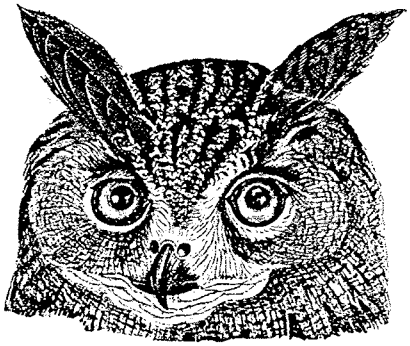
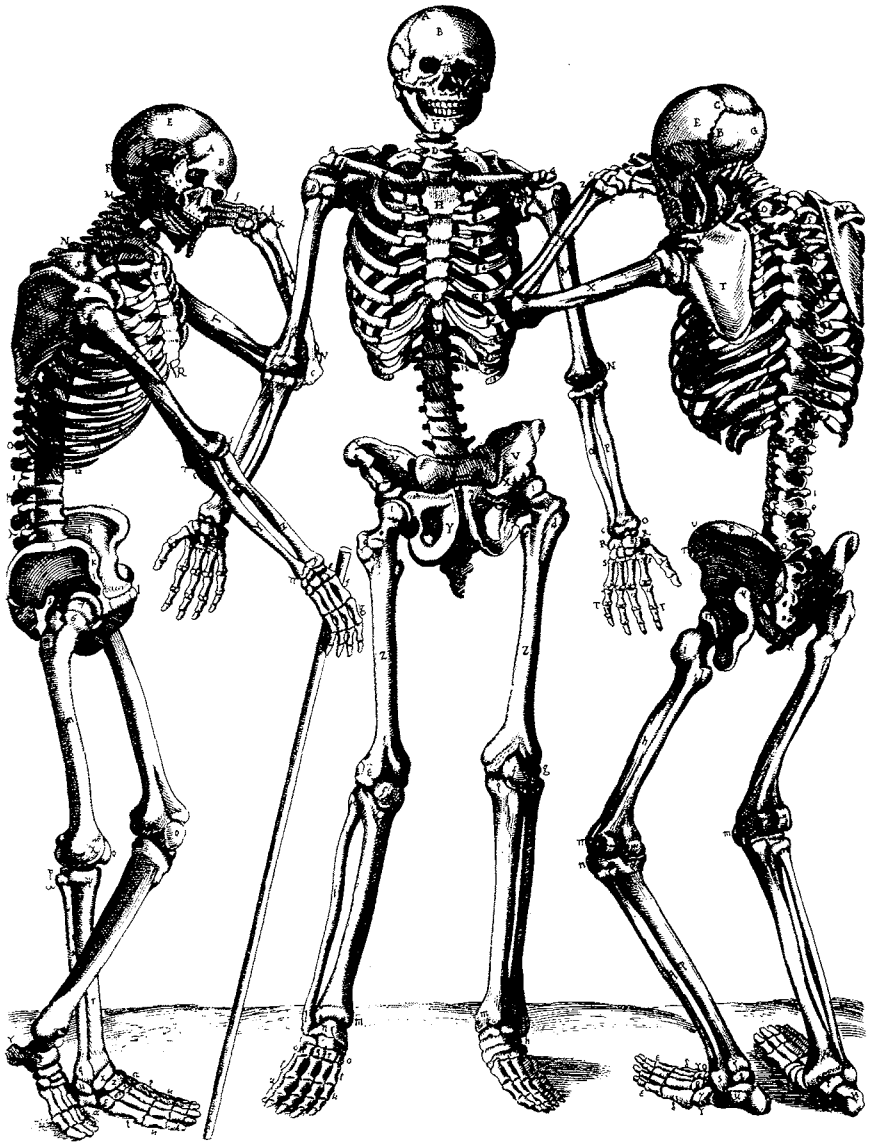


THE BIOLOGY CURATOR

BIOLOGY CURATORS GROUP

ISSUE 4 SEPTEMBER 1995

'BONES' MEETING — THREE PAPERS INSIDE



By the time this issue appears on your desk BCG's twenty- first birthday celebrations will have come and gone. For those that were not around in the mid 1970's and who are more familiar with the current system of specialist groups and good communications (comparatively at least - yes this issue is a month late!) it is hard to visualise the fragmented scene that predated BCG. Despite efforts of the Museums Association, the professionalisation of museums as exemplified by the founding of the Leicester and Manchester Museum Studies courses, coupled with the creation of new and specialist curatorial posts in provincial museums which had never had them before, left the new incumbents of these posts looking for an outlet for their skills. Mainly graduates used to dealing with publications and belonging to societies and clubs, it seemed only natural to band together for the greater good, to swap information and to organise meetings. The publications of the group have come on a long way from the duplicated pages of the early issues but, and you can guess what is coming, this newsletter, just like its predecessors depends entirely on you for its content. BCG has always encouraged all of its members to contribute to its publications, I hope it will always do so. Do not be put off by its appearance or the typeface. Please consider contributing yourself. It may be that you have a point to air, a process to describe, a new display to illustrate, all are the bread and butter of the editor and I cannot recall a single item that has been rejected outright. Send your item to the editor now!

As you can see, this is a bumper issue, several items have had to be held over and news has been truncated to give you all more meaty bits. A full account of the BCG Birthday Party will appear in the next issue.

Data Protection Act: please note that, in order to gain exemption from the provisions of the DPA **all** members must give permission for their names and addresses to be included on the computerised database which generates our mailing list. Permission can be by default so any member who has not informed the BCG Secretary of their objection to inclusion on the database in writing by October 31st will be deemed to be in agreement with the current situation.

The second half of this issue contains several papers that were presented at the Chester 'Bones' meeting earlier this year and includes an unusually high number of figures. These undoubtedly increase the value of the papers and rest the eyes a little too! Papers with figures and scurrilous photos of any kind are welcome.

Liverpool Fax: Liverpool Museum's new fax number is 0151 478 4390.

Natural Sciences Conservation Group: the following update has been submitted by James Dickinson on behalf of the committee of the Natural Sciences Conservation Group.

As you may be aware, UKIC has been going through a complete restructuring process, with severe implications for membership and subscription levels.

At the Natural Sciences Section AGM on 8 March it was agreed that the section would be left with no option but to separate from UKIC should the intended changes be ratified on 12 July.

In the light of this, the section Chair, William Lindsey, held further discussions with UKIC leading to UKIC Chair, Diane Dollery, attending the Natural Sciences Section Committee o May 18. Agreement was reached on an amicable split from UKIC and a proposal to this effect was prepared for submission to UKIC Executive. This was subsequently rejected by the Executive and on the 12 July the UKIC AGM ratified the proposed constitutional changes. The motion agreed on March 8 has therefore been implemented - *Those attending this meeting request the Natural Sciences Section Committee to prepare a new autonomous group ... to be activated in the event of an unacceptable new structure being adopted by UKIC.* The existing members of the group voted that they wished to stay together to represent the full spectrum of natural sciences conservation. Members who are paid up full or associate members of UKIC have been asked to write and request a transfer to another section to avoid an apparent division of loyalty between the new Natural Sciences Conservation Group and any remnant Natural Sciences Section operated by UKIC. The existing committee will run the new group until the next AGM (provisionally March 27 1996). Subscriptions will be £10 (considerably less than the £28 or £60 of UKIC). As members will no longer receive *Conservation News* it is intended to expand the NSCG's newsletter. A new subscription form will be issued shortly.

Care of Collections Forum is launched: details of this new multi-disciplinary group which operates across the widest spectrum of subjects and professions within museums can be obtained from Jane Henderson, CMW, The Courtyard, Letty Street, Cathays, Cardiff CF2 4EL.

PEOPLE

Jane Mee has been appointed Principal Museums Officer at Scarborough and has been replaced as Curator of Natural Sciences at Ludlow by **Kate Andrew**. **Donna Hughes** has been appointed Assistant Keeper of Botany (Herbarium) at the National Museums and Galleries on Merseyside. At Perth, long standing BCG member **Jim Blair**, who received the OBE earlier this year for services to museums in Scotland, has been appointed Director of Leisure and Cultural Services for the new unitary authority of Perthshire and Kinross while BCG Editor **Michael Taylor** has been appointed Head of Arts and Heritage. Congratulations also to Mike and to GCG's *Coprolite* Editor, **Tom Sharpe**, for their recent award of the Fellowship of the Museum's Association.

DIARY DATES

6-10 Nov 1995. Information: The Hidden Resource, MDA Conference, Edinburgh. Full programme now available from Museums Documentation Association, Lincoln House, 347 Cherry Hinton Road, Cambridge, CB1 4DH. Tel 01223 242848.

8-12 Nov 1995. BCG study visit to Brussels!

29-30 Nov 1995. Geology for all - the role of the curator in developing the public understanding of geology. GCG seminar, AGM and fieldtrip. Ludlow. Contact Colin Reid, Dudley Museum and Art Gallery, tel 01384 453574.

27 Mar 1996. AGM of Natural Sciences Conservation Group (provisional).

April 1996. BCG AGM Newcastle. Details in next issue.

INFORMATION WANTED

A colleague working on a historical

review of lepidoptera in Bedfordshire is trying to locate the following entomological works by the Rev. Charles Abbot (1761-1817): 1-*Entomologica Selecta* - a volume of notes in manuscript of over 300 pages referring to the lepidoptera of the district. This was sold in London in 1906 as one lot with a copy of Abbot's *Flora Bedfordiensis* (1798) and the description is extracted from the sale catalogue. 2-*Linnaei Insecta Anglica Lepidoptera* - an original MS "being an account of the English lepidoptera according to Linnaeus, with descriptions of their food plants, localities etc., also further notes on localities by J.C. Dale, the later owner". Listed in Wheldon and Whesley's catalogue of 1928 as "together with a copy of Flora Bedfordiensis, 1798 bound in two vols, 8vo, calf". It is not clear whether this is the same MS appearing for sale twice under different descriptions. 3-*A short Life history of insects* (1798). This was sold at auction in London in 1936.

Any information on the above to Rosemary Brind, Bedford Museum, Castle Lane, Bedford MK40 3XD. Tel 01234 353323.

Jan Ruzicka is working on a revision of the *Choleva agilis* species group (Coleoptera: Leiodidae: Cholevinae; commonly treated also as Catopidae) and would be pleased to hear from museums with holdings of this group with a view to arranging the loan of specimens for study. Jan can be reached at the Department of Ecology, Faculty of Forestry, Czech Agricultural University, CZ-165 21 Praha 6-Suchdol, Czech Republic.

The National Museums of Scotland have recently been given the catalogue (with full data) for the egg collection of J.J. Dalgleish. This important collection was dispersed among a number of museum collections. If you would like to obtain the data for your J.J. Dalgleish eggs, contact Andrew Kitchener or Bob McGowan, NMS.

NMS are also seeking a male Right Whale, *Balaena glacialis*, skull originally acquired in 1912 by Sir William Turner of the Anatomy Department, Edinburgh University. The whale was caught on June 29 1912, 20 miles NE of St Kilda by the Whaler *Samuel Scott*. It was 51 ft long and 32 ft in girth. The bulk of the Turner collection was transferred to the Royal Museum of Scotland in 1956 but this skull was not and its current location is unknown. Any information on the missing skull to Andrew Kitchener, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF. Tel 0131 225 7534.

The Horticultural Taxonomy Group (HORTAX) is an autonomous, internationally recognised forum of horticultural taxonomists and horticulturalists within the British Isles dealing with matters of nomenclature and the taxonomy of cultivated plants. Founded in 1988, it has the support of the Botanic gardens at Kew, Edinburgh, Glasnevin and the Royal Horticultural Society amongst others. HORTAX has been carrying out a survey to gather information on any herbarium collections of cultivated plants existing in the British Isles. In 1993 a questionnaire was despatched to all the relevant herbaria listed in *Index Herbariorum* followed by a request in *BSBI News*. If any member of BCG has any knowledge of such collections will they please contact Susyn Andrews, Chaiman of HORTAX, c/o Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB.

Museums Association Associateship - the new draft proposals: A Joint BCG / GCG Response.

The following was submitted to the Museums Association:

Having circulated the draft proposals document to the committee members of both groups, and after consultation, it was decided that a joint response on behalf of both groups would be formulated. This is given below. The views are a summary of all those expressed by the various members, and also take into account reactions from the current student members of our group.

Overall, the committees feel that this scheme is to be welcomed. We feel, however, that insufficient attention has been given to the details of the scheme, and that the document is not yet ready to be approved by the Council. Our reservations are set out below.

Definition: the document states or implies what the AMA is not, but remains vague about what it is. The MA seems very keen to avoid the AMA being a qualification, though it is not clear to us that there is any over-riding reason why this should not be so. This is the situation in other professions. However it is acknowledged that it would be much more difficult and expensive to run the scheme in this way. Furthermore it would remove the MA's control over the award after it has been made, as a qualification cannot be taken away after it has been given.

CPD and S/NVQ's: These have raised the biggest concerns. It is agreed that Continuous Professional Development is appropriate for a profession in which career progression and the setting of professional standards is generally open-ended and very wide ranging, but there is no indication of how they will be put into practice. In particular, the quantity and timescales seem to be entirely arbitrary, there is no acknowledgement of the fact that CPD will apply in very different ways depending on the individual, and it seems to be suggested that CPD should only be required up to the point of the award, in which case it is not CPD at all. If, however, it is to continue throughout the individuals career, then this implies that the individuals AMA status will be regularly reviewed. Before the method can be formally adopted it will be necessary to establish what training is available, and whether it will be of the nature and quantity to make this method tenable. S/NVQ's are as yet untested, and it is not clear that they will be an appropriate route to a professional award. The MTI itself has a decidedly poor reputation within the museum community (whether or not this is still deserved) and so has still to show that it is fit to be the profession's training lead authority. The whole question of assessment and validation remains open. The award's credibility rests at least in part in confidence in the system and the people running it. These issues will be crucial to the success of the scheme and will need to be fully assessed before the scheme can be approved.

Target Candidates: That the MA should be opening up its professional award to non-curators, has been questioned but it is generally accepted that this is a valid course of action. However this should not result in the dilution of the assessment for each area. Particular concern has been raised over the lack of the practical exam. Given that the context of making the award is the MA's definition of a museum, the ability to care for collections in a practical sense is of paramount importance in the assessment of curatorial candidates. It is suggested that the award may be

made under a range of divisions, each with requirements appropriate to that area of work, eg. AMA (curatorial), etc. Also of concern is the disparity between the holders of the new award and those of the old award. It seems that both groups feel there is the potential for the credibility of the status to be undermined by the other group.

Mentors: This, again, is a system that seems appropriate to the nature of the profession and this scheme. However, the demands on a mentor will be much greater than those on a diploma tutor, because of the much broader range of guidance and supervision required, and the potentially longer timescale. Furthermore, the standards of mentorship will need to be more or less uniform. It is to be expected that the mentors will need some level of guidance and possibly training. With regards to referees, there is an opinion among the students that they should not be required to assess their referees competence and knowledge, and it is difficult to see how this could be viewed as a reasonable demand upon the students.

Timetable: It is not clear what is the timetable for putting this scheme through, particularly with regard to membership approval. It is not even clear whether such approval, by the logical way of the MA AGM, is to be sought. There is certainly a suggestion that Council is seeking to have it cut and dried by the end of July. We do not believe that all the issues will have been sufficiently explored by then.

Costs: It is difficult to see how anything more than a nominal charge could be made, since none of the criteria are to be achieved at the MA's expense. Indeed, one of them, membership of the MA is to the MA's financial benefit, and carries with it the expectation of certain benefit, which includes the status of AMA when all the appropriate criteria have been achieved. Should the fees be substantial, the MA may well be expected to explain where the costs arise.

