flat skins at LACM after 1-15 years of storage and handling, and critically examine techniques for long-term preservation.

Status of Vertebrate Collections in Spain

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More than 30 new taxa have been described for the Iberian Peninsula, Balearic and Canary Islands during the past 15 years on the basis of the study of recently collected series of specimens deposited in several institutions. For this reason, these collections are getting more and more interest and, consequently, attention must be paid to their maintenance. Three public institutions are sharing 90% of all the vertebrates existing in Spanish collections: the "Museo Nacional de Ciencias Naturales" (Madrid), the "Estación Biológica de Doñana" (Sevilla) and the "Unidad de Zoología Aplicada" (Madrid). A total of 250,000 specimens are deposited in these institutions. The small budget devoted to their maintenance, reduced staff, lack of training of specialized personnel, and abandonment are the main threats to the future of these heritage collections.

Use of TYVER™ Synthetic Paper for Labelling in Vertebrate Collections

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The special properties of TYVER™ synthetic paper make it very suitable for labelling vertebrates in many circumstances: collecting, processing, storage, *etc.*, of dry material (skins, skeletons) as well as the fluid-preserved ones. This paper tolerates most of the mechanical and chemical stages in the processing or storage of vertebrates (fixation, boiling, maceration, staining, degreasing, *etc.*). It is also resistant to the most commonly used fumigant substances . The writing of data on this paper can be performed in the same way as other kinds of paper: By hand, typewriter, printer, *etc.*, with the advantage of remaining engraved permanently.

Treatment of Degraded Wood with Silicon Compounds

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Preservation treatment of degraded wood by impregnation with a mixture of methyl triethoxysilane and 2/3 equivalents of 0.1 N HCl shows promise in its sealing, stabilizing and strengthening effects. Tentative recommendations regarding optimum methods of impregnation are presented.

Curation of Samples and Appropriate Records at the Atlantic Geoscience Centre

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The Atlantic Geoscience Centre (AGC) is responsible for the curation of a major marine sediment collection at the Bedford Institute of Oceanography. AGC curation is not only responsible for all geological samples collected onboard BIO cruises and field projects, but also for monitoring the scientific and technical analyses performed on them. Underway records obtained at sea are also a responsibility of AGC curation. These include all geophysical records, tapes, log books and navigation. Monitoring the movement of these records between curation and the geological community is an ongoing process; therefore, both systems have comprehensive computer data base systems to record and access all associated information for both samples and records. The Sample Information Data Base (SID) is a System 2000 Data Base Management System (DBMS) on the BIO in-house Cyber mainframe. The SID data base provides site specific information, storage and sampling data. An IBM compatible rigid disc system using the dBASE III Plus DBMS provides location and line information for all curated geophysical records.

Impacts of a Change From Discipline to Functional Organization of Collection Management

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A recent administrative reorganization at the British Columbia Provincial Museum has resulted in a change from management of Natural History collections by four separate museum divisions (botany, vertebrate zoology, entomology and aquatic zoology) to management by one centralized Biological Collections Section. The perceived advantages and disadvantages of centralizing the management of different Natural History collections will be discussed from a collection manager's viewpoint.

Zoological Collection Incunabula: The Wied Brazilian Collection, 1815-1817

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One of the foundation collections of the American Museum of Natural History was purchased by the trustees in 1869 from the estate of Prince Maximilian. It was Prince Wied's cabinet of mounted bird, fish, and mammal specimens, collected during his travels in the New World, and it included the specimens and types Wied had retained from his Brazilian trip of 1815-1817. After reviewing the American Museum's exhibition and curatorial practices since 1869, the present condition of the

Wied Brazilian mammal collection is described. The importance of the Wied collection as a zoological and historical document is discussed.

Effects of Long-term Storage on Biological Materials

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Preparation methods and storage conditions of biological specimens in museums rarely have been recorded or monitored, but these factors are important considerations for the preservation of the objects. A recent acquisition by The Carnegie of a private collection of small mammal specimens provided a unique opportunity to study the long-term effects of standard storage environments on the condition of research specimens. These specimens received minimal disturbance for up to 50 years. They were stored in a wooden case with wooden drawers and pasteboard trays, and received periodic fumigation with paradichlorobenzene. Specimens from this collection were compared to similar specimens stored under other collection conditions. Both groups were compared to specimens collected in 1985 and 1986 from the same geographic area and season. Implications of standard storage methods for long-term preservation of biological objects are discussed.

Collections Storage

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For decades museums have faced the problems associated with storage of collections. This exercise is particularly complex for anyone involved in maintaining specimens of diverse shapes and sizes. In addition, limited budgets for capital equipment, limited space, unavailability of storage systems designed specifically for museum use, and the need to occupy buildings not intended for collections, have all contributed to the dilemma. Recently, through the efforts of both museum staff and manufacturers, major advances in storage systems have been realized. An overview of current approaches is presented. The storage system currently used by the Zoology Division of the National Museum of Natural Sciences is illustrated as a viable solution to "space conservation".

Systematic Collection Curators as Historic Preservationists: Case Studies from the MCZ Bird and Mammal Departments

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A slide-illustrated presentation will highlight selected specimens of historically significant vertebrates (birds and mammals) in the Museum of Comparative Zoology (MCZ) and problems associated with their care. "Historical significance" can be defined in terms of collector renown or of author in the case of type specimens, relative rarity in museum collections, extinction in the wild, importance of the specimen to the systematic literature (*e.g.*, type specimens), as well as extreme antiquity. The collections of the MCZ house some of the oldest natural history specimens extant in the United States including former Peale Museum specimens and material collected by the Lewis and Clark expedition. They comprise an excellent laboratory for conducting conservation-related research and for documenting the condition of preserved natural history material over a wide time period.

Compactor Installations for the Collections of Fungi and Plants at the Biosystematics Research Centre

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The plant collections of the Biosystematics Research Centre [vascular plants (DAO) and fungi (DAOM)] hold over a million species. Expansion space for specimens became critical in 1985 and it was evident that, with no additional floor space available, a movable shelving (compactor) installation was the only alternative. For example, DAOM standard botanical cabinets provided 3192 shelf units, whereas with a compactor arrangement there would be 7072 units with freed work areas at both ends of the herbarium room. The extra shelf units were gained by reducing the number of aisles (2 rather than 10) and increasing the height of the shelving sections to 2.75 m (9 ft.). The space thus gained provides expansion space for the next 15-20 years. Basic changes for the new installation required I-beams to strengthen the original concrete floors, ceiling lights relocated, new electrical outlets, new plumbing for a sprinkler system, and new floors to provide flush rail-floor surface. The fireproof building, sprinklers and smoke detectors, no smoking areas, and a registered protection agency for after hours, help to protect specimens. Users of the system are protected by light signals on the end panels, magnetic keys inserted on each mobile deactivate them and a safety sweep or kick plate along the base of each mobile cuts off power and movement instantly when touched.

