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Diary Dates

Launch of Collections at Risk Packs
27 October 1997, The Natural History Museum, London

Gentlemen and Players
22 November 1997, Meeting of the Malacological Society, Conchological Society and Society for the History of Natural History on the gradual professionalism of malacology during the early 20th century
Contact: Elizabeth Platts, Belmont, New Road, Littleton, Winchester, Hants. SO22 6QR

GCG AGM
27 November 1997, The Natural History Museum, London
Contact: Steve McLean, Hancock Museum. Tel: 0191 222 7418

Progress on Pest Control in Collections
2 December 1997, Natural History Museum, London
Contact: Phil Ackery, Dept. of Entomology, The Natural History Museum. Tel: 0171 938 9346

Entomological Collections: Entomology for Non-entomologists
24 February 1998, BCG meeting, Tullie House, Carlisle. Details to follow.
Contact: Steve Hewitt, Committee Member

Insect Pests in Museums
17-18 March 1998, Natural History Museum, London
A two-day course covering pests and damage, pest identification, pest environments, pest monitoring and control and pest management amongst other topics.
Contact: Phil Ackery, Dept. of Entomology, Natural History Museum, Cromwell Road, London, SW7 5BD. Tel: 0171 938 9346

BCG AGM
30 April-2 May 1998, Royal Scottish Museum, Edinburgh
Contact: Steve Thompson. Tel: 01724 843533

A Survey of Ethanol Concentrations in the Collections at the Oxford University Museum of Natural History

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Biological specimens have been preserved in ethanol since Robert Boyle first discovered that specimens could be preserved in "spirit of wine" in the mid-seventeenth century (Simmons, 1991). Recently there has been a (long overdue) growth in the study of the conservation of 'wet' collections, the effect of preservatives on the long-term preservation of specimens and other collection management issues associated with fluid collections (e.g. see Horie, 1989). However, as noted by Cato (1990), there is very little published data on the actual condition of collections at a given point in time. Such data is an essential part of determining the long-term effects of preservatives and management and maintenance procedures on specimens. Apart from Cato (1990) and Simmons and Waller (1994) there are a number of unpublished surveys of collections in North America (Waller, pers comm) and a paper given at the 1996 SPNHC conference by Lisa Palmer, National Museum of Natural History, Smithsonian Institution (Palmer, 1996).

The Oxford 'wet' collections include specimens of the majority of animal orders, from Protozoa to Chordata, and are housed in two basement storerooms, the Invertebrate and Vertebrate Spirit Stores. There are approximately 10,000 jars of invertebrate material and 5,000 jars of vertebrate material. The earliest material dates from the first decades of the

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Deadline: All items for next publication to reach Editors by 8th January 1998.

nineteenth century and approximately half the collection dates from that century. The specimens are all in either ethanol or formaldehyde; there is no history of the use of any other fluids in the collection apart from some specialised media for a few invertebrate specimens. Phenoxetol is now used for certain display specimens. Nearly all the specimens are in glass jars, almost all with glass lids.

The 'wet' collection is 'topped up' every summer; jars are 'topped up' with 70% ethanol or 5% formalin and a few jars, which have lost virtually all fluid, are obviously mouldy or have severe discolouration of the fluid, are refilled completely. Interviews with long-standing members of staff suggest this collection management practice has been in operation for at least 37 years and probably for many years before. Since 70% ethanol will tend to evaporate ethanol or absorb water (Simmons, 1992, Horie, 1994) this means that over time the percentage of ethanol in the jars falls. 'Topping up' jars with fresh ethanol does not correct problems of low ethanol concentration (Cato, 1990). However it was not known what proportion of jars had ethanol concentrations substantively below 70%. It was therefore decided to purchase equipment to accurately measure the ethanol concentrations in as many jars as possible. The purpose of this project was two-fold. Firstly it would provide a profile of the condition of the collection which would give an indication of the effectiveness of the current management practice. Secondly it would identify specific specimens which were currently preserved in weak concentrations of ethanol which would put their continued preservation at risk. Since it was not possible, with limited staff and financial resources, to replace all the fluid in all the jars at once this survey would enable phased replacement of ethanol, prioritising those jars with the lowest concentration first. Another incidental, but important, benefit of the project was that it enabled identification of specimens preserved in formaldehyde.