Code of Conduct: This represents the best opinion of a group of people, (MA Council), at a certain point in time, and also represents MA policy. As such, it is a political document, to which signed adherence is not to be recommended. Furthermore such an action would result in it being a set of rules not a code of conduct, and would presumably also make it a contract, with the consequent legal implications. Membership of the MA implies a general acceptance of the code, and could be removed anyway if the code was unreasonably infringed.

In general, we feel that this is an important issue, with the opportunity to create something of lasting value to the profession, and one which is unlikely to arise again in the near future. In other professions, a formal professional award, often chartership, is the hallmark of quality. It may be instructive to look at the examples of other professions in establishing this for the museums profession. We believe that the present project is moving in the right direction, and are not trying to suggest that the proposed methods and criteria are wrong. We do believe, however, that any final decision should be avoided until the above issues have been fully explored and their validity and practicability have been demonstrated.

Signed on behalf of BCG and GCG committees by

BCG Chairman	GCG Chairman
Mike Graham	Paul Ensom

REVIEW

MANUAL OF NATURAL HISTORY CURATORSHIP. Edited by Geoff Stansfield, John Mathias and Gordon Reid. Published by HMSO, £45. h/b. 1994. 306 pp. ISBN 0 11 290513 7. b/w photographs and drawings.

The first time I saw this book was in the National Museum of Natural History in Leiden on the BCG Holland study trip. Several jaws dropped to the floor as nobody else had seen a published copy, including several of the authors. However, it is now widely available and should (hopefully) be on every curators' book shelf.

The aim of the Manual is to provide a basic reference for all involved with natural history museums or collections at all levels, including curators, administrators, committee members and trustees. The book focuses on zoological and botanical material, omitting geological collections as these have been covered by recently published monographs, eg Knell and Taylor (1989). It also recognises that it cannot cover everything in great detail so has very full reference lists of more specialised publications.

The Manual has fourteen chapters written by eleven natural history curators: Functions and Organisation of Natural History Museums; Acquisition of Collections; The Preparation and Preservaton of Collections; Documentation of Collections; Housing and Maintenance of Collections; Using Natural History Collections; Natural History Museums and Biological Recording; Live Animals and Plants in Natural History Museums; Health and Safety in Natural History Museums; Education and Interpretation in Natural History Museums; Natural History Museum Exhibition; Schools and Natural History Museums; Information Services, Publications and Sales; Working with Other Bodies.

On first opening the book I was struck by the amount of text. This is a wordy tome, packing a lot of information between its covers. The chapters vary greatly in style, some general, others going into specific details, eg in depth chemistry for specimen preparation and preservation. However, I was disappointed with the lack of visuals. There are five sample labels and an MDA card, sixteen drawings of practical storage ideas and one b/w photograph of bound herbaria. I would have liked more visual examples to break up the rather heavy pages of text particularly of different methods of storage, preparation and display of both live and preserved collections. I can only assume that such additions would have added too much to the selling price. There are many recommendations for materials and equipment throughout the manual but a main suppliers' list would have been a useful addition.

This is primarily a reference work, pulling together many aspects of natural history practice. Several of the chapters read as nothing more than subject overviews, probably fulfilling their remit. Sadly, however, there is too little real practical advice for my liking. You will find some such advice in the areas of preparation, preservation, documentation, housing, maintenance and live material but you often have to hunt through a lot of haystacks to find the needles.

How useful a book this is can perhaps be measured by how often it is used on a daily working basis. Apart from reading it for this review I have to date only looked at it again twice. That

may say more about me than the book but I'll let you discover that for yourselves. As a baseline recommendation, for anyone starting up in natural history this is an invaluable publication and should be read from cover to cover. For us old lags there is enough to jog our memories and remind us to change our bad habits.

Steve Woolfall, Grosvenor Museum, Chester

PUBLICATIONS

Natural Science Collections in Scotland - this is the catalogue produced by the Scottish Natural Sciences Collections Research Unit in 1987. Now slightly out of date but still very useful. Anyone who balked at the original price of £25 can now pick up a remaindered copy for the unbelievable bargain price of £5 (incl postage), from the Publications Section, National Museums of Scotland, Chambers Street, Edinburgh.

Checklist of the Cerambycidae and Disteniidae (Coleoptera) of the Western Hemisphere - available from Wolfsgarden Books, P.O.Box 10716, Burbank, California 91510- 0716, USA. Price $84.60 incl. international postage.

World Checklist of Seed Plants - vol 1 parts I and II now available for 260 Swiss Francs from MIM Editions, Lakborslei 114, 2100 Antwerp, Belgium.

EXHIBITIONS

Natural Curiosity is a new and very interesting small exhibition in the entrance of the Royal Museum of scotland, Chambers Street, Edinburgh. It traces the history of Natural History in Scotland from the seventeenth century using historic specimens from the Scottish national collections.

Feather, Fur and Fin: a look at taxidermy is a new display at Chelmsford Museums Service tracing the origin and development of taxidermy using specimens of (mainly) birds, fish and other animals which have been included in the specimen conservation programme initiated eight years ago and which it seems, unfortunately, will be the swansong of the South East Museums Service conservators.

Julius Brenchley, Gentleman Explorer is a new exhibition at Maidstone Museum. This tells the story of JB's life and various travels around the world using the natural and ethnographic objects he collected.

The Centre for Understanding the Environment is the latest development at the Horniman Museum and has been described as one of the most advanced ecological projects of the last ten years. Built from sustainable timber CUE is insulated with recycled newspaper, finished with non-toxic organic paint and topped with a living grass and wild flower roof. [This is crying out for a review, volunteer please - Ed]

Bird Biology: an exhibition about birds - a soaring Ruppell's vulture, *Gyps rueppellii,* has spotted a dead young antelope lying on the arid sands below. It circles above the carcase rapidly losing height and eventually lands nearby, the first scavenger to arrive at this meagre meal. After tearing through the thin skin, the vulture begins to feed on the soft internal organs while a marabou stork, *Leptoptilus crumeniferus*, watches on, patiently waiting for scraps. You could be watching this scene in Africa, but you are actually looking at this first spectacular exhibit in Bird Biology, a new permanent exhibition about the biology of birds, which opened to the public last October.

Bird Biology focuses on three main aspects on the biology of birds - flight, feeding and reproduction. It makes use of the extensive collection of mounted birds of the Natural History Department, many of which were formerly on display in the gallery next door. But instead of serried ranks of every conceivable bird on Earth, this new exhibition shows how the shape, structure, coloration and size of a bird are adaptations to help birds exploit virtually every food source in every habitat all over the world.

Intermingled with the older mounts are many new specimens, which have been mounted specially in dynamic poses to show particular behaviours. So now, you can see a lammergeier vulture, *Gyaepatus barbatus*, swallowing large lumps of bone like a sword swallower, a female wreathed hornbill, *Aceros undulatus*, which has incarcerated herself in a tree nest hole with a wall of mud, leaving only a small slit through which the male feeds her, and the bizarre courtship of the male houbara bustard, *Chlamydotis undulata*, which resembles a feather duster crossed with a headless chicken.

The introduction shows that birds evolved from small carnivorous dinosaurs and the function of the vital combination of feathers, skeleton and eggs which defines birds. It also shows the biggest living bird, the ostrich, *Struthio camelus*, alongside one of the smallest, the vervain hummingbird, *Mellisuga minima*, which is no bigger than the ostrich's eyeball.

The second section, Flight, shows how birds fly and, in particular, how wing shape affects the way in which they fly, whether it be a sparrowhawk in rapid pursuit of its prey or a pheasant taking off vertically to escape a fox. Many birds in a museum are shown sitting on a perch or on the ground, but Bird Biology shows a multitude of birds in flight. The apparently mysterious way in which birds successfully migrate over thousands of kilometres is also investigated. The highlight of this section is a newly mounted female wandering albatross, *Diomedea exulans*, which can be seen gliding over the ocean with her wings stretched fully to their three metre span - a truly magnificent sight.

The third section, Finding Food, aims to show some diversity of the birds of the world by looking at how they are adapted to feeding. By focusing on different diets (eg seeds, fish, nectar etc), it is possible to see how different bird families have evolved either very similar or very different solutions for feeding on a particular diet.

The fourth section, The Cycle of Life, looks in detail at the many different aspects of reproduction from nest-building to hatching from the egg and rearing of the young. In particular it looks at the wide diversity of nests and nesting materials and how these relate to the shape and coloration of eggs. It also focuses on cuckoos and other birds which parasitise the nests of other species and so avoid the labours of parenthood, and contrast them with many other bird species, in which young from the previous year help to rear their siblings.

The final section, Attracting a Mate, completes the cycle of life by showing the different ways in which birds attract mates using songs, brightly-coloured plumage and often bizarre displays. It shows that birds have two main mating strategies - most are monogamous, but a few are polygamous with either males or

females benefiting from multiple partners to increase their reproductive successes. The importance of choice is illustrated to good effect with a reconstruction of the display ground or lek of a wading bird, the ruff, *Philomachus pugnax*, where the female has come to choose a mate from the many displaying males. This section also features an audio-visual programme, which allows you to hear the songs and calls of birds from around the world.

Bird Biology is a spectacular mix of the old favourites and the new, and will provide an interesting and popular insight into the often bizarre biology of the birds of the world.

Andrew Kitchener, Natural History Department

National Museums of Scotland, Edinburgh

[The above is reproduced, with thanks, from an article which appeared in the National Museums of Scotland's *Reporter* for autumn/winter 1994]

A POINTS STANDARD FOR AUDIO-VISUAL PRESENTATIONS: A Rating system for slide presentations.

[*Editors Note: This talk was given last April at the Manchester Conference on the Value and Valuation of Natural History Collections. I thought those members of BCG who were unable to attend might appreciate reading it*]

It is suggested that from next year, all speakers have to submit audition videos in advance of giving an audio-visual presentation. Everyone starts with 1000 points. A score of 500 is needed in order to be permitted to speak. You have been warned!!!!

-100	Use of any of the following buzzwords: buzzword, bottom line, target date, cost-effective, interface (as a verb), human resources, state-of-the-art, impact (as a transitive verb)
-50	Blaming slides/lighting/ collections/museum/planet on director/curator/collections manager/janitor
-500	Opening with "I want to take you on a little slide tour of my museum, which has never been represented at these meetings before"
-100	Use of any of the following phrases:
-	"Let me tell you a little bit about my background."
-	"Let me tell you a little bit about my museum."
-	"As I was putting this talk together last night..."
-	"Why did I put this slide in here?"
-	"This talk made sense when I put it together."
-	"I know that slide is in here ; somewhere. Well, we'll just get to it later."
-	"Oh! Forgot that slide was in here."
-	"I should have used this slide earlier."
-	"What is this? Oh, this is a closer view of the object in the previous slide."
-	"Now, this is an SEM shot...wait, maybe this is the topo map."
-	"I should have used this slide for the last point. I guess I forgot to forward it, eh?" {Americans: read "eh?" as "huh?"}
-1000	Saying "Oh! My God!" and staring at the screen for more than 5 seconds.
-	Saying "Well, I guess that everyone has days like this, huh?"
-	Saying "I was going to write my talk up in advance, but I decided to wing it instead. I know you'll understand."
-5000	Saying "The next speaker's not going to be here, so they asked me to put a few slides together for you."
-20	Dropping notes.
-50	Saying "oops" after dropping notes.
-5	Dropping microphone.
-100	Knocking over lectern.
+100	Choreography after knocking over lectern.
+15	Each minute under the time limit.
-100	Sunset slides
+10	Musical background
-20	Soft jazz musical background
-50	Use of overheads
-500	Combining slides and overheads without practising the use of either
+10	Use of videos
-20	Slide upside down or reversed
-50	Stopping talk to flip slides
-100	Telling audience that slides are upside down or reversed
-20	Slide with vast quantities of data in illegibly small type
-100	Telling audience that it is not expected to be able to read such a slide
-20	Underexposed or overexposed slides
-100	Informing audience that slide is too dark (or light) to be seen
-75	Trying to convince audience that slide is not overexposed, but is instead archival
-200	Slide of something dark floating in a pan of indeterminate liquid with someone's finger pointing to an indeterminate feature.
-100	Group shot of entire staff looking uncomfortable and artificially posed
+100	Group shot of entire staff looking entirely too comfortable and artificially relaxed
-50	Inappropriately dirty pictures
+100	Appropriately dirty pictures
+500	Appropriate phone numbers
-50	Aerial shot of building from satellite orbit level

AUTOMATIC DISQUALIFICATION

- Photo of any living relative (photo of cute child will result in a 2-year suspension)
- Photo of pet
- Photo of speaker's cluttered desk
- Photo of food
- Photo of museum parking lot

+100	Cartoon no one has seen before
+100	No overheads
-50	Thumb or lens cap in photo
-75	Out of focus
-100	Misidentification of slide taken by speaker
-100	Going back to any previous slide
-200	Leaving slide up on screen until it melts
+100	Handouts
+200	Snacks
+500	Taking audience to bar
-500	Spending too much time in bar before presentation
-10	Taking the first 5 minutes to show slides of work area 66 when talk has nothing to do with it
+1000	Taking the first 5 minutes to give audience drink vouchers to use in bar when talk has nothing to do with it
-10	Forgetting name of the organization to which speaker is speaking.
-10	Giving a boring talk
+50	Admitting the talk is boring

John Simmons, Collections Manager, Herpetology, Museum of Natural History, University of Kansas, Lawrence, Kansas USA, and Sally Shelton, Director, Collections Care and Conservation, San Diego Natural History Museum, PO Box 1390, San Diego, California 92112, USA.

THE "BONES" MEETING - Monday, 20th February, 1995 at the Grosvenor Museum, Chester.

Editors Note:

53 people attended the meeting.

The morning session was chaired by Maggie Reilly, Hunterian Museum, Glasgow, and talks were given by James Rackham (an Environmental Archaeologist), Chris Norris, Kate Andrew (Geological Conservator and Collection Care Consultant), and Paul Finnegan (Natural History Centre, Liverpool Museum).

The afternoon session was chaired by Steve Garland, Bolton Museum, and talks and demonstrations were given by Kate Andrew (again), Clem Fisher, Geoff Yates, and Rosina Down (University College London).

Three papers based on the talks are published here; it is intended that papers by James Rackham, Kate Andrew and Rosina Down will appear in the next issue.

THE USE OF OSTEOLOGICAL COLLECTIONS FOR SYSTEMATIC RESEARCH

Dr Christopher A. Norris, Zoological Collections, The University Museum, Parks Road, Oxford OX1 3PW

Introduction

Osteological material has a very great significance in systematic studies of vertebrates. As Szalay (1994) states, its use ensures the vital continuity between living and extinct forms. Even with the great advances in molecular techniques made over the last twenty five years, the osteological collections of the world's museums remain in constant demand as a source of taxonomic data.

This paper briefly reviews the categories of research methodology that can be employed when using osteological materials for taxonomic purposes and their applicability to the range of osteological collections available in museums. The types of bone most commonly used are described and, in conclusion, some of the problems and opportunities for managers of osteological collections are discussed. The paper concentrates to a large extent on mammalian systematics, but the general principles are applicable to most types of vertebrate material.

Research Methodologies

Broadly speaking, the systematic research methodologies employed on bones can be characterised as "direct" or "indirect." Direct methodologies involve the use of the actual bones as a source of data, be it in a quantitative or qualitative form. In contrast, indirect methodologies use the bone as the starting point for the analysis, but derive their final result from the molecules contained within the bone; for example, through the comparison of homologous sequences of DNA.