Applications of an Inventory of a Museum Collection

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Many researchers remain largely uninformed of the nature and content of collections housed in museums. In any museum, large or small, with collections needing to be properly identified, curators can take an active role in communicating the value of their collection to specialists. A relatively low cost approach is the preparation of an inventory, itemizing unidentified collections by geographic location. This system provides easy access to the collections for specialists who wish to study the material.

The crustacean section of the National Museum of Natural Sciences is currently developing an inventory system for the research collection. The use of the inventory at its current stage of development and its uses in the future are discussed.

Orchids and Roses as Samples of Chemically Preserved Flowers

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Red and white roses as well as cymbidium and cattelya orchids, treated for 24 hours by the chemical method reported in the Proceedings of the 1985 Workshop on Care and Maintenance of Natural History Collections (edited by J. Waddington and D.M. Rudkin), are displayed as cut flowers or inside decorative containers. This method of flower preservation is currently being marketed by Delve Incorporated.

Microfil Injections of Small Vertebrates: An Adjunct to Clearing and Staining

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Historical Collections at the Academy of Natural Sciences of Philadelphia

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The Academy of Natural Sciences of Philadelphia is the oldest continuing natural science museum in the western hemisphere, and its collections have great historic value. The Academy's collections include books, manuscripts, art objects, personal effects, mounted specimens, and artifacts, as well as "biological specimens". Historic objects are often treated as little more than curiosities by natural history museums because they seem to have little direct value to the advancement of scientific research. The results are usually to discard these objects or give them a low priority in terms of preservation. The Academy has had increasing success in reversing this trend by utilizing historic objects for exhibitions. This has made it possible to provide conservation of the objects and to document them properly. Several examples are described.

Endangered Species Museum Specimens: The Problem of Identification and Protection

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Damage to specimens is a risk taken every time material is loaned. Recent damage to several specimens of endangered species has led us to re-evaluate our loan policies and take steps to identify such material within the collection. Our primary assumption is that material from extinct and endangered species should be accorded additional curatorial attention and strict loan policies. Lists of protected species from several sources were reviewed and used to generate a table of vulnerable material in our collection. Using color coded signal dots, these taxa were "flagged" in the systematic card file. Special labels were prepared to "flag" individual specimens. This system allows staff unfamiliar with protected species to quickly identify vulnerable specimens. It also enables us to identify specimens of extinct and endangered species and any material that requires special curatorial attention.

Marsil Museum

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The presentation will include a short introduction of the museum with a resumé of our association with the Redpath Museum of McGill University. This will include a description of past natural-science exhibitions and the manner in which Redpath and the Marsil Museum have co-operated with each other.

Preventative Destruction of Amber: A Search for Preventative Conservation

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Deterioration of amber in museum collections is an ongoing and poorly understood phenomenon. In an attempt to identify the destructive agents, small pieces of Dominican amber were exposed at high concentrations to substances or conditions that might be encountered in a museum display or storage environment, including common air pollutants, volatile biocides, and cleaning agents, as well as light, temperature, and relative humidity. Several of the chemical treatments resulted in almost immediate surface disintegration. Fresh surfaces are less affected than surfaces that have been exposed to the air for several years. Further investigations into possible causes are being carried out.

The Effects of DDVP Fumigation on Museum Materials

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Concern for protecting museum materials from insect pests has resulted in the use of various pesticides in museums. Because of the increasing popularity of using DDVP (Vapona, dichlorvos) to fumigate natural history objects, there is an obvious need for critically evaluating this pesticide. Studies have confirmed the effectiveness of DDVP on insects and the environmental parameters that promote effective fumigation. However, very little is known about the effects of DDVP on museum materials.

Additional studies investigated the effects of 12 months of continuous DDVP fumigation on object and storage materials. The results of these studies are presented.

Working in Natural History Museums – A Health Hazard?

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The tools of the trade for those working in natural history museums encompass a wide array of chemical products including solvents, pesticides, adhesives, corrosive liquids, organic and mineral preservatives and salts. Increased awareness of the hazardous properties of these materials suggests that specimen preparators are faced with certain risks to their health and safety if precautionary measures are not carefully followed. Control of hazards may be exerted through ventilation practices, substitution of agents with safer products, use of personal protective equipment, utilization of proper storage and handling techniques and training of personnel. Familiarity with the chemical, physical and toxicological properties of chemical products is a must when determining the appropriate control methods to employ, so ready access to comprehensive precautionary information is a prerequisite. Traditionally, the training provided to the personnel of natural history museums placed little, if any, emphasis on health and safety topics. This is exemplified by the notable absence of such information in standard methods manuals for specimen preservation. Hence, in order to better control hazards in the workplace, preparators of natural history specimens will need to supplement their currently available sources of information.

Reviews

Following are reviews of a booklet on preservation techniques, and of 11 chapters from a recently published book on museum collections, all of which are pertinent to the concerns of natural history collection workers. I gratefully acknowledge the input of time and effort by the reviewers. Mary R. Carman
Publication Review

FRANK, P.G. 1982. Some techniques for narcotizing and preserving invertebrate animals, except insects. National Museum of Natural Sciences, Ottawa, ON 29 pp.

This paper is a general overview of a variety of methods for narcotizing, killing, fixing and preserving animals from the major invertebrate taxa (except insects, as noted in the title). Following introductory remarks and advice on preparing and preserving specimens, the body of the work – organized systematically by phyla – presents an outline of techniques that have been successfully used for each group. A bibliography of sources and appendix of formulae for solutions mentioned in the text finish up the work.

In the light of the fact that the reviewer has only had experience in preserving pulmonate gastropods, no comments will be made on the actual techniques described in the paper. Rather I offer the observation that it is precisely in my situation – near total lack of knowledge – that this document would prove most useful. Confronted with an out-of-the-ordinary preservation problem, reference can be easily made to this source. If the information it contains is not sufficient, it provides a convenient starting point for a search of the literature.

Another possible benefit that comes from reading through Mr. Frank's paper is the realization that the 'old tried and true' technique is not the only or necessarily the best method. When possible, trying out techniques one has not used before or experimenting with variations on the old may lead to better results in preparation and preservation.

All in all, this paper should prove a useful reference for invertebrate collections.