Methods & Materials

Measurement of density is the most convenient and common method of determining ethanol concentrations in simple ethanol-water solutions (Boase & Waller, 1994). The Museum purchased a DMA 35 Digital Density Meter in 1995 to enable the density of the solution in the jars to be measured accurately. The meter was filled with fluid from the middle of the jar, to avoid any sediment at the bottom of the jar which would invalidate the reading. The meter was filled twice before a reading was taken, to flush out any traces of the previously recorded solution; in addition, after each set of ten readings, it was washed out with distilled water. The fluid was not put back in the jar but was discarded. The density and temperature readings were recorded. The project was completed over the summers of 1995 (Invertebrate Spirit Store) and 1996 (Vertebrate Spirit Store).

A proportion of the jars had extremely well sealed lids with mixtures including gutta percha, bitumen, asphalt and lead. The documentation of recipes used in the Museum showed these jars had been sealed in the first half of this century. Since breaking these seals would have, in some cases, required breaking the jar and these specimens also showed no signs of evaporation, it was decided, in the interests of the long-term preservation of these specimens, not to break these seals. These specimens were assumed to still be very close to 70% ethanol concentration.

The readings, of density and temperature, were then entered onto a computer in a form suitable to be analysed using a computer programme written by Tom Strang of the Canadian Conservation Institute in 1989. This programme, ETHANOL, converts the density and temperature readings into a percentage ethanol reading. After the conversion the results were scrutinised and readings under 40% and over 75% were remeasured. It was particularly important to check the low percentage readings as the density of low grade alcohols is close to that of formaldehyde solutions (Moore, 1994). In all but a few cases the readings did not change.

Results

Table 1. Summary of Data

	No. of readings	*Percentage of total no. of jars*	*Mean percentage ethanol*	*Standard deviation from Mean*	*Median Percentage ethanol*	*Percentage of collection between 60-75% ethanol*
Invertebrate Spirit Store	2331	26	63.1	0.22	66.3	73
Vertebrate Spirit Store	2542	53	63.4	0.21	66.2	77

The results are summarised in Table 1 and Figures 1 and 2. The total number of readings taken was 4873. This represents approximately half the jars in the Vertebrate Spirit Store (the other half were mainly jars which could not be opened) and about one quarter of the jars in the Invertebrate Spirit Store (the other three quarters being split between jars containing formaldehyde and jars which could not be opened). Results for the two stores were very similar and there was no significant difference between them. The mean and median ethanol concentrations were, respectively, 63% and 66% ethanol concentration. Approximately three-quarters of the specimens were in ethanol concentrations between 60 and 75%. One tenth of the specimens measured were in less than 50% ethanol with a fifth of these in less than 30% ethanol. Those jars with very low percentage ethanol concentrations were usually those with low fluid levels and/or in which the fluid was badly discoloured.

Discussion

The results show a very healthy collection profile; the majority of the specimens are in concentrations of 60-70% ethanol. The overall collection profile is likely to be even better than the sample used in this study since the majority of those jars not measured showed extremely low evaporation rates. There are two particular reasons which may explain this. Firstly the stores have good environmental conditions for "wet" collections. Ideal environmental conditions for fluid-preserved material are given as 18°C and 50% relative humidity (MGC, 1992). Both the spirit stores in the Museum are basement stores and are thus dark, cool in summer and cold in winter; for this reason the relative humidity would, in the UK climate, be quite high. These conditions are good for lowering evaporation rates. Secondly

Figure 1 : Plot of the frequency count for the percentage ethanol for the Invertebrate Spirit Store