Direct methodologies

1) Quantitative studies. These involve the measurement of the specimen (using a variety of dimensions) and the replication of these measurements across a large number of other specimens. Analysis of the resulting data using a specialist software package produces phylogenies based on numerical similarity. The strength of such methodologies lies in their ability to distinguish the subtle differences in proportion that may separate populations of a species, or species within a genus. However, this same sensitivity makes such methodologies unsuitable for studies of more distantly related taxa, where the magnitude of the differences may swamp the analysis.

There are a large number of confounding variables in such analyses, whose elimination tends to dictate the requirements in terms of material. A largen umber of specimens is required, in order to reduce the effects of individual variability (e.g. in size). It is helpful to have access to series of specimens from the same locality, in order to separate within-locality variation from between locality variation. Wherever possible, specimens should be compared with those of the same age and sex, to reduce the effects of variation based on these factors (e.g. sex-based dimorphisms). It is also important to have a set of measurements that may be accurately replicated. The type of collection available may have a marked effect on this. For example, in the taxonomic review of the marsupial genus Phalanger carried out by Menzies & Pernetta (1986) a large proportion of the specimens used were hunting trophies obtained from indigenous peoples in New Guinea. In such specimens the cranium had usually been shattered to allow removal of the brain. The specimens were thus reduced to the orbito-rostral and palatal areas of the skull (see below). Although more complete specimens were available in the museum collections utilised by Menzies & Pernetta, the need to ensure replicability across all the samples meant that the study was restricted to a set of palatal dimensions (figure 1) which represented the "lowest common denominator" of the material available.

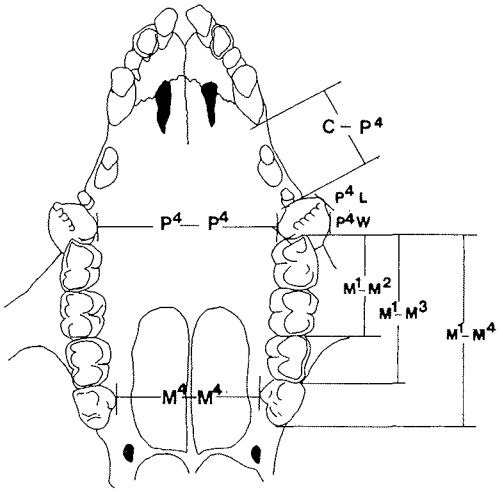


Figure 1. Palatal view of the skull of a cuscus (Phalanger), showing the dimensions recorded by Menzies & Pernetta (1986).

The demands of quantitative studies, in terms of the size and characteristics of the collections required and the quality of the associated data, are such that they cannot be effectively undertaken in any but the largest of collections.

2) Qualitative studies. Such studies involve examination and categorisation of a variety of distinctive morphological features of the specimen. An example would be the relationship between two bones in the skull - do they meet directly at a suture, is there a third bone separating them, etc? Comparison of a number of specimens within the same taxon enables a judgement to be made as to whether the formation of the character is consistent for that grouping. If it is, then it can be added to a set of characters to be compared between taxa. The observations are converted into a binary format for

each character (e.g. 1 = bones touch; O =bones are separated) which can be entered into a specialist software package which compares the data sets and produces a phylogenetic tree based either on overall similarity (phenetic) or specific character distribution (cladistic). Such studies are best employed for elucidating the relationships between higher level taxa (i.e. at a supra-generic level). At lower levels the analyses are handicapped, because the differences between taxa at the specific and subspecific/population levels are often not of such a magnitude that they can be picked out by eye.

Overall, the effect of confounding variables in qualitative studies is much smaller than for quantitative work. For this reason, qualitative studies represent a less demanding discipline in terms of the quality of material available. In contrast to quantitative studies, species coverage in "breadth" rather than "depth" is required. This makes qualitative work suitable for moderately large collections such as those at Oxford, where the emphasis on the teaching role of the Zoological Collections has led to a wide species coverage, but only limited numbers of specimen per species.

Indirect methodologies

Over the past five years, much interest has been generated regarding the potential for extracting molecular information from museum specimens. In particular, the development of the polymerase chain reaction (PCR) in the late 1980s has made it possible to amplify selected sequences of DNA from the quite small fragments available in preserved materials, to the point where they can be sequenced. This interest has been heightened by a number of high- profile successes, notably the extraction of "ancient" DNA from a skin of the extinct marsupial "wolf" *Thylacinus* (Thomas et al, 1989), a 13,000 year old giant ground sloth of the genus *Mylodon* (Paabo, 1989) and a 17-20 million year old fossil *Magnolia* leaf (Golenberg *et al*, 1990). Thomas *et al* (1990) have carried out a study of the relationships between populations of the rodent *Dipodomys panamintinus* on the California Channel Islands based entirely on DNA extracted from museum specimens (see also Diamond, 1990). The use of museum collections for such work may increase in the near future, but a number of caveats should be attached to this statement. Firstly, such studies remain the preserve of the well-resourced and highly-specialised molecular biologist and are currently beyond the means of all but the largest of museums. The degraded nature of ancient DNA makes extraction particularly problematic, with Paabo (1989) reporting that the condition of DNA from a specimen of 100-200years' age is little better than that of a specimen of many thousands of years' age. Consequently, the expertise required is restricted to a small number of groups worldwide. Although DNA can be extracted from bone, osteological material is not ideal: tissues with a high cell-count, such as muscle, kidney, testis or ovary, tend to be more suited to such work. Consequently, extractions from bone are only really worthwhile when this is the only material available. For systematic studies, this is only likely to be true in the case of extinct or extremely rare specimens. In such cases, the collections manager is faced with some difficult ethical decisions, which are discussed at length below.

Classes of Bone used for Systematic Studies

The Postcranial Skeleton. The postcranial skeleton is made up of two of the three skeletal systems that make up the vertebrate body; the axial (i.e., vertebrae, ribs, sternum and, if present, gastralia) and appendicular (i.e., limbs, girdles) skeletons. Whilst there is potential for qualitative studies employing postcranial bones, the region is rarely utilised in qualitative systematic studies at less than the familiaral level and, where postcranial characters are used, they form only a limited proportion of the total character set: for example, in the review of the systematics of the Family Bovidae by Gentry (1992) only 35 of the 112 characters sampled were drawn from the postcranial skeleton; the remaining 78 characters were those of the skull, horns and dentition. There are very few studies that employ only postcranial bones; a notable exception is the work of Szalay on the morphology of the ankle joint in primates (1975) and marsupials (1982;1994) .Where postcranial characters are incorporated this is often a reflection of a frequent occurrence of postcranial material in the fossil record for the group concerned, as in the case of the bovids. Equally, the absence of postcranial characters from a study may reflect a paucity of this material in the museum collections used. This is a problem which afflicts even the largest of collections. For example, the Mammal Collections of the Natural History Museum, London, contain well in excess of 200 specimens of cuscus (genera *Ailurops, Strigocuscus and Phalanger*), yet in only four cases was the author able to find associated postcranial material. There is a good reason for this, namely that the conditions under which field collection of specimens is carried out may impede the collection of postcranial material. Given the fact that time and resources are often limited, complete dissection of the skeleton is often not feasible. A choice must then be made between preservation of the whole specimen in spirit (with the attendant problems of weight) or only part of the specimen, usually the skin (with tail and feet) and skull. In general, the latter option prevails, driven both by the necessity to reduce costs (in porterage and air freight) and the belief that postcranial material is of only limited use for systematic work. For this reason, postcranial material should be regarded as a rare and potentially valuable resource in museum collections.

The Skull. The skull is by far the most commonly used skeletal element in systematic studies of vertebrates. There are three main reasons for this. Firstly, the skull contains a large number of bones. Related to this is the fact the number of bones involved, and the complex patterns of development within the region, give rise to considerable scope for variability. However the third, and most likely reason is that the skull is the most commonly preserved bone complex in museum collections.

A wide range of potential character complexes exist within the skull. In mammals, these may be conveniently divided between three main regions.

1) The dentition. As Szalay (1994) points out, much of the mammalian fossil record is dental. This is particularly true for Mesozoic mammals and, since an understanding of the inter-relationships of these groups is vital for fixing the fundamental branching patterns of mammal phylogeny, it is perhaps unsuprising that judgements regarding taxonomic diversity and relationships are often based on dental characters. This is reflected in the complex nomenclature that has been developed to describe tooth morphology (figure 2). However, there is no a priori reason why dental characters should provide a better reflection of phylogenetic relationships than any other part of the animal's phenotype.

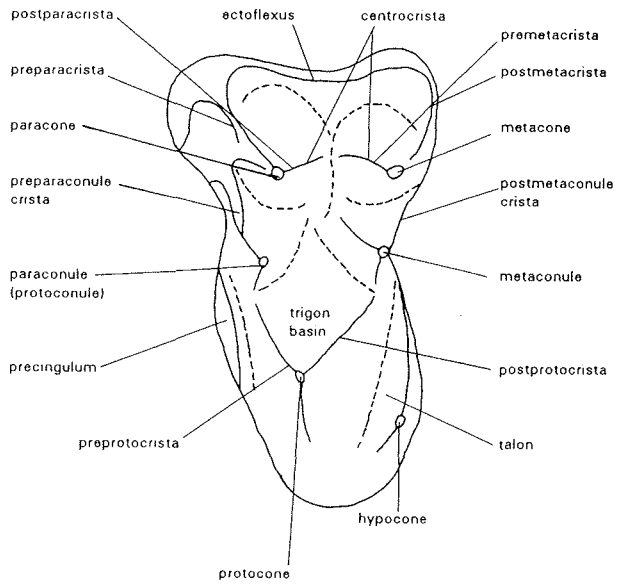


Figure 2. Occlusal view of the upper tribosphenic molar of a therian mammal, showing some of the cusps and other common features.

Teeth can be used in a number of ways for systematic studies. From a qualitative point of view, attention can be concentrated on the presence or absence of particular teeth, for example the premolars (always given that truly homologous teeth are being compared; Archer, 1975). Alternatively the morphology of the individual teeth can be studied, in terms of the presence or absence of particular cusps or ridges (cristae). Quantitative studies can look at the distances between teeth, the length of tooth rows, or the length of individual teeth. The latter is often difficult to measure directly, particularly in small mammals: a good way round this problem is, for example, to measure the length of the whole molar row (M1-4), then subtract the length of the

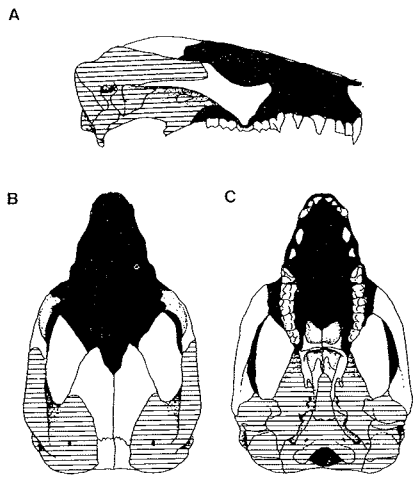


Figure 3. (A) lateral, (B) dorsal and (C) palatal views of the skull of a brushtailed possum (Trichosurus vulpecula). Dark shading = orbito-rostral region; horizontal shading = basicranial region.

row from the second to the last molar (M2-4) to give the length of M.

2) The orbito-rostral complex. As the name suggests, this is basically the snout and the facial portion of the skull (figure 3), including the orbits. From the perspective of quantitative studies this is an extremely important area: the dimensions and proportions of the bones in this region are

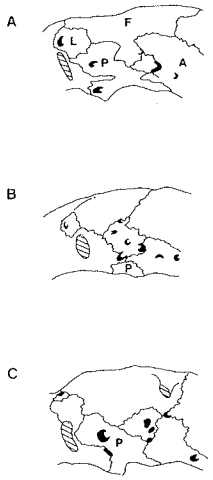


Figure 4. Orbital mosaics from (A) a marsupial (Didelphis), (B) an insectivore (Echinosorex) and (C) a primate (Lemur). L = lachrymal; F = frontal; A = alisphenoid; P = palatal. Shaded regions are cut surfaces of zygomatic arch (A, B & C) and postorbital bar (C only).

largely responsible for determining the shape of the skull. Qualitative studies in this area tend to concentrate on the relationships of the individual bones to each other, for example in the pattern of suture formation amongst the bones of the "orbital mosaic," which lies behind the eye (figure 4).

3) The basicranium. This is a region of great complexity, forming the underside of the braincase and including the jaw articulation and the bony structures of the middle and inner ear. Most of the major cranial nerves and blood vessels leave the skull through foramina in this region and the considerable variation in the branching patterns of these vessels leaves its mark in the variability in distribution of these foramina and their associated canals and sulci (grooves). Two of the most complex bony structures in the mammalian body, the periotic bone (which houses the cochlea and the semi-circular canals) and the auditory bulla (the bony floor of the tympanic cavity) are found in this region: both have been the subject of taxonomic studies (Novacek, 1977; MacPhee, 1981; Wible, 1991; Norris, 1993; 1994). Many of these structures are actually concealed within the skull and require dissection, although fragmentary specimens can prove useful in such cases.

Problems and Opportunities for Managers of Osteological Collections.

Given the revolution in the use of molecular techniques for systematic studies, it may seem surprising that there are still plentiful opportunities for the use of osteological characters in such studies. Ironically, however, the growing use of molecular techniques is likely to increase rather than reduce the demands made on museum collections. Phylogenies based on molecular data often conflict with established theories based on morphology, demanding re-examination of old morphological character states and the exploration of new character complexes (Novacek, 1992). It is in this climate of change, which Novacek optimistically describes as "a new renaissance" for morphological studies, that curators and collection managers will be faced with not only with great opportunities for the use of their collections, but also some important ethical dilemmas .

Destructive sampling. Extraction of DNA from bone for molecular studies requires the removal and destruction of part of the specimen. As was mentioned above, bone is not an ideal material for the extraction of DNA. For this reason, it is likely that such request is likely to be made in cases where osteological specimens are the only material available. Such cases could include specimens that are scarce in collections nationally, or where the species involved is either rare or extinct. Given that bone is a poor candidate as a source of DNA, it is probable that increasing the amount of the specimen removed will increase the chances of a successful extraction. Clearly, once a decision has been made to permit such destructive sampling, a successful outcome to the project is highly desirable if only because it makes it easier to justify the damage caused. For the person with responsibility for such material, a number of questions have to be asked. Is the project unique and important, or does it duplicate other studies? Are there alternative sources of material? If the decision is made to permit sampling, how much material should be removed? If the extraction is unsuccessful, should repeat sampling be permitted?

Dissection of specimens. Related to the issue of destructive sampling is the question of when to permit the dissection of osteological material. The constant drive for "new" character complexes for systematic studies means that the attention of taxonomists is increasingly being drawn to structures which are not visible externally. An example of such a character would be the periotic bone, which is one of the most substantial and complex bones in the mammalian skull and yet is barely visible externally in many groups of mammals. In such circumstances damaged specimens, in which the cranium has been smashed, can reveal many details of periotic structure. However, where such material is not available, partial dissection of the basicranial bones may be required.

Management practices. There is a growing realisation that analysis of character states in organisms involves not just an analysis of adult morphology, but also an understanding of the ontogeny of the character. In their early stages of development, skeletal characters are often membranous or incompletely ossified. Some characters may never fully ossify; for example the auditory bulla remains an entirely membranous structure in some mammalian taxa. Small bones may be suspended within such membranes, such as the taxonomically enigmatic class of bones known as entotympanics. Such features may be easily damaged, or even completely removed, by over enthusiastic cleaning of specimens. This is a factor that must be taken into account by collection managers, if they are not to dramatically reduce the utility of parts of their osteological collections.