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EDWARDS, R.Y. 1985. Research: a museum cornerstone, chapter 1, pp. 1-11. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

R. Y. Edwards' introductory essay entitled, "Research: a museum cornerstone," questions the role of collections and research, documentation, information management, and education in museums, as well as the role of the natural history collection in society. To the general public the words museum and exhibition are virtually synonymous. This misconception is partially due to the blockbuster exhibition mentality that pervaded the early 1980s. Edwards argues successfully that the raison d'être of a museum is research based upon collections, and the information about objects created by such labor-intensive tasks as acquisition, conservation, and collections management. Edwards recognizes that it is not enough to collect, but that through documentation, proper collections management, and conservation methods museum research can be encouraged by nurturing an environment in which information and care and collection of specimens are regarded as interdependent. Thus, the museum collection becomes more than just an endless inventory of objects.

While the essay focuses primarily on biological specimens and research it serves as basic reading for anyone interested in museums and in the utilization of older museum collections.

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OGILVIE, R.T. 1985. Botanical collections in museums, chapter 2, pp. 13-22. In: Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Ogilvie reviews the functions, limitations and scope of today's herbaria. The herbarium is described as a repository for dried plant material collected for research and education; associated with these specimens may be a wide variety of ancillary items such as photos, wood samples, pollen slides or notebooks containing original documentation of the collector.

A valuable practice of most herbaria is the policy of loaning specimens to researchers in other institutions for study. Additionally, exchange of duplicate specimens between institutions is a cooperative measure serving to disseminate information.

A most cogent point made by Ogilvie is that information contained on the herbarium specimens not noted or appreciated in one period of time may prove most useful at some future date. This point may be seen clearly in retrospect: who could have imagined one hundred years ago the potential importance of chemical analysis in terms of flavonoids, alkaloids, *etc.*, to systematic study? Thus new fields of scientific study continue to find new ways to use the information that the herbarium sample and its associated field data provide.

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BERRY, W.B.N. 1985. The signifigance of type specimens and old collections to research in the biological sciences, chapter 3, pp. 23-27. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Berry's article begins with a historical perspective of natural history collections. He then emphasizes the point that old and type collections within natural history museums, like a library of rare books, should be managed as recommended by Article 72 of the "International Code of Zoological Nomenclature", for their current and future historical and scientific significance. With the continuing growth of collections and in order to preserve old and type collections, up-to-date technology in storage is required, as well as data retrieval systems, computer based cataloguing, and circulated museum records and catalogues.

Berry suggests that scholars of biological sciences could look for research and thesis ideas in circulated inventory lists of well-maintained old collections and type specimens. As grandiose a project as complete published (circulated) inventory lists would be, unresearched old collections and not recently studied type specimens are certainly sources of potential research ideas. One could take Berry's idea of circulated inventory lists a step further and compile a directory of all available inventory lists/catalogues.

Statistics would complement Berry's subject matter. How many museums and institutions house biological type specimens? How many house old collections? How many published catalogues of type specimens or old collections, and from which institutions, are already in existence?

The conservation needs of biological collections that Berry is concerned with also apply to other natural history departments.

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ALBERCH, P. 1985. Museum collections and the evolutionary study of growth and development, chapter 4, pp. 29-41. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

In recent years there has been an upsurge of interest in the relationship between development and the study of evolutionary pattern and systematics (Kluge 1985; Kluge and Strauss 1985). A considerable divergence of opinion exists concerning the application of concepts and principles related to developmental data, and the pathways taken in the investigation of such matters have been varied (Thomson 1986). Landmark contributions in these endeavours include those of Alberch *et al.* (1979), Bonner (1982), Goodwin *et al.* (1983), Gould (1977), Nelson (1970) and Rieppel (1979). Standing at the base of these various approaches is the requirement for suitable and appropriate study material. It is in this context that Alberch presents his case for museums becoming repositories of material applicable to such pursuits.

Embryonic, larval and juvenile material has, of course, always been included in museum collections, but generally there has not been any concerted effort to compile comprehensive and representative sets of such material. Alberch thus calls for a change in general curatorial policy in such a way as to place some degree of emphasis on the acquisition and maintenance of appropriate specimens. This contribution by Alberch discusses the significance of incorporating immature specimens into collections and provides valuable information and advice on its curation.

Alberch begins by outlining how typology has influenced the structure of collections, with juveniles and embryos being reduced to a subordinate level of importance in alpha-systematics. With the inception of more populational outlooks in systematic and evolutionary biology, however, the adequacy of purely adult-oriented typological collections is called into question. This concern about the utility of immature specimens and the characters thereof is not new, and was, for example, considered in some detail by Crowson (1970). Its re-emphasis in a volume specifically oriented towards curatorial policies and procedures is, however, both timely and appropriate.

The building of collections that can be of more direct use in evolutionary studies is advocated, with the suggestion that adding this depth will greatly increase the utility of reference collections. Embryonic and juvenile material has played a central role in comparative and evolutionary morphology for a considerable time (von Baer 1828; de Beer 1940), but such material has generally been available for relatively few taxa. Additional material must be available in collections before many questions of import can be addressed.

To this end Alberch provides some helpful guidance. He outlines areas in which such materials can be employed (homology determination, character polarization, heterochronic and allometric studies, and investigations into experimental embryology) and reviews the literature to give examples of such applications. Curatorial procedures for the collection, fixation, storage, processing and clearing and staining of specimens are outlined. Thus, Alberch's contribution provides both a theoretical background and some practical instruction for building collections of immature specimens. It conveys a powerful message that curators of appropriate collections should institute policies that would ensure the systematic acquisition of pertinent material, rather than rely on occasional addition on a serendipitous basis. Without detracting from the traditional roles of reference collections, the planned acquisition of material representing immatures will greatly enhance the utility of these collections in evolutionary studies.

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BAKER, A.J. 1985. Museum collections and the study of geographic variation, chapter 6, pp. 55-77. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Readers who consult this chapter "Museum Collections and the Study of Geographic Variation" will be disappointed, for the title is misleading. While it does give an overview of the types of research being done on geographic variation and the problems involved with interpreting this research, it does not adequately discuss the role of museum collections in this research. In fact, although the author alludes to the "central role played by museum collections...in most of the research reviewed," he proceeds to largely ignore this role in his review. The few paragraphs on museum collections make the general point that, in the author's opinion, existing collections are inadequate for study of geographic variation.