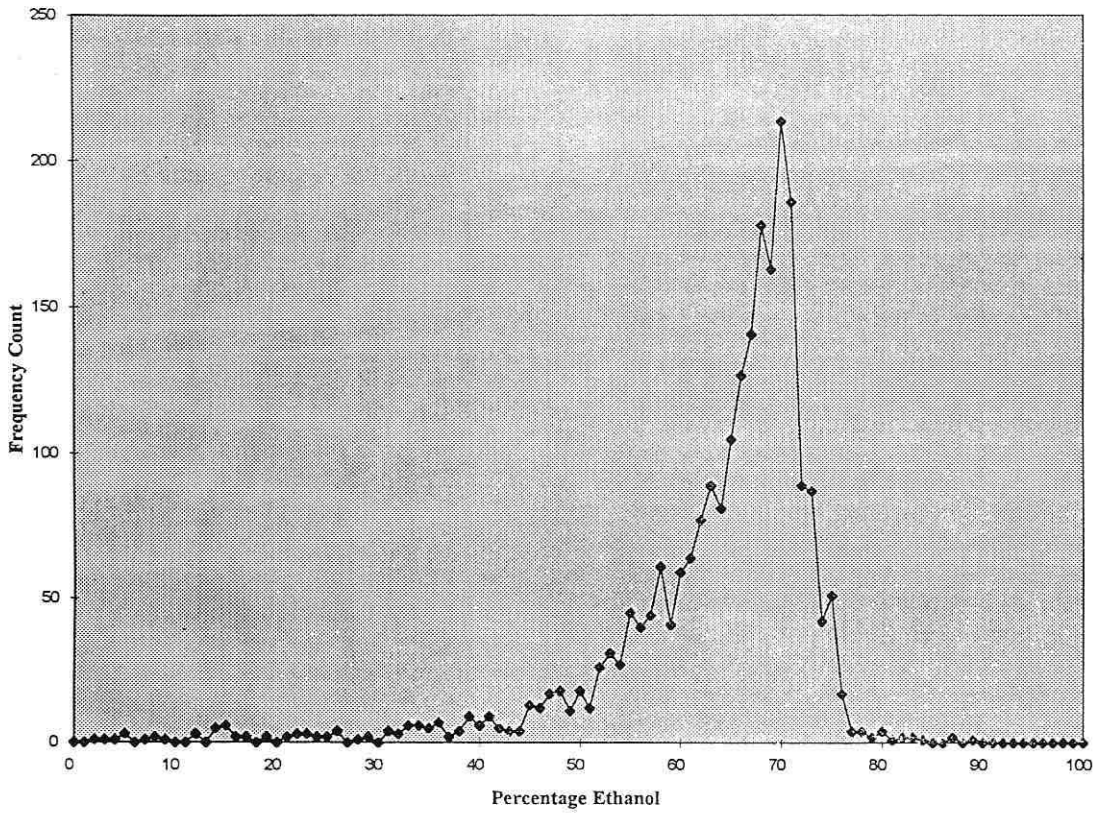
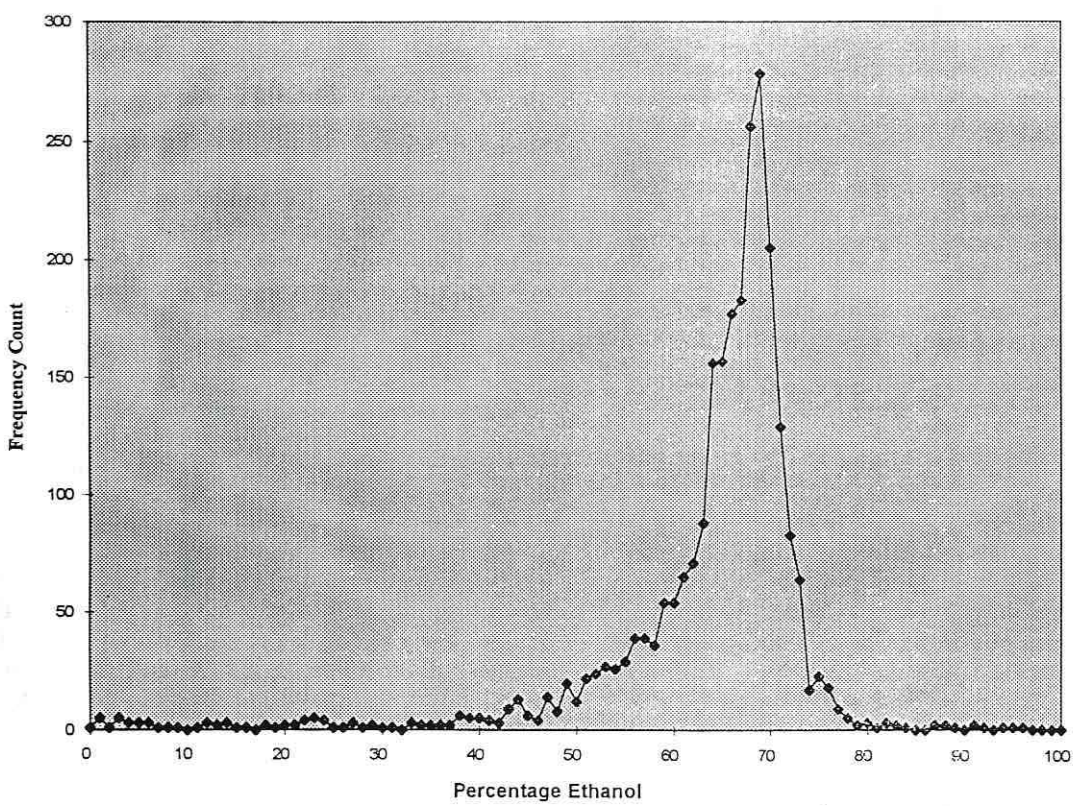