Collecting and accessioning. Many of the requirements of the systematic researcher are addressed by a well thought out accessions policy. Clearly, it is vital that specimens come with good associated data, particularly where the collection may be used for quantitative studies (see above). Series of specimens from the same locality are also desirable, particularly where they build on existing strengths within the collection. There are other aspects which are perhaps less obvious at first sight. Even quite severely damaged specimens can prove useful for systematic studies where they reveal details of internal structures that would not otherwise be visible without dissection of the specimen. The collection and accessioning of postcranial material should also be considered as a priority: current practices may well be handicapping research workers, by leading to an overdependence on cranial characters.

Conclusions.

1) Museum osteological collections remain a valuable resource for systematic studies, whose usage is likely to increase with the increasing challenges presented by molecular studies. Bones are the only truly direct link between living species and the fossil record.

2) The usefulness of the collection is largely dictated by the research methodology to be employed. Quantitative studies are not easily undertaken in any but the largest of collections. Qualitative studies tend to require species coverage in breadth rather than depth. Molecular studies on osteological material should only be envisaged where bones are the only material available.

3) The majority of systematic work carried out on mammals concentrates on cranial characters. This is likely to be a reflection of the low numbers of postcranial material present in many museum collections.

4) The collections manager has an important role to play in increasing the utility of their collections for systematic studies, through the use of intelligent and proactive collection and accessioning policies and sensitive preparation, care and maintenance of specimens. In seeking to encourage the use of such collections for systematic studies, however, the collections manager will be required to address difficult ethical issues, particularly in relation to the dissection and destructive sampling of specimens.

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THE OSTEOLOGICAL COLLECTIONS OF THE ZOOLOGY DEPARTMENT, LIVERPOOL MUSEUM.

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Introduction.

The osteological collections at Liverpool Museum amount to about 3,600 specimens, of which by far the greatest number are of mammals. Most of this material is housed in 36 wooden osteological cabinets, which were purpose built (many in-house) over several years (fig.1). They measure 220cm high, 93cm wide and 77cm deep and have a varying number of wooden drawers according to the height needed for the specimens stored. Eight of the cabinets are divided vertically down the centre so that they take half-width drawers (fig. 2); these were designed for the smaller specimens such as the birds and rodents.

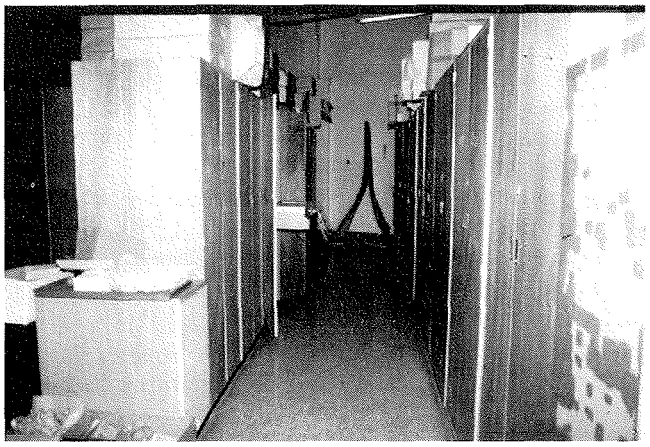

Figure 1

There are also mammalian skulls kept with their associated skins in the study skin collection, which is now housed in metal cabinets. A few specimens of awkward size, such as a pair of champion African elephant tusks, are stored with the larger mounted mammals in a separate storeroom. All these cabinets and storage areas are on the Upper Horseshoe Gallery of the Liverpool Museum, but some osteological specimens are in use on the floor above by the Natural History Centre or are on display on the Natural History Gallery. One of our most famous specimens - the skeleton of Ambush II, the Prince of Wales' horse and the Grand National winner of 1900 - is on display in the Museum of Liverpool Life, next to the Maritime Museum on the waterfront. Ambush, who was genteelly flaking and who for some reason had had his real skull swapped with one of a zebra, was completely renovated for Liverpool Museum's Grand National Exhibition of 1989 and is now more suitably depicted with his original skull and in a galloping position (originally, he stood foursquare).

The osteology specimens can be summarized as consisting of one or more of the following sorts of material: antlers, horns, skeletons, skulls, loose mandibles, postcranial material without skulls, skulls with skins or mounts, teeth or tusks.

The small amount of human skeletal material that is held for comparative zoological reasons is stored in the same cabinet as other primates, but in separate clearly marked drawers. It is not used for general handling in places such as the Natural History Centre; replicas are used if required. These procedures are designed to satisfy the scientific and educational role of human material, whilst acknowledging the stated requirement of the Trustees of NMGM that we treat human remains with sensitivity.

Figure 2

Curation and Re-storage.

The curation and re-storage of the osteological collection has taken place over the last 20 years. In 1975 the collection was housed in a jumble of large cardboard boxes, in no particular sequence, on 'Dexion' racking covered with plastic sheeting making access impossible for either staff or visitors. The game heads (which were piled on the top rack) were the first to be removed, cleaned, mounted on plinths and then hung on racking; a position far less hard on their ears. They now hang in sequence, covered with a moveable canopy. They include mounted skulls and antlers as well as trophy skins.

As the new osteological cabinets became available, the specimens were removed from the large boxes bit by bit, each piece being cleaned, mended, identified and properly labelled (figs 3 and 4). Nearly all the specimens are now in

individual cardboard boxes, of suitable size, with a further protective plastic bag and with an acid-free (and fray-free) cottonwool lining if necessary. Tissue paper is used, instead of cottonwool, for specimens which might have a tendency to get entangled. The white osteology boxes, which are covered with acid-free paper, have been made for us over the years, in specified sizes, by North-West Box Makers of Stockport. Both the lid of the box and the specimen itself are clearly labelled in ink with scientific name, form of specimen and the accession number. The labels, which are of glossy white card and with a brass eyelet, are pre-printed "Liverpool Museum" and are attached securely to the specimens with strong white thread tied in a double knot.

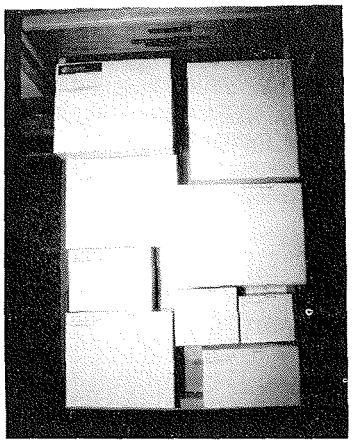

Figure 3

In many cases the osteological specimens were found to be unregistered and therefore, for inventory purposes, have been given a recent accession number; thus the preponderance of recent dates associated with the specimens (for instance, some specimens are clearly marked as being from the collection of the XIIIth Earl of Derby, which came here in 1851, but they were not accessioned then and are now marked 198x.xxx etc). Many specimens were identified, and their catalogue entries found, after massive detective work involving such clues as pencil scribbles, green scalloped labels, or the method used to wire articulated skeletons together. Scraps of paper in the bottom of a particular box full of items could sometimes be re-united with the correct specimen by a process of elimination, or even by matching the hole in the label with the string-knot left on the specimen.

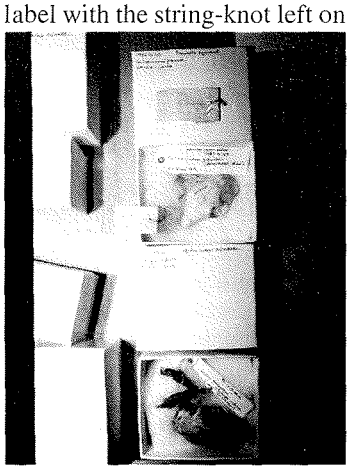

Figure 4

One particular jigsaw puzzle was a large card, on which several bird sterna had been glued above their labels and from which they had fallen. After many hours work each had been matched up with the marks left on the card by the original glue, which could be fitted to traces left on the bones themselves. The value of this endeavour only emerged later, when it transpired that two of the sterna were all that remained of the types of *Caprimulgus tamaricis* Tristram and *Kakatoe citrino-cristrata* Fraser.

All the specimens, whether in osteological cabinets or skin drawers, are stored in an amalgamated taxonomic sequence arranged by various check list orders for different classes; for instance the order in Honacki (1982) was followed for that particular section, Peters (1932-1987) for the birds. A catalogue which will be produced in the next year will follow the same taxonomic order as these references for order, family and genus, followed by species in alphabetical order. A purely alphabetic index of current scientific names, both genus and species, will be provided. The catalogue will also include complete donor, collector and locality indices, arranged alphabetically.

Notable parts of the Collection.

Perhaps the most important component of the osteology collections are the specimens from the collection of the XIIIth Earl of Derby, whose seat at Knowsley Hall (near Liverpool) housed in the early 19th Century a most spectacular and comprehensive collection of live mammals and birds. Lord Derby also commissioned specimens from collectors all over the world for his museum at the Hall; into this museum too went the prepared skins and skulls of animals from the menagerie. This collection was bequeathed to the City of Liverpool upon the Earl's death in 1851 and indeed founded this institution. It is one of the most historically important bird and mammal collections in the world, full of type specimens and examples of species now extinct or endangered.

Figure 5

Many of the Derby osteology specimens, like the skins, have importance on taxonomic grounds, or because of the present conservation status of the animal in question. Together with types obtained from other sources than the Derby Collection, the taxonomically significant specimens amongst the osteological material are as follows:

Soricidae.	*Crocidura bottegoides* Hutterer & Yalden, 1990. 3 skins and skulls from Katcha, Bale Province, Ethiopia in 1986. Paratypes.
Soricidae.	*Crocidura harenna* Hutterer & Yalden, 1990. 6 skins & skulls from Ratcha, 1986. Paratypes.

Bovidae.	*Cephalophus rufilatus* Gray, 1846. Skull. Collected by Thomas Whitfield in Sierra Leone. Earl of Derby's collection. Syntype.
Sciuridae.	*Pteromys momonga* Temminck, 1844. Skin & skull. From Japan. Earl of Derby's collection. Possible syntype.
Anomaluridae.	*Anomalurus peli* (Schlegel & Muller, 1845). Collected by H.S. Pel, "Cote du Guinea", West Africa. Earl of Derby's collection. Possible syntype.
Cricetidae.	*Brachyuromys ramirohitra* Forsyth Major, 1896. Skin & skull. Collected by C.I. Forsyth Major in Ampitambe Forest, Madagascar, 1895. Possible paratype.
Cricetidae.	*Gymnuromys roberti* Forsyth Major, 1896. Skin & skull. Collected by Forsyth Major, as above. Paratype.
Muridae.	*Notomys longicaudatus* (Gould, 1844). 2 skins & skulls. Collected by John Gilbert at Toodyay and the Moore's River, Western Australia, in 1843. Earl of Derby's collection. Paralectotypes.
Muridae.	*Pseudomys australis* Gray, 1832. 2 skins & skulls. Collected by Gilbert on the Darling Downs, southern Queensland, in 1844. Earl of Derby's collection. Paralectotypes of Mus lineolatus Gould, 1844.
Muridae.	*Pseudomys nanus* (Gould, 1858). Skin & skull. Collected by Gilbert on the Victoria Plains, Western Australia in 1842. Earl of Derby's collection. Paralectotype.
Cacatuidae.	*Cacatua sulphurea citrinocristata* (Fraser, 1844). Sternum & pectoral girdle. Died in Knowsley Menagerie, 1850. Belongs to type specimen, which is missing.
Caprimulgidae.	*Caprimulgus nubicus tamaricis* Tristram, 1864. Sternum & pectoral girdle. Collected by Canon H.B. Tristram at Ain Feshkhab, Dead Sea in 1864. Tristram Collection. Probably from syntype, which is no longer extant.
Sturnidae.	*Aplonis zelandica maxwellii* Forbes, 1900. Sternum & pectoral girdle. Collected by Fornest on Santa Cruz Island, Western Pacific. Tristram Collection. Probably from type specimen.

Extinct species are represented by bones such as a skull of the Falkland Island Wolf *Dusicyon australis,* those of Moa and Elephant Bird, of Great Auks and Dodos, and by the subfossil skeleton of an extinct goose (*Cnemiornis calcitrans*) from New Zealand - as well as by bones from long-gone Mauritian Fruit-bats and Chatham Island Rails.

Undoubtedly the collection with the most osteological style is that of Mr Guy Otter, presented to the museum in 1961. The collection had belonged to his grandfather, Sir Edmund Loder (1849-1920), and is an immaculately prepared series of 200 skulls and skeletons. Many of these originated from the Loder's menagerie in the grounds of Leonardslee, their home in Sussex. We recently managed to track down Guy Otter, now in his eighties, at his home near Poole. He was delighted that his collection should prove such an important part of this catalogue and gave us valuable background information on the specimens, such as the fact that a number of the game heads from the Otter collection are in Rowland Ward's Records of Big Game (Dollman & Burlace 1935).

We also spoke to Sir Edmund Loder's great-grandson, Mr R.R. Loder, who lives adjacent to the original house at Leonardslee. He told us that wallabies still live there, but the colony of beavers that had been the pride of the menagerie died out after the breeding females were given to the London Zoo. However, the beaver restraining fence can still be seen. Mr Loder remembers seeing mouflon and capybara in the grounds; Guy Otter particularly recalled the Rocky Mountain goats.

The Guy Otter collection came to us through the recommendation of the world deer expert, Mr G.R. Whitehead.

Other interesting specimens include those of Canon H.B. Tristram, of Durham Cathedral, who sold his main collection of birds to the Liverpool Museum in 1896. There are also many specimens from the time of the Liverpool Free Public Museum, immediately after the museum was founded.

The point of separation between Geology and Zoology at the Liverpool Museum has been somewhat clouded in the past; some specimens drifted between the two departments until a policy decision was made in the early 1980s; all post-4,000 Bp material (marking a distinct local change in sea-level) was to be held in Zoology. Thus we immediately received a trolley piled with drawers which included the Kendal collection of cave material, mostly from Helsfall Point, and given to our safekeeping by Kendal Museum in 1960.

The osteology collections also include some interesting local sub-fossil material: horses and aurochs from the River Weaver alluvium, pigs and aurochs from the Wirral shore, Red Deer from Blundell sands (to the north of Liverpool). These ancient bones will prove invaluable for the new Merseyside Archaeology and Landscape Gallery, being planned for 1997, which will illustrate the huge changes in this area since the last ice-age.

Uses of the Collection

These are very wide, and have expanded remarkably since the collection became accessible and documented. Perhaps the most common use is for education; the specimens are much more robust than other museum specimens and are thus ideal for teaching and display. It is interesting to look back after over ten years' successful operation of the Liverpool Museum's Natural History Centre, and remember that the first trial "hands-on" session in 1982 used osteological specimens; they are still a great stalwart in the Centre. One of the most popular specimens has been the "Build the Badger" puzzle - involving reconstructing a badger skeleton. The specimens are also used extensively by the two Liverpool universities for

teaching, both for natural sciences and veterinary courses.

Many artists use the specimens; the clean lines provide an ideal model for still lives and our specimens are immortalized in many portfolios. However, the scientific uses of the specimens are paramount and many are prepared with archaeological work in mind. The least fallible way to identify an archaeological bone is by direct comparison with a bone whose provenance is certain; thus the bird osteology collection has been built up over the last ten years to include all common British birds past and present. The collection is used by Chester Museum's Field Archaeology Unit to identify their excavated material, and many other archaeological reports have been based on our material. One of the sources of income for the department has been the contracts undertaken by the Curator of Birds & Mammals on the identification of bird bones from archaeological excavations.