It is true that in many disciplines, collections are inadequate and the acquisition of specimens is still desirable. However, in some cases, this is not possible. For species which are endangered, disappearing, or rarely occurring, it is unlikely that a statistically significant sample of specimens can be collected, making study of specimens in collections essential. In addition, in each of the examples of studies on geographic variation, the role of museum collections could have been featured more prominently. In fact, the author's approach to geographic variation studies appears to focus on sampling problems, ignoring the fact that collections already exist.

The section entitled "Analysis of Geographic Variation" gives a good review of the mechanics and statistical approach to geographic variation, interweaving the types of study and approaches to them, with appropriate statistical tests noted. The review, as the author states, is limited in scope to his particular area of expertise.

Finally, a large segment of the paper, Section III "Evolutionary Significance of Geographic Variation", is a philosophical treatise on geographic variation. While it is an interesting subject, the unequal amount of space given it in a publication on the role of museum collections is not appropriate.

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CESKA, A. 1985. Museum collections and phytogeography, chapter 7, pp. 79-91. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

In this chapter, Adolf Ceska succinctly analyzes the role of "regional museums" (specifically herbaria) in phytogeographical research. Phytogeography is defined as "that branch of science that deals with problems concerning the geographical distribution of plants." It attempts to answer the questions: what plants? occur where? and why? Different approaches, past and present, have been taken in the science of phytogeography, including: (1) the study of the distribution of vegetational types (*i.e.* plant communities and the larger scale, physiognomically defined plant formations) and their relationships to environmental factors; (2) the floristics of an area (*i.e.* the total species composition, with interpretations of the various floristic elements present); and (3) the study of the geographical distribution of certain taxa (involving interpretations of their overall ranges vis-à-vis evolutionary relationships). The first (*i.e.* vegetational) approach, although historically often emphasized, is essentially excluded in the author's modern definition as representing the science of plant ecology rather than phytogeography.

The author presents a well referenced review of the state of phytogeographical knowledge of British Columbia. While this is largely bibliographic, indicating where pertinent information may be found in the literature rather than an actual account of the plant geography of the province, it does include a good summary of the post-Pleistocene evolution and paleoecology of the British Columbian flora.

In his discussion of the role of the regional museum (*i.e.* herbarium) in phytogeographical research, the author emphasizes its primary role in serving as a depository of well labelled specimens documenting the distribution of plants. The basic unit of phytogeographical information is the known occurrence of a particular taxon at a certain locality, documented by a verified herbarium specimen. For geographical regions such as British Columbia that are still poorly explored botanically, the primary initial tasks are basic floristic exploration and specimen collecting to build up good herbarium collections that adequately depict the distribution of plants.

But the author further maintains that the regional museum's (or herbarium's) role in phytogeographical research is more complex than that of being a specimen-depository alone. It should also be a depository of other plant distributional information such as field-notes and diaries of collectors, local species lists, regional botanical reports, available distribution maps, and periodically updated information on those plant populations that are rare, endangered, or otherwise of phytogeographical importance. Regional museums or herbaria should also aspire to take major roles in directing, cooperating with and encouraging botanical collecting activities by professional botanists, environmental consultants, and amateur naturalists.

The author considers the application of data-base management systems for herbaria to be a top priority. Materials in herbaria are filed taxonomically. A data-base management system would also be able to provide information on what has been collected in particular areas, the relative density of collecting in different places, the production of continually updated distribution dot maps, and even the documentation of particular collectors' activities. Few would argue with this ideal, but the practical difficulty and expense of entering label data of 50,000, 100,000 or often many more herbarium specimens into a computer data-base may represent an overwhelming task beyond most limited budgets.

This chapter is not an exposition covering the scientific field of photography. Rather it is exactly what it was intended to be, *i.e.* a discourse on the role that herbaria may or should have in phytogeographical research, with some special attention given to the situation in British Columbia. Thus focusing his discussion, Adolf Ceska makes his points clearly and concisely, leaving no obvious gaps in his topical coverage. This reviewer, at least, finds little argument and can only concur with the author's points and conclusions.

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RAIKOW, R.J. 1985. Museum collections, comparative anatomy and the study of phylogeny, chapter 9, pp. 113-121. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

This chapter is organized into seven sections including an introduction and summary. The chapter's focus is on the role museum collections play in phylogenetic studies through comparative anatomy. The author's objectives are to offer practical information for users and curators of alcoholic (spirit) and skeletal specimens in museum collections. Additionally, based on his personal experiences in the study of avian phylogeny, he discusses aspects regarding the growth and management of these collections.

All users and curators of museum collections should read this chapter. It is especially valuable to the investigator embarking on research entailing the use of consumable museum specimens. R. J. Raikow concisely presents practical information. Particularly instructive in the section on using anatomical specimens are subsections dealing with procurement, preparation and storage, consumption and conservation, and sample sizes. In research procedures, excellent advice, albeit somewhat didactic, is given on examination strategy and anatomical illustration. While results certainly should be published, the author points out that the availability of the raw data to future investigators is of equal if not greater value. He expresses his views in sections on the mutual responsibilities of museums and users and on the future of anatomical collections. He advocates decency and a common sense approach for users and curators. In his opinion, planned growth of collections by museums should emphasize taxonomic or geographic specialization and the collection of series of specimens, that is, skeletons and spirit specimens in addition to skins.

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HEBDA, R.J. 1985. Museum Collections and Paleobiology, chapter 8, pp. 93-111. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Hebda's article "Museum Collections and Paleobiology", is an excellent summary of the status of fossil collections in natural history museums today. The article is well organized beginning with a general discussion of the relationship of fossils to the origin of life and the planet Earth.

Chapters 2 through 4 deal with the nature and role of paleobiology collections. In chapter 2, "What is Paleobiology?", the author distinguishes between two often misused terms, paleobiology and paleontology. Hebda notes the importance of the use of fossils to both the stratigrapher and the systematist. Later, in chapter 4, he emphasizes the fact that museums serve as repositories for type and referenced specimens, and urges all researchers to reposit voucher specimens in established institutions. Museum collections often serve as a basis of comparison for descriptive and taxonomic research, but are valuable also in providing a basis for global paleobiogeographic and evolutionary studies. In addition, museum collection may become even more valuable because areas such as the Burgess Shale localities have restricted accessibility.

In the final three chapters Hebda outlines the past, present and future states of paleobiology collections. Hebda begins with a historical treatment of fossil collections from the ancient Greeks to 1960, stressing the emergence of paleobiology in the 19th Century; and in chapter 5, 1960 to present, he emphasizes the importance of preserving historical collections.

Hebda concludes that if researchers continue to inquire about the earth's history and the life upon it, then museum collections are likely to grow. Thus, museum professionals will need to practice quality control of accessions. In the 1980s there has been an increased awareness for the need of professional curatorial staff and the need for consistently high standards of curation. Hebda's article on "Museum Collections and Paleobiology" maintains the theme of this series and presents a thoughtful summary of museum fossil collections.

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FITZPATRICK, J.W. 1985. The role of scientific collections in ecolgical morphology, chapter 14, pp. 195-207. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Having only this one chapter to read, I felt somewhat at a loss to say how it fit into the whole collection. At least two other chapters were referenced but without them I could not judge how this paper detracted from or complemented the whole. The author's writing is clear, straight to the point and free of unnecessary jargon. He presents interesting questions for which answers are lacking and for which natural history collections can play an important role in supplying these answers. Certainly this chapter summarizes well the role of collections in ecological studies in general, and in ecological morphology in particular.

Fitzpatrick makes two points that bear repeating. First, unless the question being asked is carefully and clearly posed, the answer will be of little value. Second, there is a need for ecological morphologies to combine field studies of behaviour with detailed studies of structure and this is where the scientific collections will be of special value. Those collections including large numbers of specimens and specimens collected over a long period of time should prove most valuable, as is their continued growth into the future.

Anyone familiar with studies of avian ecology or behaviour will recognize the references cited by Fitzpatrick and he mentions his own bias in this regard. One should not conclude that it is only in avian studies that collections will be needed. Ecological morphology of any organism will depend upon scientific collections as a source of information. As Fitzpatrick concludes it is these collections that will continue to allow us "to imagine questions and measure the answers as to how organisms became as numerous and structurally diverse as they are."

John C. Topping
Department of Biology
Queen's University
Kingston ON

ASHTON, P.S. 1985. Museums and botanical gardens: common goals?, chapter 15, pp. 209-214. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Ashton argues that the systematic living collection has the potential to be an invaluable scientific resource. Presently, living collections are most commonly utilized in systematic research, most notably anatomy, morphology and monographic work. Advances in scientific disciplines such as physiology or genetics through the use of living collections are less common. This is, presumably, because the researchers in these disciplines tend to experiment with familiar, well studied organisms. Ashton assigns systematic biologists the instrumental role of recognizing and selecting living collections of potential interest and import to other such biological disciplines. It is the systematic biologist, he maintains, who, having a breadth of knowledge of all organisms, may best suggest alternative or promising study organisms to those whose research is, for example, at the cellular and subcellular level. Actualizing the potential of the living collection will involve the development of such breadth among students of systematic biology. At the university level, students need to explore the diversity of living organisms with enthusiasm. A living collection offering a synoptical representation of organisms, with space for research and experimental organisms, must be available. Independent living collections in zoos and botanical gardens, for example, must assist and supplement their university training.

If it is able to contribute to the development of an overall breadth of knowledge among biologists, then the living collection can be justified in terms of research alone. Worthwhile will be the demands such a collection exacts on space, finances, and curatorial care. Aside from any such goal of botanical study or instruction, a "botanical garden" is a mere collection of horticultural and ornamental plantings, not considered by Ashton in this essay.

Nora Murphy
Botany Department
Field Museum of Natural History
Chicago IL

OUELLET, H. 1985. Museum collections: perspectives, chapter 16, pp. 215-219. In Miller, E.H., (ed.), Museum Collections: Their Roles and Future in Biological Research. Occasional Papers 25, British Columbia Provincial Museum, Victoria BC.

Henri Ouellet's concluding chapter, "Museum collections: perspectives," urges curatorial responsibility in the study of objects, introduction of new methods of study and interpretation of older collections, and for the continuing growth of natural history collections. Ouellet recommends institutional cooperation in collection development, public education as to the importance of comprehensive research collections, and advocacy in terms of legislation.

In his conclusion he states:

> Museum curators have an enormous responsibility to insure that their collections are properly curated, maintained, rationally utilized and expanded appropriately. The burden of this responsibility must be shared by museum directors, administrations, xand] trustees.... (p. 219)

Omitted are collections managers, conservators, registrars, archivists and librarians – all of whom are professionals charged with equally significant collections and information responsibilities. Inclusion of records creators and managers, conservators and collections managers, as well as curators, directors, and administrators is essential for effective progress in comprehensive planning, development of goals and implementation of strategies, research, and the redefinition of the natural history museum in present-day society.

Janet Miller
Anthropology Department
Field Museum of Natural History
Chicago IL

Miscellany

The Conservation of Geological Material

In January, the Geological Curators' Group held a conference entitled: "The Conservation of Geological Material" at the British Museum (Natural History) in conjunction with the Museum's Department of Palaeontology. The primary aim of the meeting was to improve the state and status of geological conservation within the United Kingdom.

Several papers have been published. They include:

SAFETY CONSIDERATIONS FOR THE GEOLOGICAL CONSERVATOR **M.P. Howie**

ENVIRONMENTAL CONSIDERATIONS **J.A. Smith**

CONSERVATION DOCUMENTATION **J.A. Cooper**

A STRATEGY TO SAFEGUARD THE GEOLOGICAL COLLECTIONS OF THE SMALLER MUSEUM **A. Taylor**

SOME ADHESIVES AND CONSOLIDANTS USED IN CONSERVATION **S. Keene**

AN INTRODUCTION TO THE USE OF SILANES IN STONE CONSERVATION **S.M. Bradley**

A VIEW OF ETHICAL CONSERVATION AND MINERAL SPECIMEN FALSIFICATION **R. Waller**

SPECIAL PROBLEMS IN THE CONSERVATION OF PALAEOBOTANICAL MATERIAL **M.E. Collinson**

APPROACHES TO THE PREPARATION AND DEVELOPMENT OF CALCAREOUS FOSSILS FROM CALCAREOUS MATRICES **J. Wilson**

THE TREATMENT OF DECAYING PYRITIFEROUS FOSSIL MATERIAL **L. Cornish**

THE ACID TECHNIQUE IN VERTEBRATE PALAEONTOLOGY: A REVIEW **W. Lindsay**

THE CONSERVATION OF SUB-FOSSIL BONE **A.M. Doyle**

ARCHAEOLOGICAL CONSERVATION: SOME USEFUL APPLICATIONS FOR GEOLOGY **H. and R. Jaeschke**

The reference to this publication is: Crowther, P.R. and Collins, C.J. (eds.) 1987. The Conservation of Geological Material. *Geological Curator* 4(7): 375-474.

This publication is available to non-members for Sterling 7.50 (including postage and packing) from: Tom Sharpe, GCG Treasurer, Department of Geology, National Museum of Wales, Cathays Park, Cardiff CF1 3NP, United Kingdom.