Database Format

All specimens have a unique entry on DBase III and the information is arranged as follows:

Taxonomic classification number.
Family.
Genus & species.
Authority and date of description.
Accession (registration) number.
Sex.
Form of specimen.
Locality where specimen was collected.
Collector's name.
Date of collection.
Donor or seller of specimen.
Date of acquisition by the museum.
Notes.

Acknowledgements

The curation of the Osteology collection would not have been possible without the help of a great many people. The most important of these is Tony Roberts an archaeo-zoologist and natural curatorial ferret, who has, in several periods on contract to the museum, curated the main bulk of the mammal and lower vertebrate specimens. It was he who made the connection between green labels, "Leonardslee" and the Otter collection, and who located the family responsible for the specimens.

I would also like to acknowledge the work that Tony Parker (Assistant Curator, Vertebrates) and Phil Phillips of the Information Technology Department have both done, particularly in using their expertise in computing techniques to help prepare the forthcoming catalogue. Professor Robert Roaf, a retired orthopaedic surgeon, spent several years helping to document and accession the collection. Others have helped greatly with the identification of specimens, notably the Mammal and Bird Sections of the Natural History Museum in London. I would also like to thank Valerie Evans, Malcolm Largen, George McInnes and Ian Wallace of NMGM for their help.

I am very grateful to the Director and Trustees of National Museums & Galleries on Merseyside, for their support over the many years that the osteology collection has benefitted from curatorial time.

This paper is based on the Introduction to the Catalogue of the osteological specimens in the collections of the Zoology Department, Liverpool Museum, which is being presently edited for publication.

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THE PREPARATION OF SMALL MAMMAL SKULLS

Geoff Yates, Bolton Museum, Le Mans Crescent, Bolton BL1 1SA

There are a number of methods available for the preparation of small skulls and it will depend on the facilities available as to which method is used. It may also depend on your disposition and sense of smell. Methods include maceration, burial, insects, boiling, sodium perborate, and enzymes.

Maceration in either cold or warm water is an effective way to clean bones but you will need a laboratory with a good extraction system or you risk becoming very unpopular.

Burial in a sand tray outdoors removes the problem of smell but it does take a bit longer.

Insect preparation is also very good. A *Dermestes* colony will give very good results, but as it has to be sited away from the collections it does present problems. I have never been brave enough to try this, mainly because if ever a Dermestes was found in the collections I would probably have to leave the country under police protection.

Boiling, or rather simmering gently, is a common way to prepare skulls, the meat being scraped off when it is easily removed. If the boiling is overdone, damage can occur, so be careful. This method can also be smelly.

Sodium perborate works very well on small mammal skulls. After simmering and cleaning the skull, add Sodium perborate to the water, approx. 2 tablespoons per litre, and leave to cool overnight, then wash thoroughly.

Enzymes - Papain, Trypsin, Pepsin etc. are a very effective way of cleaning skulls. However. they do have the disadvantage of being very smelly and the staff at Liverpool Museum were warned of a health risk from the scum which forms on the surface when treating the bones.

Enzymes. At Bolton I use enzymes in the form of biological washing powder. I happen to use Persil but I am sure they are all much the same (not always good for getting grease out of your shirts but great on weasel skulls). As with all methods the skull must first be skinned and roughly fleshed. The more flesh you clean off now the quicker the cleaning process will be. The skull is then placed in a suitably sized container of water at approx 400°C and the detergent added. Keep the water at a constant temperature and agitate frequently. Check the skull now and again and scrape off the remaining flesh as it becomes easy to do so. This can be done with a variety of tools - knives, scalpels, brushes and scrapers. Scrapers can be fashioned from wood

or bamboo to suit your own needs and are less likely to do any damage.

Take great care when cleaning bones not to damage the surface or any delicate parts. Also be very careful not to lose any bits down the drain. Always use a fine sieve when disposing of the water and sludge. It is very embarrassing being caught dismantling the sink trap trying to recover lost teeth etc. When cleaning is finished always rinse well.

Degreasing and bleaching is usually unnecessary on small mammal skulls when using this or the sodium perborate methods.

Whichever method is used please take care of yourself as well as the specimens. There are obvious risks attached to this work. Use protective clothing and have good ventilation. There is nothing like the smell of rotting flesh for making you unpopular with workmates so as well as a good extraction system I can also recommend NEUTRADOL room deodorisers. They are very good at counteracting bad smells.

OBSERVATIONS ON THE TREATMENT OF AN INSECT INFESTED OSTEOLOGICAL COLLECTION.

Julian Carter, Conservation Officer, National Museum and Galleries of Wales, Cathays Park, Cardiff, CF1 3NP

ABSTRACT

A large collection of bone material which had been donated to the National Museum of Wales was found to be heavily infested with a number of insect pests and was rapidly falling into serious decay. This paper describes the means of dealing with the collection and the measures taken to prevent further infestation.

Introduction

The Barbara Noddle collection of disarticulated skeletal material was donated to the National Museum and Galleries of Wales, Cardiff (N.M.G.C.) Zoology department in 1988. The collection essentially consists of agricultural animal bone specimens, but does have a component of 'wild' mammal bone material. Much of this material represents endangered or lost agricultural breeds giving the collection an important diagnostic base.

The collection is particularly dominated by various sheep breeds, taking some 63% of the catalogued material. The rest of the collection is of cattle(15%), goat(4%), pig(4%) and the remaining being a miscellaneous cross section of mammalian material.

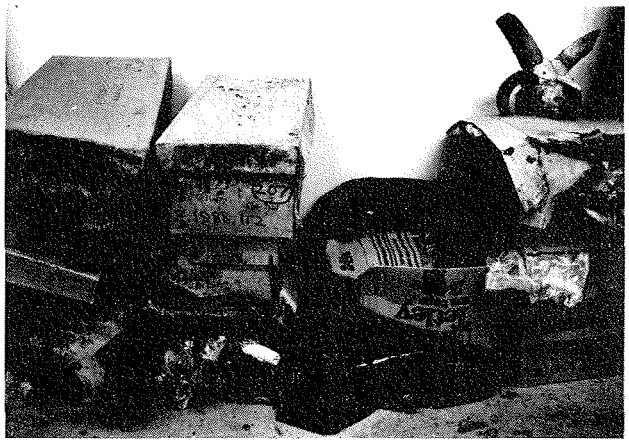
With the 1988 inventory of the collection it was realised that serious problems existed with the state of conservation of the bone material which had suffered from a combination of poor preparation, inadequate storage conditions and heavy insect infestation. This resulted in 75% of specimens showing some sign of damage which varied from some mild surface insect boring to the complete destruction of some specimens.

Thus in 1992 a complete cleaning and sorting project was initiated on the collection in order to conserve, identify and catalogue the bone material.

History

The bone material in the Noddle Collection was predominantly prepared by hot water maceration (Noddle personal communication) which involved skinning and eviscerating the animal and then dividing up into manageable proportions which were then simmered in a heated water vat until the bones were free. It appears no standards were involved in the method, relying on intuition and experience to determine when the material was prepared. Once cleaned the bone material was simply rinsed in water and allowed to dry before being packed loosely into plastic bags and boxed. In many cases excess animal tissue has remained on the bone material and has become encrusted by the drying process.

Much of the collection later came under storage pressures at the University College of Cardiff. This resulted in the boxes being stored in damp basements causing extensive mould growth and insect invasion affecting the stored bone material, adding to future conservation problems.



A Sample of the collection in its original state.

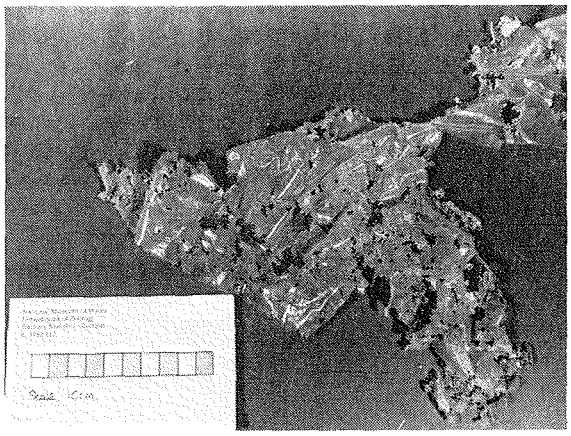
Observations

Much of the previous treatment of the collection has not been beneficial to the bone material. This relates to both the preparation methods and subsequent storage. From this a number of points have been noted;

- The original bone material has often not been completely devoid of remaining pieces of muscle and tendon.
- Previous storage by loosely packing the bone in open plastic bags and then placing in cardboard boxes has failed to give adequate protection. The boxes have often been over packed, which coupled with acidic attack from the cardboard and insect invasion has resulted in abrasion, crumbling and overall physical deterioration of the material. Improper storage has also opened the material to effects from temperature and humidity fluctuations.
- The preparation methods used may well have affected the long term stability of the bone material (Shelton and Buckley, 1990, William's 1992) especially if over treatment has occurred. Although initial treatment has failed to degrease much of the bone material, this grease content does now appear to be helping to keep some of these specimens intact but does present the problem of grease seepage over the coming years.

Any factor which weakens the bone structure increases the likelihood of insect damage by providing sites of

weakness for insect action to exploit e.g. the laying of eggs in small cavities provides a site for larvae to burrow into the material. Insect boring has been noted around sites of weakness especially in sheep and goat material where the lines between the skull plates has been particularly prone to damage causing a sectional breakdown in the skull. This insect action has also been noted along the lines of fusion relating to accessory ossification, causing a breaking off of the end processes of limb bones such as the proximal epiphysis. The endochondral bone, which has a more open spongy structure, is then open to insect action presenting the problem of beetle larvae being present deep in the structure of the bone and effectively unmovable without causing damage.



A Sample of plastic packaging showing extensive damage by insect action

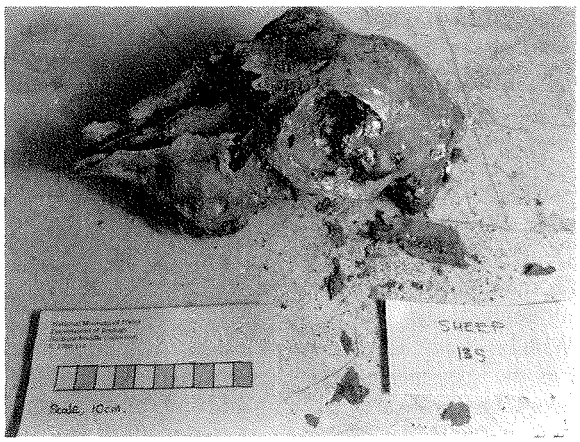
Once insect infestation had occurred there has been resulting damage to the packing bags which have then started to disintegrate causing a mixing of the box contents and damage to any contained paper labelling. This has then caused problems in identifying both the contents and separate specimens. Labelling on the individual bones has also suffered as this was usually marker pen which has started to run usually due to grease seepage from the bone or in cases where the bone is very dry and brittle the markings have been lost by surface flaking. The most successful marking in this bone collection has been pencil.

The main insect pests have been Coleoptera;

- ***Dermestes lardinius,*** L; (Larder beetle).
- ***Ptinus tectus,*** Boield.(Australian spider beetle).
- ***Necrobia rufipes,*** DeG. (Copra beetle).

Infestation problems also occurred with the House Moth, *Hofmanophilla pseudospretella* and an assortment of spiders and mites.

The beetles cause damage throughout their life cycle, starting with the feeding action of the larvae which bore into the bone causing a weakening of the bone structure and producing a great deal of frass material. In all three species the larvae will bore deep into hard and often inedible substances in order to pupate leaving further debris of pupal cases and frassplugs (Busvine, 1980). The boring actions from both larval and adult beetle types causes damage to both the bone material, which can be both food source and brood site, and to the surrounding packing material. The corrugation in some of the cardboard boxes provides a ready made site for pupating.

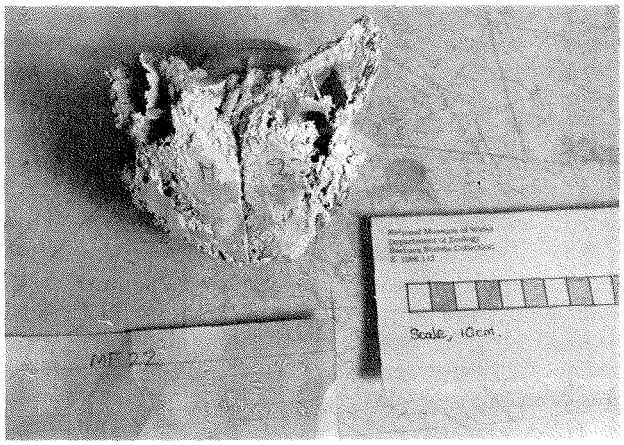


A Sample of the collection in its original state.

The result has been that much of the collection has been extensively weakened and physically damaged, especially the smaller herbivore skulls such as sheep and goat, and any young or foetal skeletal material. Most of this damaged material tends to be in a dry brittle condition and has needed careful handling.

The treatment of the Noddle Collection.

The problem was now to sort this large collection (initially stored in just over 500 boxes) and to carry out a level of conservation which would provide adequate future protection but within a time and cost scale. Full scale conservation would be expensive and time consuming, thus a general programme of cleaning and treatment was set up, with the idea that once the true composition and state of the collection had been established then it would be possible to go back and further conserve any material in poor condition.



Sheep Skull: the insect frass and general debris has been removed from the original storage box showing damage from mould and insect action.

It was also important to ensure that the problems occurring with insect infestation were properly dealt with, especially to prevent any re infection of cleaned and packed material from any larvae or eggs present in cavities in the bone material and to prevent any pest types re-establishing themselves in the bone material. The effects of not properly treating the insect problem has already been demonstrated with material from the Noddle collection which was cleaned and sealed in two layers of polythene but not treated with any means of pest control. Insect action has continued in these

sealed specimens causing almost complete destruction within a two year period.

Sheep skull which had seen prior cleaning and then sealed in polythene, but which had received no form of pest treatment. Note the insect frass around holes in the skull arising from continued insect action. This specimen had been cleaned prior to the start of this project.

The cleaning of the Noddle collection took place in the N.M.G.C. Zoology departments preparation rooms which are away from the main museum and have several coldstore rooms. This enabled infected material to be brought out of the way of the main museum and placed in coldstore to slow down the insect pests present in the boxes. Subsequent material received was treated by placing in a Rentokil bubble and exposing to Phosphene for a period of 7 days, and then placing in coldstore to prevent any re-infection until treatment could be carried out. This helped to reduce the movement of any infected bone material.

It was then necessary to attempt to identify the contents of the boxes and to cross-check with a card file. Often this proved difficult since the surface markings on the bone had become faded or eaten as had any card labels placed with the specimen. The process then involved trying to keep the separate specimens apart since the bags the bones had been contained in were falling apart causing a mixing of the contents. Subsequent attempts to sort the mixed up specimens proved to be time consuming.

The general cleaning was a straight forward process of separating the intact bone material from the debris and insect frass and removing this material by vacuum cleaning. The bones were then carefully brushed of any surface debris and dust. Problems occurred with removing debris from the very greasy material. In such cases the material would be treated by wiping with alcohol (in the form of I.M.S.), or in very stubborn cases using toluene. Skulls needed particular attention in order to ensure as much material as possible was removed from the bone cavities which provided an ideal site for insect eggs and larvae.