Peter Crowther
City of Bristol Museum and Art Gallery

Conservation Resources

The Conservation Committee Chairperson, Carolyn Rose, of the Society for the Preservation of Natural History Collections has produced a booklet entitled *A Preliminary List of Natural History Collections*. It is dated May, 1987, and is a preliminary list which is valuable for anyone searching for natural history conservation information. The Subject Index includes the following topics: Conservation Centers and Major Laboratories (national and regional), Conservation Funding Sources, Conservation Organizations (international, national, regional), Conservation Publications, Conservation Education and Training, Health and Safety, Museum Publications, Natural Science Organizations and Laboratories.

This 24-page booklet is available for $3 (Canadian or U.S. currency). Send a cheque or money order made out to S.P.N.H.C. Forward your name, address, money order and a request for "A List of Conservation Resources" to: S.P.N.H.C., Box 6520, Station J, Ottawa ON K2A 3Y6.

Some Relevant Definitions!

CURATOR: Among civilians, a person regularly appointed to manage the affairs of minors, or persons mad, deaf, dumb, *etc.* See *LAW.*

Law: Curators are given, not only to minors, but in general to everyone who, either through defect of judgement, or unfitness of disposition, is incapable of rightly managing his own affairs. Of the first sort, are idiots and furious persons. Idiots are entirely deprived of the faculty of reason. The distemper of the furious person does not conflict in the defect of reason, but in an overheated imagination, which obstructs the application of reason to the purposes. Curators may also be granted to lunatics, and even to persons dumb and deaf, though they are sound of judgement, where it appears that they cannot exert it in the management of business.

From: *The Encyclopaedia Britannica, 1771*

Chloe Younger
Dalhousie University, Halifax NS

The Museum Computer Network

The Museum Computer Network is an organization of individuals, principally North American, but extending worldwide. The organization encourages and facilitates the use of computer technology by museums particularly for documentation and collections. The organization collects data and reports relating to computer applications in museums and makes these available as an information resource. Their meetings and publications provide a forum for exchange of information and airing of concerns among institutions and individuals involved with museum computerization. If you are interested in membership, send $25 (U.S.) to MCN, Box 2018, Empire State Plaza Sta., Albany NY 12220.

The Museum Reference Center – Smithsonian Institution

The Museum Reference Center in Washington DC is a branch of the Smithsonian Institution Libraries. It is an information center and library with a working collection of resources on all aspects of museum operations. The center is the only central source of museological information in the U.S. which makes these materials available to researchers. The Center offers library, information, and bibliographic services to museum professionals and students throughout the world. The Center contains evaluation studies, visitor surveys, volunteer manuals, long-range development plans, sample bylaws, charters and museum collection management records generated by individual museums, historical sites and societies, science centers, zoos, botanical gardens, aquariums, and nature centers.

The Center seeks materials related to museum operations and activities from anyone producing them. On the other hand, museum professionals from around the world may request information from its files in a number of fields. Readers of *Collection Forum" are invited to send their requests for help.*

Edward Johnson
Museum Reference Center, Smithsonian Institution

ICOM Starts a Newsletter

After about 10 years without newsletters, the ICOM Natural History Museums Committee has again started one. When the previous newsletter editor passed away, the newsletter died too. Now an energetic new executive has been elected to develop a program for the Committee. The executive has decided that "Biological Diversity and Our Natural Heritage" will form the basis for the Committee's Triennial Program (1987-89). If you are a member of ICOM or would like to become a member of the Natural History Museums Committee, write the President, Craig C. Black, Los Angeles County Museum of Natural History, Los Angeles CA 90007, or Secretary, Robert Julien, Office de Cooperation et d'Information Museographiques, 17 ruu Abbé de l'Epée, 34000 Montrellier, France. The 1987 annual meeting was held in Arusha, Tanzania, on 24-30 August.

Society Business

We are members of a world team. We are partners in a grand adventure. Our thinking must be worldwide.

Wendell Wilkie

Message from the President

Our Society continues to make progress, slow but certain. The annual meeting in Montréal was a huge success. I would like to take this opportunity to thank all those members who worked to make the Montréal meeting so successful. I will never, ever, forget the pleasant vibrations that arose from that gathering. The next annual meeting will be at the Carnegie Museum in Pittsburg, so make your plans to get there – somehow.

Membership is increasing and continues to be broad. I would like to encourage each of you to contact a colleague and tell them about our Society's activities. Since this is a member-driven, volunteer society, we need lots of interested persons to keep the wheels greased and turning. We also need financial support from industries, so if you have a supplier of bottles, labels, fluids, *etc.*, who might put an advertisement in *Collection Forum*, send me their name, address and what they supply to you.

A newsletter for our Society has been started to increase communication among our members. Paisley Cato and Julie Golden have taken on this responsibility and we need to thank them for their time and efforts. Contact either Paisley or Julie if you have something to contribute.

Several comments have come to me that separate publications, outside of our newsletter or *Collection Forum*, might be ready to put together by SPNHC committees. It's nice to know that in only one year the objectives and activities of the Society have stimulated persons into thinking along these lines. If you have any idea for a publication that the Society can support or help to publish, please send me a letter describing it.

See you in Pittsburg.

Daniel J. Faber

1987 S.P.N.H.C. Council

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National Museum of Natural Sciences
Ottawa ON

Cesar A. Romero-Sierra (President-elect)
Queens University
Kingston ON

Shirley S. Albright (Secretary)
New Jersey State Museum
Trenton NJ

J.P. Cuerrier (Treasurer)
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Janet B. Waddington (Member-at-large) (Retire 1990)
Royal Ontario Museum
Toronto ON

Stephen L. Williams (Member-at-large) (Retire 1990)
Carnegie Museum
Pittsburgh PA

Fred J. Collier (Member-at-large) (Retire 1989)
U.S. National Museum of
Natural History
Washington DC

Wynn Watson (Member-at-large) (Retire 1989)
Wilfred Laurier Univ.
Waterloo ON

Ingrid U. Birker (Member-at-large) (Retire 1988)
Redpath Museum
Montréal PQ

Carolyn L. Rose (Member-at-large) (Retire 1988)
U.S. National Museum
of Natural History
Washington DC

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Ottawa ON

Call for Papers – 1988 Annual Meeting – Carnegie Museum

The 1988 annual bash will be held at the Carnegie Museum in Pittsburgh. Duane Schlitter and Steve Williams are planning the program. If you are interested in participating, write them. The proposed program is as follows:

TENTATIVE PROGRAM

Monday 30 May, 1988

All day – SPNHC committee and council meetings
Evening – Icebreaker

Tuesday 31 May

Morning – Invited papers
Afternoon – Contributed papers
Evening – Symposium: Controlling the environment.