Once the bone was cleaned, some form of pest treatment was carried out. All the specimens were treated with a Bendiocarb-based pesticide prior to packing. The Bendiocarb was deposited on the surface of the bone in order to give long term protection by hopefully dealing with any insects emerging at a later date. Initially the material was briefly immersed in I.M.S., but this was both messy and required a very well ventilated area. Particularly badly infected material, especially skulls, were placed in the evacuated chamber of a freeze dryer and subject to low temperature, -25°C for a suitable period, followed by pesticide treatment prior to packing.

Packaged and sealed specimen.

Once treated the material was packed into polythene tubing which was then heat sealed, with a second layer of tubing then being added and sealed, effectively double bagging with the labelling being contained between the two layers. This effectively;

- Traps the material in a cushion of air. helping to prevent mechanical damage.
- Prevents damage from contact with acidic materials such as the cardboard boxes used for storage.
- Lessens the impact from any environmental fluctuations.
- Prevents any re-infection of the collection.

Once packed the material was placed in cardboard boxes of uniform size, cut to suit the storage racking available for the collection. The collection has since had regular checks to ensure that the preventative measures are working.

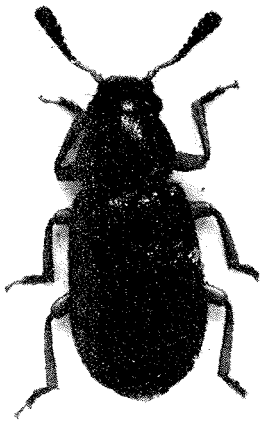
Discussion.

The damage which has occurred to the Noddle collection has unfortunately affected the overall level of preservation, thus affecting the scientific integrity of the specimens in the collection. It has hence been essential to halt the level of decay occurring and to attempt to preserve the material in order to protect the collections research value.

The whole problem associated with the long term stability of the collection can be related back to the initial preparation and storage of the bone material. Some studies have suggested that the soaking and washing of osteological material with any kind of aqueous solution could be destructive due to the hydroscopic and anisotropic nature of the bone (Lafontaine and Wood 1982; Williams 1991 and 1992) but as details are lacking and much of the material came from agricultural research centres it is difficult to say exactly how the original treatment affected the material, although in a personal communication Barbara Noddle mentioned that since the vats used had no thermostatic control, then the material often became over boiled and thus exposed to a prolonged period of excess heat and solution. Thus it is certain that some of the material has suffered from initial over-treatment weakening the bone structure. Insect pests have exploited sites of weakness as egg laying and larval feeding sites. This is particularly evident with *Necrobia rufipes* whose larvae are found deep in the bone

material and can quickly honeycomb the more spongy structure of the endochondral bone. The larval forms of both *Dermestes lardinius* and *Ptinus tectus* can feed on dry animal matter, often left over from the preparation process, as well as hair, horn and paper. *Ptinus tectus* tends to be a scavenger of miscellaneous debris throughout their life cycle. Once the adults have emerged then their continued feeding actions can cause further damage especially with adult females who need to feed for the maturation of their eggs.

When the collection transferred to much dryer and warmer storage conditions it appears both the beetles *Dermestes lardinius* and *Ptinus tectus* died off, whereas *N.rufipes* persisted with specimens regularly being found alive. *N.rufipes* is not usually a widespread pest in this country as requires all year round high temperatures (Busvine), whereas the other two beetle types are more tolerant to British conditions and certainly *Dermestes lardinius* is a well known pest of natural history collections. It is probable that both the spider and larder beetles were more dominant in the former damp storage conditions but have become less persistent as desiccation has decreased the food availability. Also they may have responded to previous pesticide treatments which *N.rufipes* was either more resistant to or as the larvae can occur deep in the bone unaffected by treatments. Thus *N.rufipes* has remained an active pest being the most adaptive to these conditions and the most capable of feeding on the bone material.

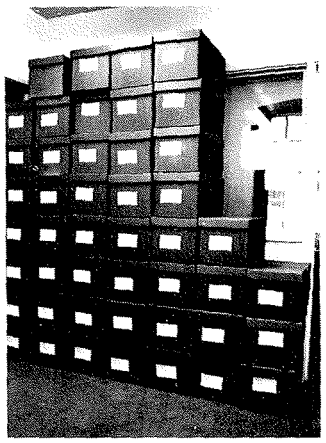


Necrobia rufipes: a persistant pest of the collection.

In looking at the effectiveness of the treatment methods one year on from when the initial material was cleaned and sealed it is encouraging to note that although there have been signs of insect activity in some of the bone material, it has mostly not persisted. A survey of boxes revealed a *N.rufipes* emergence of adult beetles in 10% of boxes. In most cases these have died off, presumably due to residual pesticide deposits. However in about 2% of cases the live adult beetle has persisted. This has been dealt with by putting the affected specimens in prolonged cold storage and this has proved effective.

Although various methods of pest treatment have been used with this collection, thought must be put to the future effects of this treatment. Alcohol in the form of I.M.S. has been used throughout the treatment of the collection. Ethanol is considered to be one of the less intrusive solvents (Matienzo and Snow, 1986) but concern has been expressed over its effects as a desiccant and as a solvent that may cause mobilisation of lipids along with possible material reactions with the ultra structure of bone (Williams, 1991). Other future problems may also relate to the use of pesticide which will remain on the surface of the bone. Thus warnings will have to be placed on the boxes in case of future handling by any person working on the collection.

A further concern was with the sealing of the bone material in two layers of polyethylene with the establishment of micro climates within the polybags. This concern was monitored by placing ACR stick-on loggers with the sealed bone material. So far the results have been very favourable with internal storage temperature of less than 20°C and a relative humidity of around 45%.



Packaged and sealed specimen.

The whole collection is now stored in clean, stable conditions with clear type written labels on the outside of all the boxes making the collection accessible and it's various specimens identifiable. If the material had been left in its previous condition then the extent of decay would have certainly destroyed a great proportion of the collection within a few years. As it was some 20 boxes of specimens were deemed in too poor a state to be considered saving, with several specimens totally reduced to fragments of bone, insect frass and pupal cases.

Conclusion.

The conserving of this collection has demonstrated the level of damage biological decay can cause on research material which has not been properly treated or stored. The collection was donated to the National Museum of Wales in a poor condition and thus required conserving in order to ensure that the pest problem and long term stability were dealt with. During the cleaning work it was important to keep the collection as isolated as possible so that it did not affect other specimens. This level of treatment is highly recommended before moving and treating any suspect material. The preventative measures taken appear to be working well, but will involve long term monitoring as part of a pest management programme.

Acknowledgments

Bob Child, Piers Langhelt and Vicky Purewal (National Museum and Gallery, Cardiff), Jane Pickering (Oxford University Museum).

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LEEDS CITY MUSEUM - its Natural History Collections
Part 2 : The Invertebrates

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Abstract

The invertebrate collections held by the Leeds City Museum, in numerical terms, comprise about two thirds of the natural history department's holdings of over 300,000 specimens. The following paper describes some of these collections, the people who assembled them, and some of the staff, researchers, outside specialists and others who subsequently worked on them. The paper also discusses some aspects of their scientific and historical significance, and their importance both to Leeds, and to the charge-payers who finance their existence.

The Early Collections

The devastating effect of the bomb which fell on the Leeds City Museum in March 1941, and the resulting aftermath, caused considerable damage to the invertebrate collections. Much of the early material was lost or damaged to such an extent that only small numbers or parts can now be identified back to their specific collections and collectors. Some of the more fragile groups in particular, for example some of the insect collections, totally failed to survive this traumatic event. Included amongst these early collections, now lost, were the insect collections of John Atkinson, the first curator of the museum, and those of William Hey, one of the early presidents of the founding organisation, the Leeds Philosophical and Literary Society.

The Post-War Period

The appointment of Mr John Armitage as Keeper of Biology in 1954 proved to be the salvation of the museum's invertebrate collections. Born in 1900, he developed an early passion for both natural history and photography and also developed artistic skills which enabled him to get a place at the Manchester School of Art. After leaving the School of Art, he joined Oliver's of Manchester as an illuminating artist and worked on many illuminated manuscripts, including one for John W.Taylor of Leeds. This illuminated address was presented by the Conchological Society of Great Britain and Ireland to John W. Taylor on his seventieth birthday in February 1915, the original manuscript now being part of the Leeds City Museum's collections. John had produced the manuscript at the tender age of 15 years and details of it can be found in the Proceedings of the Conchological Society for April 1915. Vol.14 (10) 316-319.

At the age of 21 he became a full time naturalist, earning a living by giving lectures, writing articles for various newspapers, and using his artistic abilities to earn extra income as required. This freedom enabled him to travel widely, and to gain experience over a wide field of knowledge. The main drawback to his appointment in 1954 was his lack of knowledge of museums, and thus he entirely underestimated the importance of good records, and record keeping at that time. It is unfortunate, that he, and his assistant Jean Parkin (nee Mitchell), appear not to have kept any records of the many disposals of dirty and damaged material which took place at that time.

The State of the Collections in 1954

The collections proved to be dirty, infested with pest beetles, moth and mites and in need of emergency salvage, restoration and renewal. Jean Parkin undertook the task of cleaning, re-lining as required, re-papering, and the laying out of all the insect collections. This was a formidable task which must have taken many years to complete. The style chosen for the layout of the drawers did, however, restrict the subsequent expansion of the collections. For example, the allocated space given for any group of beetles within the cabinets was the same regardless of the size of the beetle. Thus only one, or at most two, examples of the larger beetles could be stored within the collection. This was repeated throughout the insect collections, with the exception of the lepidoptera, and all species regardless of their rarity or existence within the collection were allocated the same amount of space. This resulted in some drawers being over crowded whilst others remained empty. Jean Parkin, under John Armitage's expert guidance, developed an ability to card- mount insects almost faultlessly, an admirable skill which was put to good use. Over the years, she must have mounted in excess of 10,000 specimens, mostly British beetles.

The Present Position

Over the past two decades efforts have been directed to fully documenting the collections, and advertising their scope and size to individuals and outside bodies. The production of registers of natural science collections, and in particular the register for Yorkshire and Humberside, (Hartley, et al 1987), has considerably helped with both aspects of this work. The production of the register made us examine the collections against the registers, and try to establish which of the several hundred received over the years were still extant. The sorting of collections, usually amalgamated in the past without any lists or identification marks, proved difficult and in some cases impossible. The whole exercise did however, produce results as several collections believed to have been lost were eventually re-

identified. Perhaps the most surprising was the shell collection of Charles Herbert Moore (1869-1949). This collection was thought to have been destroyed in the 1950s, but it proved to be still in existence, having been amalgamated into the general collection. For a small collection to have been mislaid in this fashion is understandable, but when one realises that the collection contained an estimated 20,000 specimens, it is much harder to believe or understand. The introduction of Museum Documentation Association (M.D.A.) index cards helped in this process, and we soon began to appreciate the size and scope of the collections. At the present time, over 100,000 M.D.A. cards have been filled in across the collection as a whole. The use of M.D.A. cards has also enabled the production of typed catalogues of some of the individual collections where these did not previously exist. Thus, even though the collections had been amalgamated it is now easier to sort material from specific collections for display or research. It is hoped that the introduction of new technology which took place in the late spring of 1993 will help to increase the amount of material documented in the card indexes, and the number of collections thus recorded.

The invertebrate collections can be divided into two equal parts, the molluscan collections, and the rest. The following account divides the collections into these two parts.

The Molluscan Collections

Since the foundation of the museum in 1819 records show over 150 donations to the molluscan collections. Many of these acquisitions were relatively small, but others contain many thousands of specimens. The selection of specific collections to represent the museum's holdings in the following account was difficult and, therefore, I have selected just a few of the more interesting ones for a fuller account, whilst leaving others to be dealt with in more general text. The largest, and perhaps the most important, collection held by the museum is that of Sylvanus Charles Thorpe Hanley 1819-1899. The Hanley collection was transferred to Leeds from the Tolson Memorial Museum in Huddersfield in 1957. When it arrived the collection was contained in some 13 cabinets, 206 drawers. Little is known about Hanley as a person, but his work on mollusca is fairly well documented although, as yet, much of this information has not been published. The collection was built up over some 60 years mainly as a result of correspondence with many of the major naturalists of the period. This included such great names as Isaac Lea, from whom he acquired many now rare or extinct species of *Unio*. He also acquired syntypic material from many collectors including Adams, Anthony, Benoit, Blanfield, Carpenter, Dall, Guppy, Hinds, Jeffries, Leath, Loven, Montagu, Pease, Philippi and Tryon to list just those identified to date. During his lifetime he published over 40 books and scientific papers and described over 200 new species. He also published the first book on shells using the then new technique of photography, (Hanley, 1863). The collection has had a chequered history. After his death in 1899, the collection became the property of his nephew Mr Crew Hanley. From him, the British Museum purchased about 104 type sets of marine mollusca. Actually, 117 of the 146 specimens registered in the British Museum's collections are types (S.Wybrow pers. comm.) The rest of the collection was sold to H.Harvey a shell dealer of Houndsditch. Harvey presented the British Museum with a further 1,073 lots of which 248 are at present listed as types. Some time in the early 1920s the remaining collection was placed in storage at the depository of T.R.Roberts Ltd. No information is available to us from this period, and it has not even been possible to trace the site of Roberts' depository. The next time the collection came to light was in August 1932 when Mr J.C.North of Huddersfield donated it to the Tolson Memorial Museum as the Hanley and Harvey Collection. In 1957 the collection was transferred to Leeds under the care of the then Keeper of Biology Mr John Armitage. Due to the lack of information about this collector and his methods and some bad advice and guidance in the late 1950s, a considerable amount of irreparable damage was done to the collection because many of the original labels were lost, and as a result, some of the original type and figured specimens are now untraceable. However, it still contains many identifiable type and figured specimens.

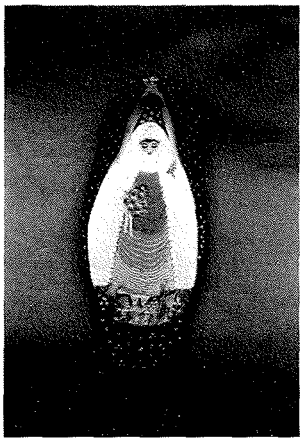

Figure 1. Painted Cuttlefish (Sepia Officialis). By A. G. Stubbs.

The oldest collection of British land and freshwater mollusca in the City Museum's collections is that of Charles Ashford (1829-1894). Born in Baldock, Hertfordshire, Charles Ashford was sent to the Friends' School at Ackworth at the age of nine and remained there for thirteen years, first as a pupil and then as a teacher. In 1854 he published the Mollusca of Ackworth. He worked closely with W.Dennison Roebuck for many years and was noted for his early studies of the 'darts' of British land snails. His collection of 43 boxes of *Pisidium* was examined by Peter Dance and A.W.Stelfox in 1958; many of them were collected and identified by others. Several of these collections date back to the early 1850's, a time when the *Pisidium* fauna of Britain was very little known, and several of our common species were still awaiting description. The main tropical collection held by the museum is the Atkinson Memorial Collection. This collection is of particular interest to the Leeds City Museum, in that it is associated with the very first honorary curator of the museum, Mr John Atkinson. The collection is made up exclusively of land species, and contains material from most areas of the globe. It was acquired over many years by two generations of Atkinsons - the father, Edward, and his two sons Victor Rupert and Francis E. Atkinson. The collection, however, predates the Atkinsons, dating back to William Hey the 2nd, the grandfather of Edward, who started the collection in Palestine in 1858. The collection was acquired by the Leeds City Museum in 1927 from Francis E.Atkinson L.R.C.P. Lond., M.R.C.S., of Bowerley in memory of his father Edward Atkinson F.L.S., F.Z.S., Hon Surgeon at the Leeds

General Infirmary, Past President and Hon Curator of Zoology of the Leeds Philosophical and Literary Society, and his son Victor Rupert, Sec.Lieut 1st/6th West Riding (Duke of Wellington's) Regt., who was killed in action at Passchendale in November 1917. Most of the material comprising the Atkinson Memorial Collection was purchased from dealers and collectors, and some high prices must have been paid for the rarer material. The collection contains, for example, three sinistral and three dextral specimens of the land snail *Achatina (Lissachatina) fulica* (Bowdich, 1822) acquired from the collection of Sir David William Barkley (1808-1888) and originally from the island of Mauritius. Less than ten sinistral specimens of this species are known (T.Pain pers. comm.).

The most recent addition to the museum's collections is that of Mr John Armitage. This collection includes the bulk of the best and most important material from the collection of Fred Taylor of Oldham. The purchase from John Armitage, with the aid of an M.G.C. Science Museum PRISM Fund grant, of the main elements of the Fred Taylor collection, has resulted in the re-amalgamation of the majority of Fred Taylor's original collection. When Fred Taylor died in February 1949, his shell collection was housed in cabinets at his home in Lanseer Street, Oldham. He wished his collection to be given to John Armitage, a close friend for over thirty-five years. However, due to circumstances prevailing at the time, the collection was split and the cabinets used for other purposes. John was allowed to remove all he could carry in one large suitcase; his knowledge of the collection ensured that he acquired all the most important material. Fred Taylor's daughter retained the remaining elements of the collection. In 1975, and again in 1983, sections of the original collection turned up in the hands of dealers the first at Knaresborough with Edward Milborrow and the second at the Cheshire Taxidermy Studios of Sale, Cheshire. This probably still leaves a section of the collection unaccounted for, but by far the most important elements are now back together. This includes the left handed specimens of *Helix pomatia, H. aspersa,* and *Trichia striolata* but I can find no trace of the sinistral specimens of *Cochlicella acuta* & *Oxychilus draparnaldi* which he also had in his collection. Fred Taylor was noted not only for his ability to clean shell immaculately, but also for his generosity.

It was well known that the Leeds City Museum was interested in acquiring material from the original Fred Taylor collection, and a close watch was kept by many colleagues for likely material. This resulted in several finds, perhaps the most interesting being as a result of a telephone call from the molluscan section of the Natural History Museum in London stating that part of the Taylor collection had turned up in Rotherwick, Hampshire. It was with great interest and anticipation that I made contact. However, the collection proved to have belonged to yet another Taylor, this time a school caretaker in Manchester by the name of George H.Taylor. Fred, in his generosity, had given this little known collector some 36 boxes of material all collected between 1897 and 1908, including two boxes of *Catinella (Quickella) arenaria* (Bouchard-Chantereaux 1837) collected at Braunton Burrows.

Other collections at Leeds include those of Charles Allen; Hugh Brooksbank; J.W.Davis(1846-1893); C.Frazer; C.H.Moore (1869-1949); William Nelson (1835-1906); Jack & Vi Saville; L.W.Stratton (1900-1971) (Part); Arthur

Figure 2. Arthur Goodwin Stubbs (1871-1950).

Goodwin Stubbs (1871-1950); David Northey Richardson (1929-1992) (grandson of A.G.Stubbs); William Temple (1889-1960); W.Thurgood, plus many smaller collections, and some which remain anonymous. Further collections are still being added to the museum's holdings, not least of which are those of Mr Terry Crowley, parts of whose collections are now being transferred to Leeds. The remaining parts will come in due time. This collection is noted for its scientific standing containing as it does many type, figured and cited specimens.

The Insect Collections

The museum's main reference collections have been compiled through the amalgamation of material put together by many different naturalists. This is particularly noticeable when looking at specific collections such as the beetle, diptera or hymenoptera collections.

The British Beetle Collections. As described above, the original 6 Hill cabinets of beetles were fully laid out by the museum's natural history assistant, Jean Parkin. Jean also mounted over 10,000 specimens for the collection. She quickly developed a great skill in the mounting of these insects and took pride in the display of the material within the drawers. Each species could only have its allotted number of specimens within the space allocated, the average being six, usually all from the same locality. Any extra material collected was discarded or placed in a separate storage cabinet. It is very fortunate that the bulk of this material is still extant, some of this material having been transferred to other museums, schools and even private collectors. The high standard Jean set for the collections, however, saved the older material as her pride would not allow sub-standard material to be passed on to others. Any specimens in the collection which were below the high standard of mounting she required were also discarded to the storage cabinet. Thus, most of the early material collected and identified by J.R.Dibb and W.D.Hinks was downgraded in this way. A similar fate awaited any other material, sometimes regardless of rarity or local significance, which came into the museum from other entomologists, and which did not reach her high standards. Despite the low esteem, by today's standards, in which historic and some local material was held, local entomologists worked closely with the museum and helped with identifications, and even assisted with the acquisition of material. One of these entomologists to whom the museum owes a great deal is Mr John H. Flint,

one of Yorkshire's leading coleopterists. Over the years he helped John Armitage, Jean Mitchell and myself with the identification of these insects. He also arranged for the collection of the Rev.Thomas Basil Kitchen (1905-1987), Honorary Cannon of the Cathedral Church in Gibraltar, to come to Leeds after his death in Scarborough in 1987. The collection reflects his career in the church, having been based both in Yorkshire and in Devon, (Obituary, Flint, 1989) This collection housed in 7 Hill cabinets, contains some 13,497 specimens of at least 2,782 species, with several hundred specimens still awaiting identification.

The Diptera Collections The diptera collection is based around those of Christopher Arthington Cheetham and Dr H.Henson. These two dipterists acted as county recorders for the Yorkshire Naturalists' Union for nearly half a century. Amalgamated with this material are the diptera collections of several other entomologists including material collected by C.D.Day and Dr & Mrs Broadhead. The diptera collections are in the process of being reassessed, re-identified, documented and rehoused. Work on three major groups has been completed, the Syrphidae, the Tipulidae and the Brachycera, the last two with financial aid from the Friends of Leeds City Museum and a RECAP grant from the Yorkshire and Humberside Museums Council (RECAP = Reclassification of Collections Access Project, a special grant for natural sciences collections. The hoverfly collection was worked on by a specialist volunteer, Mr Norman R. Frankel, who, with the aid of other specialists, and the author, worked through checking and re-housing the whole collection. The Tipulidae, numbering over 3,000 were checked and re-identified by the national recorder Dr Alan Stubbs, whilst the Brachycera was worked on by Mr Roy Crossley. The group of flies within the Brachycera known as dolichopods proved to be very important, as this part of the collection housed material from continental specialists, including specimens collected by Raddatz and Kowartz principally in Austria between 1864 and 1879 (Crossley, 1992). The material collected and identified by Mr Chris Cheetham has always been difficult to use with any degree of certainty, as he had a reputation amongst dipterists for occasionally doubtful identifications. The work on these three sections did show some weakness in his abilities, but not to the extent expected. Some of the county records which had been dismissed as being incorrect were in fact, found and proved to be correct.

The Hymenoptera collections The Hymenoptera collections comprise material combined from that collected by numerous entomologists. The collection is divided into four parts: bees and wasps, saw-flies, parasitica, and ants. The whole collection of bees and wasps has been checked and re-identified by Dr. Michael Archer, the County Recorder. Parts of the collection of parasitica have also been checked and re-identified by Mr. W.A.Ely who is the County Recorder for this section of the Hymenoptera. The saw-flies have mainly been checked or identified by Mr. & Mrs J.H. Flint. The above collections are almost wholly of British origin.

The ant collection is the only part of the Hymenoptera collection which has an international base. The collection contains examples of nearly the complete European fauna, as well as examples from as far afield as Hong Kong and the U.S.A. This is mainly the result of work undertaken by Dr. C.A. Collingwood, one of the leading authorities on ants in the U.K.

It is hoped that we will be able to re-house the whole of the Hymenoptera collection in new cabinets sometime in the near future.

The Lepidoptera collections The Museum has several outstanding lepidoptera collections, which, for the purpose of this paper, are best divided into the British and European collections, and those comprising the tropical Collection. The first of these include the collections of Richard Wilding (1858-1950) and Joseph Norman Thornton (1892-1956), and the latter the collections of F.Benson-Jowett, Wing.Cmdr.J.M.Maud, and Major Walter Brown Arundel (1854-1927). Recently, the museum has acquired the collection of Mr John Armitage with the aid of an M.G.C. Science Museum PRISM grant. This collection includes long runs of some of the more localised European species, and was a very welcome addition to the collections.

The most outstanding of the British material is the Wilding collection which, amongst other things, contains a series of Large Heath from Simonswood Moss, Lancashire. Richard was familiar with this site as early as 1886 when he gave a talk to the Lancashire & Cheshire Entomological Society entitled 'A Day on Simonswood Moss'. Richard Wilding was well known as a coleopterist, and his collection of some 10,000 beetles can be found in the Liverpool Museum (now part of the National Museums on Merseyside). The collection of British Lepidoptera collected by J.N.Thornton is also outstanding for its long runs of specimens including a large series of pug moths. The tropical collection is mainly based around the collection of Benson-Jowett, but includes material collected by J. & B. Ross from the Sepik River area of New Guinea, and a long series of Raja Brooke's birdwings confiscated by H.M.Customs and Excise at Yeadon Airport in Leeds.

The purchase of John Armitage's collection of British and European lepidoptera has greatly added to the museum's lepidoptera collections. The original cabinets which house John Armitage's collection were purchased by him from a barber in Folkstone, where they had been stored in a cellar prone to periodic flooding. The cabinets originally contained the collection of R.A.Nicholls who left his lepidoptera at the barber's in lieu of an outstanding debt. Nicholls never returned to redeem his collection and nothing is known of what happened to him. Several drawers of Nicholls' material still survive within the collection, although much had to be destroyed.

Hemiptera - Homoptera The collection of bugs is still relatively small consisting of only a few thousand British and Continental species. Unfortunately, the Continental material has still not been identified to a satisfactory standard, and therefore its scientific use is still limited. **Dragonflies** The collection of British dragonflies is fairly small but covers most of the species represented in our fauna. The dragonfly collection was originally very extensive and contained large numbers of type specimens from the Amazon basin.(Fraser, 1946) The type specimens were, unfortunately, transferred to the British Museum and much of the remaining material found its way into the Manchester Museum's collections. Only a small amount of papered material now remains in Leeds.

Other Invertebrates

If one person is to be picked out to represent the other invertebrates, then this person must be Mr Douglas Turnbull Richardson of Skipton. Over the years, he has built up large

collections of invertebrates for the museum, in particular, woodlice, millipedes, and centipedes, as well as spiders, harvestmen, leeches, and several other smaller groups. The bulk of this material is preserved in spirit and it is the basis for the field records for the county of Yorkshire. All Mr Richardson's collections have been presented to the museum fully documented, and they are outstanding both in the form of the documentation and in the detail supplied. Many other people have helped with the acquisition of these collections including Clifford Smith, the County recorder for spiders and Margery Andrews, the caddis-fly recorder. Amongst the smaller collections are a series of British and European brachiopods acquired from Robert Ferris Damon (1845-1929), a dealer based in Weymouth.

Miscellaneous collections

Glass Sea Anemones In the Leeds Philosophical and Literary Society Annual Report for the years 1865/6 there is the following statement. 'For the purpose of furthering the study of certain Invertebrate tribes, which, from their minuteness, cannot be examined with the unaided eye, and the beauty of whose structure is imperfectly exhibited in spirits, the Council have obtained from Prague accurate magnified models in plaster of some of the Foraminifera, and a beautiful series of models in glass, showing the natural size and colour of the European Actineae.' The information published in the list of acquisitions (which are now catalogued as LEEDM.C.1865.23) states : 'A Series of 64 accurate Coloured Models of the European Species of Actinea by Wenzel Fric, of Prague : Purchased by the Society.' Time and the bomb has taken its toll on these glass models, 27 of which are still extant, although a number are damaged to some extent. Mr John Armitage salvaged the models and did some restoration work on them in 1959. In April 1991 David Whitehouse, the Deputy Director of the Corning Glass Museum in New York, contacted the Leeds City Museum, as a result of research he was undertaking on the father and son team of lampworkers, Leopold and Rudolf Blaschka. It was soon established that Wenzel Fric was in fact Vaclav Fric, a Czech dealer in natural history specimens, and that our models came from the Blaschka workshops. In October 1991 two members of the museum's Friends photographed the models and copies were forwarded to David Whitehouse at the Corning Museum. The following paragraph is an extract from a letter by David Whitehouse dated September 17th 1991: 'The photographs were a revelation and I am immensely grateful to you for sending them. Leopold made his first models of sea anemones (for the natural history museum in Dresden) in 1863. As far as I am aware, they do not survive. Indeed most of the models I have located were made in the 1870s and 80s, after Leopold had been joined by his son, Rudolf, who eventually did most of the painting. The difference in quality between your very early objects, some of which seem rather crudely modeled and have strident colours, and the later versions (such as the models that Cornell University acquired in 1885) is remarkable. It is the first evidence I have seen that throws light on Leopold Blaschka's development as a scientific modelmaker. Indeed, it may help to explain a curious statement made by Leopold towards the end of his life, when he said that Rudolf was a better craftsman than himself, having greater "tact".' The Leeds material has recently been examined by Susan M. Rossi-Wilcox the Administrator of the Glass Flowers at Harvard University, (for details see Schultes & Davis, 1982), who considered the specimens to be 'significant', as very little material is known from this early date.

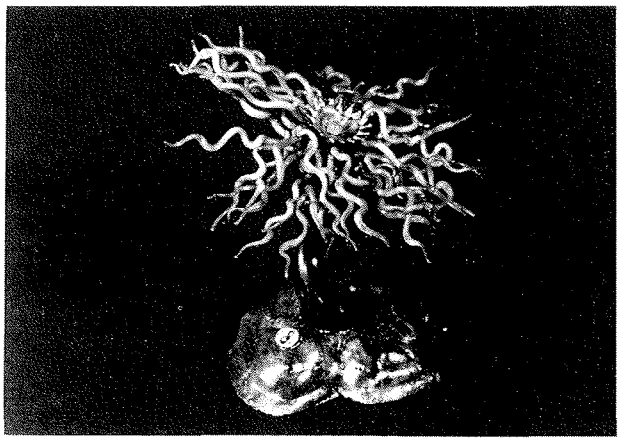

Figure 3. Glass Sea-anemone. (Aiptasia Couchii). By Leopold Blaschka c. 1865.

ACKNOWLEDGEMENTS

I would like to thank the many collectors, volunteers and staff at the Leeds City Museum for all their help in the production of this paper. In particular I would like to give special thanks to Helen James who volunteered her services as a full-time researcher, and without whose help this paper would have taken many more months of hard and painstaking work to produce.

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LABELLING SPECIMENS IN THE LIFE SCIENCE DEPARTMENTS AT THE NATURAL HISTORY MUSEUM, LONDON USING COMPUTERS

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INTRODUCTION

Throughout the Natural History Museum, registering or databasing our collections using computers has become the norm and many of us use computers to generate specimen labels. However, few in Life Sciences use specimen registers or databases to generate specimen labels direct, as is the case in Palaeontology and in many other natural history institutions. To reduce additional keyboarding effort, it obviously makes sense, where possible, to generate any required specimen labels from the specimen registers or databases as we are developing them, rather than continue to regard specimen registration and labelling as totally distinct and unrelated tasks.