Wednesday 1 June

Morning – Contributed papers
Morning – SPNHC business meeting
Afternoon – Contributed papers
Evening – Soirée

Thursday 2 June

Morning – Workshops
Afternoon – Workshops

Friday 3 June

All day – Symposium: Health hazards associated with natural history museums.

Editor's Note

Each volume of *Collection Forum* has brought improvements in quality and quantity. In my opinion, *Collection Forum* is now suitable as a journal for scientific and feature articles on various aspects of natural history collections. It is the only one of its kind devoted to the natural sciences.

I encourage comments about it from readers, both complementary and critical. We are now working on subscriptions and advertisements to ensure its continuity and continued success.

Collection Forum was originally planned to be published in spring and fall but manuscripts are prepared mainly for annual meetings. It appears now that the proceedings from any meeting will probably be published partly in the fall issue of one year and partly in the following spring issue. Encourage your colleagues to prepare manuscripts to ensure that there are enough papers for each volume.

D.J.F.

Second Annual Meeting – Montreal 1987

From May 31 until June 3, 1987 I had the pleasure of attending and participating in the second annual meeting of "The Society for the Preservation of Natural History Collections". The meeting was hosted by the Redpath Museum/McGill University, Montréal, Québec Canada. Thanks to the members of the organization committee who were Delise Alison, Ingrid Birker, Susan Gabe and Joan Kaylor of the Redpath Museum and Dan and Joanne Faber of the National Museum Corporation and Cesar Romero-Sierra of Queen's University.

Throughout the meeting 102 participants (curators, conservators, collection managers, professors and technicians) presented information ranging in content from "Collections storage" to "What is a Discovery Room?" Participants were present from Canada, U.S.A., England and Spain. Twenty-five (25) oral papers and eighteen (18) posters were presented. Adding to the quality of the presentations were the Keynote addresses. After being treated to a most informative and arousing address on Monday morning by Dr. David Baird entitled "A Lifetime of Collecting", we were to be further informed and enlightened by such topics as "The Development of Geological Specimen Conservation in the United Kingdom" by Cristopher J. Collins, Leicestershire Museums, Leicester, U.K., "Funding for the Natural History Museums – An Historical Perspective and Presentation of Alternative Strategies" by D. Doell, Royal Victoria Hospital, Montréal, and "Training in the Care of Natural History Collections: Report on the CCPTP at the Natural History Museum of Los Angeles County" by L.J. Barkley and K.L. Garrett, Natural History Museum of Los Angeles County, Los Angeles.

During the paper and poster presentations a series of special activities was arranged which included demonstrations and field trips. Fourteen (14) people stomped up Mount Royal with Dr. Colin Stearn (Geological Sciences, McGill); 29 were given a behind the scenes tour of the Montréal Aquarium; 18 visited the McGill Anatomy Museum (myself included); and 8 enjoyed a natural history tour of McGill University campus with Delise Alision (Redpath Museum).

The final day proved to be the "creme de la creme" of the meeting. It was devoted to special demonstrations and workshops including:

1) "Tricks with Plexiglass" by Tony Briza;
2) "Cleaning and Staining of Small Vertebrates" by Dan Faber;
3) "Eucapsulation of Specimen Labels" by Cathy Hawks and Carolyn Rose.

and others.

I attended a workshop on "Moulding and Casting" given by Gerry Fitzgerald (National Museum of Natural Sciences, Ottawa). If this workshop was indicative of the others, I am sure that all participants found theirs most informative and interesting as well. What I learned from the workshop will definitely prove to be most helpful to me in my anatomical work.

Following the daytime programme, participants were treated to generous and funfilled evening activities. Upon arrival and after registration on Sunday, we attended an "Icebreaker" which proved to be very uplifting (glasses, that is). The next social event, a "Soirée" held at the Alley, McGill University Centre, featured Québecoise cuisine, including tourtières and sugar pie. The Soirée also provided us with a sample of local entertainment, resulting in a delightful singalong and evening for all. Le vieux Montréal was visited by most on the free evening.

I am convinced that with the quality of presentations and the variety of candidates from different disciplines, the future will secure the necessity for the preservation of all kinds of natural history collections. It is with great praise and many, many thanks that I say "It was a great meeting" to the organizers and to all the staff of the Redpath Museum.

Wayne Lyons
Queen's University

Redpath Photos

Valerie Pasztor, McGill University, presenting the welcome address at Icebreaker.

Robert Carroll, Director of the Redpath Museum at the soirée.

Attendees viewing a poster paper.

Leanne Rockburn, Vanier College, demonstrating how to prepare bird skins.

Liz Sifton, Redpath Museum, behind her table of books.

(Left to right) **Front Row:** Delise Alison (Montreal), Ingrid Birker (Montreal), Eric Romero-Sierra (Kingston); **Middle Row:** Joanne Faber (Ottawa), Robert Carroll (Montreal), Shirley Albright (Trenton), Julie Golden (Iowa City), Carla Kishinami (Honolulu), Jane Danis (Drumheller), Julio Gisbert (Madrid); **Top Row:** Wayne Lyons (Kingston), Len Marhue (Ottawa), Dan Faber (Ottawa), Joan Kaylor (Montreal), Iris Hardy (Dartmouth), Paisley Cato (College Station), Carolyn Rose (Washington DC), Janet Waddington (Toronto), Stephen Williams (Pittsburgh).

Delise Alison describing Québecoise cuisine to Dave Fenner while Dan Faber and Mrs. Derek Ellis talk in the background.

Sunday night's Icebreaker. Can you recognize anyone?

Colin Stearn describing geological formations on Mont-Royal.

Julie Golden examining sponge spicules while Henry Reiswig and an attendee look on.

Photos by Louise Fabiani

Profiles

Daniel J. Faber, Ph.D.

From 1958 – 1962 Dan Faber spent his summers at the northern Wisconsin Limnological Station where Edward Birge and Chauncey Juday performed their early studies of North American limnology. In those lakes Faber discovered that certain species of larval fishes lived in the deep, open waters of small temperate lakes. Faber graduated from the University of Wisconsin in 1954 with a B.Sc., from the University of Rhode Island in 1959 with an M.Sc. in Biological Oceanography and from the University of Wisconsin (Madison) in 1963 with a Ph.D. (a student of Dr. Arthur Hasler).