The Life Science Departments at the Natural History Museum have functioned as autonomous units for most of their existence. It is perhaps not surprising, therefore, that each of the Departments has developed its own methods of labelling specimens. Indeed, there is considerably diversity even within Departments, such that different groups of organisms are labelled using different qualities of paper or card, different inks and different fields of data. Some of these differences undoubtedly arose and continue to exist as a result of the different methods of preservation demanded by the material (dry, fluid or slide-mounted) and the differing needs for different groups of organisms.

However, this review of labelling across the Life Science Departments has identified the possibility of unifying some of the labelling methodology to facilitate computer generation of labels and incidentally, but perhaps just as importantly, standardising on more permanent materials.

MATERIALS

Whatever the state of preservation, the primary requirements are that the media used are as permanent as possible.

Although suitable printers, papers and inks have been identified for printing permanent data labels for dry, fluid-preserved and slide-mounted natural history specimens using computer technology, it may be necessary to continue labelling single specimens or small numbers of specimens with identical data using traditional methods until sufficient hardware is available to all to make these methods no more practical than using a computer. But it should be remembered that specimens so labelled will still need to be databased on a computer! For practical reasons other labels which do not carry primary data, such as maps and those used to cross reference material in the herbarium, would continue to be preprinted and/or be printed using traditional methods.

Papers

All specimens preserved in fluid (alcohol or formalin) require an immersible label printed in permanent ink on 100% rag paper (Wiggins Teape WT HWS 550), Goatskin Parchment Paper (Wiggins Teape) or Resistall (Byron Weston Paper Company; supplied by Preservation Equipment Ltd (UK) and University Products (USA)). Some curators also use a non-immersible label printed on Archive Quality Paper (Conservation Resources (UK) Ltd) or Pancake Particle gummed paper 80 gms/metre (Smith & McLaurin via H.M.S.O.) (identical with respect to data to the immersible label) which is glued to the outside of the glass container in which the specimen is preserved using either the gummed label's adhesive or UHU glue.

All specimens mounted on glass microscope slides require one or two square/oblong labels printed either on Pancake particle gummed paper 80 gms/metre (Smith & McLaurin via H.M.S.O.), or foil back microscope labels (Preservation Equipment Ltd or University Products Inc.) or Archive Quality Paper to be gummed directly onto the glass slide or existing card label (4-sheet Bristol board) using either the gummed label's adhesive, UHU glue or PVA. In addition to labelling each microscope slide with a printed label it is good practice to scratch a unique identifying number onto the glass slide using a diamond point, so that even if the label does become detach the mounted specimen can be associated with its data.

Blick self-adhesive labels do not adhere to glass very permanently and should be avoided.

All specimens preserved dry need a label printed on acid-free archive quality paper (e.g. herbarium sheet labels), 100% rag paper, Goatskin Parchment or thin card (e.g. insect specimens - Mellotex Smooth Ultra White 135 gsm card from Tullis Russell via HMSO).

Herbarium sheet labels are generally glued on to the herbarium sheets with latex glue (J. Hewitt & Sons Ltd) by the plant mounters. Latex glue, however, has recently been tested and shown to severely discolour when subjected to accelerated aging at 50% Relative Humidity and 90°C for 12 days (Annemarie Wierda, Amsterdam).

Tie-on labels, each with a hole punched in it (the hole reinforced with a brass eyelet) are used extensively in Zoology. These eyelets may disintegrate in fluid over time (pers. comm. Oliver Crimmen). Moreover, these labels present a problem for computer generation. In such cases printing onto an adhesive label which is subsequently stuck onto a tie-on label might overcome this difficulty for dry specimens. Alternatively labels could be printed onto a standard label with a wide left hand margin. After printing the left hand edge of the label is folded over and then a hole punched through the double thickness of card to accept a tie.

Inks

Several types of ink are available. Water-based ink such as that used in standard Deskjet printers is not suitable for

labelling natural history specimens as the ink is not waterproof. Indelible or permanent ink is, however, suitable. Misco Computer Supplies Ltd can supply an indelible black ink cartridge suitable for use with a Hewlett Packard Deskjet printer; and Automated Office Products can supply alcohol resistant ink suitable for re-inking dot matrix printer ribbons. Both require the label to be washed in alcohol after drying to remove excess ink prior to immersion in alcohol or formalin. Indian or China ink is generally made from lamp black and animal glue. Printing ink is generally made from carbon black and oil (and sometimes varnish). Unlike indelible inks, they are not suitable for use in Deskjet printers as they block the jets, but Indian or China ink can be used in Rotring and Rapidograph type pens for hand writing labels, even for immersion in alcohol or formalin.

PRINTERS

It is possible to standardise on printers and inks and a few paper/card types for printing labels for all natural history specimens. Three types of printer (laserjet, deskjet and dot matrix) can be used for printing labels for natural history specimens. Each has advantages and disadvantages.

Hewlett Packard Laserjet Printers

Hewlett Packard Laserjet printers can be used for printing non-immersible labels, provided that Hewlett-Packard's ink cartridges (and not less expensive products) are used. Non-immersible labels should be printed on Archive Quality paper or card if this is not to discolour over time due to the effects of ultra-violet light on the toner and paper, which can also effect the permanency of cheaper Laserjet ink (pers. comm. Adrian Rissone).

Labels printed on Laserjet printers or photocopied appear to suffer toner degradation if submerged in an ultrasonic cleaner (Sims, 1989) and are subject to abrasion and excess heat (Daly & Jordan, 1989). However, for many applications (i.e. pinned insect labels) abrasion is unlikely to occur. If there is a risk of abrasion then labels should be printed on a Hewlett-Packard Deskjet printer using a cartridge filled with indelible black ink (see below).

Neither Laserjet printed nor photocopied labels should be immersed in ethyl acetate (used by entomologists as a killing agent) as the toner is soluble and the ink will wash off.

Scaleable fonts are available, the sans serif fonts are easier to read.

Hewlett Packard Deskjet Printers

Hewlett-Packard Deskjet printers can be used to print a permanent immersible or non-immersible label provided that indelible black ink (M6651 from Misco Computer Supplies Ltd) is used to refill the cartridges. Standard Deskjet ink cartridges should not be used as they are not even waterproof!

For immersible labels only 100% rag paper such as Wiggins Teape's HWS WT 550, Wiggins Teape's Goatskin Parchment or Byron Weston's Resistall should be used, however, as other papers tend to break up over time. Immersible printed labels, once dry, need to be washed in alcohol to remove excess ink prior to use. The black ink turns to blue-black overnight, but thereafter seems to be permanent.

Non-immersible labels should be printed on similar paper or on Archive Quality paper or card.

Unfortunately the range of fonts available on a Hewlett Packard Deskjet printer is somewhat limited if using Wordstar 6.0 for DOS, the smallest suitable font being Times 6.0 PC, but most Windows wordprocessors offer a choice of scaleable fonts.

Dot Matrix Printers

Dot-matrix printers, such as the heavy duty "WriteImpact" 24-dot matrix printer (Mackintosh compatible) manufactured by GCG Technologies or the Epson LQ-2550 24-dot matrix printer (PC compatible) and others, can be used for printing labels provided that the ink is alcohol-resistant (pers. comm. Paul Hillyard). Ribbons can be re-inked with alcohol-resistant ink available from Automated Office Products (USA). As with labels printed using a Hewlett Packard Deskjet with indelible ink, printed labels, once dry, need to be washed in alcohol to remove excess ink prior to use. As with Hewlett Packard Laserjet and Deskjet printers only 100% rag paper such as Wiggins Teape's HWS WT 550 Wiggins Teape's Goatskin Parchment or Byron Weston's Resistall should be used for immersible labels, as other papers tend to break up over time.

Non-immersible labels should be printed on similar paper or on Archive Quality paper or card if this is not to discolour over time due to the effects of ultra-violet light on the toner and paper, which can also effect the permanency of cheaper Laserjet ink (pers. comm. Adrian Rissone).

Handwritten labels

If data is written onto an immersible label then permanent Indian ink in a Rotring or Rapidograph pen can be used. Staedtler's mars graphic pigment liner which contain pigmented, waterproof and lightfast ink, are apparently also suitable.

BAR CODES

Some Institutions, including this Museum, use bar codes to uniquely identify specimens. Pre-printed self adhesive labels are used in Botany to uniquely identify herbarium sheets sent out on loan.

Although very small photographic quality bar-coded labels are used by INBIO, Costa Rica to uniquely identify insects, there are practical difficulties in their use. In particular, the labels can only be read by a bar-code scanner if they are not obscured by the specimen. Moreover, the available scanners for the bar-code used often require several passes over the label before the code is read (as is often is the case in supermarkets which use very much larger bar codes). There are also practical difficulties in associating a pre-printed bar-coded label with a particular specimen, especially if the unique numbers are generated automatically in a multi-user environment.

PRINTING

Real difficulties arise from the diversity of fields of data required on labels for different groups of organisms preserved dry, in fluid or slide-mounted. The Data Dictionary compiled for use with the Paradox for DOS Specimen Registers in use in Botany and Zoology, for example, comprises more than 100 fields (including 31 "core" fields), although only a maximum of 51 fields are used in any one database.

It is imperative that a data input form for each different group of organisms is included in the Collections Management System currently under development.

In order to simplify data input and subsequent label generation it is important that only those fields required for each group of organism are included in the data entry form for that group and these fields (or a subset thereof) are included in the report form, which generates the labels.

The data input screen should allow users to enter relevant data for one or many specimens (without the need to rekeyboard the same data for a series of two or more specimens) and assign a unique number to each specimen. This will enable large series of specimens with identical data to be databased with minimum of effort.

The system should offer the choice of printing one or more data labels at one time (as a range) to minimise time and resource wastage.

The system should offer the choice of printer (Laserjet or Deskjet; local or remote networked printer; and the paper tray in the case of multiple tray printers) and the fonts to be used for the label required

Ideally the system should allow the user to preview the printed labels prior to printing.

Some groups, notably insects, will need options to print data labels only or determination labels only or both, as specimens may not be identified at the time they are databased.

Some groups such as specimens in fluid will need options to print data labels of a set number of different sizes and fonts to suit the size of container used to preserve the specimens.

For plants preserved on multiple herbarium sheets there is a need to print continuation sheet labels bearing the basic data and sheet number.

For plants preserved both dry and in fluid there is a need to print identical labels on different papers - immersible and non-immersible.

For some groups of organisms it may be necessary to print identical labels for different methods of preservation e.g. ferns and their spores, insects and their genitalia.

Such is the complexity of the required system, that it may be more practical to direct all printing, initially at least, to a file and then subsequently print this via a word-processor! Particularly since not all required relevant hardware is in place and it will require a great deal of form designing and network configuration for remote printers!

LABELLING PROGRAMME

I have written such an application for registering specimens and generating labels for Entomology in Paradox for DOS . The application is multi-user and network compatible, so that several users can simultaneously enter, edit and print data.

The application could be fairly easily modified to suit any group of organisms, and has been recently modified for databasing library photocopying requests!

The application can be used EITHER for registration of individual specimens OR for label generation OR both simultaneously.

The application automatically assigns a unique specimen number to each record and automatically adds your username and the current date to each record.

If you have a series of specimens with identical data, there is a repeat option which allows you to automatically replicate a record as many times as you wish, automatically assigning a unique number to each specimen.

The application allows you to edit any record. To ensure data security, however, you cannot delete records once they have been committed to the archive, although you can delete a record prior to committing it to the archive i.e. during an input session.

The application can be used for unidentified specimens as there is an update option which allows you to update a record at a later date - to add the identification and then subsequently print a determination label.

Collection data labels and determination labels can be generated from the data for dry pinned specimens, alcohol-preserved specimens or slide-mounted specimens. The application automatically punctuates your data prior to printing, adding such things as parentheses around subgeneric names; a colon after country; commas after state and county (if these are followed by a place name); commas between latitude, longitude and altitude (if included in the data); etc.

Currently, labels are printed to a file which needs to be "tweaked" using a wordprocessor to set the printer type and required font. It is also necessary to reformat the output file to word wrap long lines of text prior to printing and to globally edit sex symbols. Although this is not ideal, it offers considerable time saving over entering raw data into a wordprocessor, using macros or block copy options to replicate labels. It also means that the data has been captured for further use. Moreover, it ensures a consistency of layout and style for all labels. The fact that the file is in wordprocessor format also means that it is possible to edit the label text, the layout, etc to suit your individual needs.

If you opt to print your labels via Wordstar, the file generated by Paradox includes detailed step by step instructions on what to do prior to printing. If you opt to print your labels via WordPerfect or Word, then at present no instructions are included in the wordprocessor file and it would be necessary to check that no label starts at the foot of a column and finishes at the top of the next column (or page). The Wordstar version of the Paradox output file ensures that no label starts at the foot of a column and finishes at the top of the next column (or page).

Insect Order- specific versions of the application, which differ only in respect of additional fields included and range of unique numbers available, are currently being used in Entomology by the David Green to database termite spirit material and by Nigel Wyatt to database British tachinid flies with host data. The application will shortly be used to database the arachnid spirit collections and generate specimen labels as required. The database around which the application is written is currently also being used by Phil Ackery to database birdwing butterflies, by Julia Pope to database swallowtail butterflies and by Carolyn Lowry to database blackflies (all of whom started databasing before the application was complete)

References

Daly, H.V. & Jordan, C.L. 1989. Computer generated collection labels: They are fast, but will they last. *Insect Collection News.* **2** (2):

Sims, L.L. 1989. How permanent are they? *Insect Collection News.* **2** (2):

SUPPLIERS

Automated Office Products Inc
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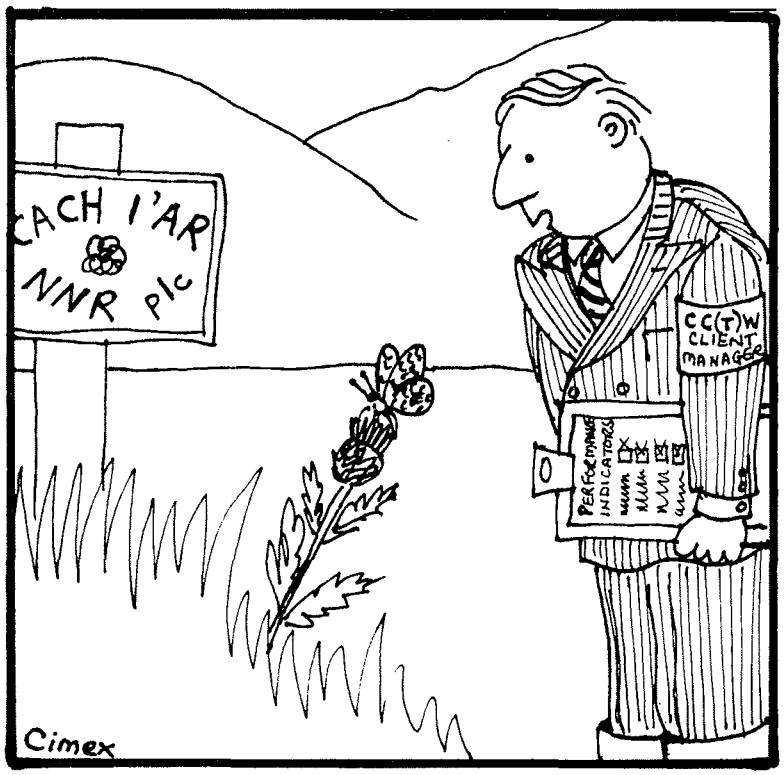

face up to it Eurodryas — one more season like this — you're off the reserve and the niche goes out to tender!