In 1963 he accepted a position as Research Scientist with the Ontario government at the South Bay Fisheries Research Station on Manitoulin Island. In 1967 he was appointed Acting Director of the Station on Manitoulin Island. Dr. Faber moved to Ottawa in that same year to head the IBP initiated Canadian Oceanographic Identification Centre at the National Museum of Natural Sciences.

The Canadian Oceanographic Identification Centre was transformed into the Canadian Aquatic Identification Centre with four service units: marine zooplankton, marine benthos, freshwater and microbiota. The Identification Centre became a highly respected aquatic sorting and identification centre which flourished during the days of "environmental impact surveys". Faber attended the International Meeting of Sorting Centre Directors in Tunisia and was an observer on SCOR's Working Group 23, The Preservation of Marine Zooplankton. He went through the Northwest Passage in 1970 on the last leg of the famous "Hudson 70" Scientific Cruise around North and South America.

In 1978 the Identification Centre was terminated. After that, Faber began his studies on the early lives of fishes in earnest. He had started studies on larval whitefish in Lake Huron and gradually expanded his study areas to Barkley Sound in the Pacific and Gulf of St. Lawrence in the Atlantic Ocean. He taught workshops on technical aspects of larval fish study at Wheatley, Ontario; Winnipeg, Manitoba; Québec City, Québec; and Ottawa, Ontario; he invented a unique light-trap which captures numerous species of newly hatched larval fishes and aquatic invertebrates. In 1980 Faber was invited to join the Organizing Committee of the Early Life History Section of the American Fisheries Society and held a term as President (1981 – 1982).

Faber co-hosted the 1981 Workshop on the Care and Maintenance of Natural History Collections at the National Museum of Natural Sciences in Ottawa and edited the proceedings (*Syllogeus* No. 44, 1983). He was the founder of the Museum's publication *Syllogeus* in the Museum a decade earlier. He encouraged a second workshop, which was held at the Royal Ontario Museum in 1985. He chaired the Organizing Committee of the Society for the Preservation of Natural History Collections at the Buffalo Museum of Science and founded *Collection Forum* as a journal for natural history collection studies. He was subsequently elected the Society's first President.

Faber lives in Ottawa, Ontario, with his wife, Joanne, and a son and daughter. He has more than 50 publications and is the 1987-88 President of the Ottawa Club of Sigma Xi.

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 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.

Feature articles are not peer-reviewed. They are written to provide information about specific subjects to readers. They need not have references.

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. The Editor makes the final decision on whether a manuscript is acceptable for publication. 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 8-1/2 × 11 in. (21.6 × 27.9 cm), with margins of 1 to 1-1/2 in. (2.5 to 3.8 cm). Each page of the manuscript should be numbered. The first page should have only the title, byline, 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 8 printed pages. *Webster's Third 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 but complete 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.

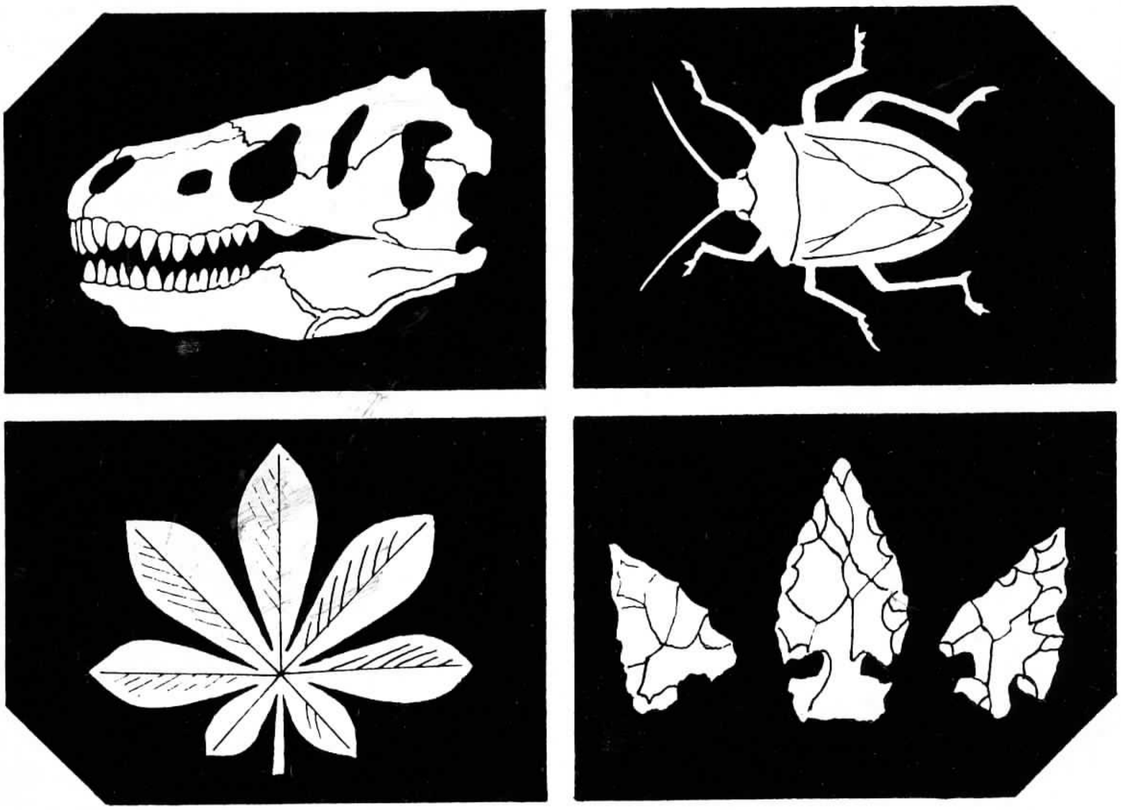
Line Drawings – The original drawing or a photograph and two sets of clear copies are required. Drawings should be made with India ink on plain or blue-lined white paper or other suitable material. Any coordinate lines to appear should be ruled in. All lines must be sufficiently thick to reproduce well, 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 1 mm high when reduced.

Photographs – One photograph and two good copies are required. The print must be of high quality, made on glossy paper, with strong contrasts. The copy for reproduction should be trimmed to show only essential features and mounted on white cardboard. The photo and each copy should be identified by the authors' names and title of paper, preferably written on the back and on the mounting cardboard with pencil. Coloured photos cannot be accepted at this time.

1988 ANNUAL MEETING OF THE

SOCIETY FOR THE PRESERVATION OF NATURAL HISTORY COLLECTIONS

MONDAY, 30 MAY TO FRIDAY, 3 JUNE



THE CARNEGIE

FOR MORE INFORMATION
PLEASE CONTACT

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