Figure 2 : Plot of the frequency count for the percentage ethanol for the Vertebrate Spirit Store



the collection is stored in all-glass jars most of which have ground-glass stoppers. Such jars have very effective seals, which is vitally important for reducing evaporation (Simmons and Waller, 1994) and perform well over long periods of time (Lincoln, 1989, Clark, 1992).

The results were remarkably similar for the two collections. In one sense this is not surprising, given that the collections are subject to the same maintenance regime and are housed in similar conditions. Although this was not measured, however, the usual size of jar in the two stores is different, with the jars in the vertebrate spirit store tending to be much larger. The results tentatively suggest that jar size and the type of specimen do not affect ethanol concentration.

There were a surprisingly high number of specimens (on average 17%) with ethanol concentrations above 70%, in particular between 70-75%. This is most likely to be the result of inaccurate measurement of the 'topping-up' solution. The 70% ethanol is made up from Industrial Methylated Spirit, supplied at 99%, using a glass hydrometer, using the same system employed in most museums described in Simmons and Waller (1994). Staff (pers. comm) also tended to err on the generous side because of the assumption that the ethanol concentration in the jars was likely to be lower than 70%. Those few specimens with extremely high alcohol concentrations are difficult to explain but, since such high concentrations are likely to be detrimental to the specimen, causing dehydration, they were replaced with 70% alcohol.

The specimens which are in ethanol concentrations below 50% are particularly at risk. It was noted that often these specimens had very low fluid levels and/or were badly discoloured and thus were likely to have been completely replaced in a normal year. This was not always the case, however, and specimens in ethanol concentrations of below 20% are at risk of decay (Stoddart 1989). Those specimens in concentrations below 30% were immediately re-spirited into 70% ethanol, through a series of stages as sudden large changes in ethanol concentration can cause dehydration and specimen distortion (Moore, 1989). The possible causes of low ethanol concentrations are evaporation, leaching of water from specimens and periodic topping up (Cato 1990); given the age of the specimens, it is likely to be evaporation and consequent topping up which are the major factors involved.

The results provide an interesting comparison with the survey carried out on the mammal collection in Texas described by Cato (1990). The Oxford project was more limited in scope than that of Cato but provides an interesting contrast to it as the collections measured are much older and more varied. Cato measured 400 jars of recent mammals, 90% of which were collected after 1960. The median ethanol concentration was 64%, the minimum value scored being 41% and the maximum 71%. Those jars with low ethanol concentrations (under 60%) made up just under one fifth of the number measured and generally had more specimens per jar and a smaller specimen to fluid ratio. This is similar to the results here; the median was 66%. The range of concentrations in the Oxford survey was much greater, but this would be expected given a much larger number of readings and the greater age of the collection. Similarly, approximately one fifth of the jars measured in the Vertebrate Spirit Store had ethanol concentrations below 60%. The fact that this figure rises to one quarter for the invertebrate collections, which have more specimens per jar, lends cautious support to Cato's conclusions. Interestingly, Cato's assertion that older collections may show "more marked trends" in storage conditions is only borne out in one respect; that there is a more substantial 'tail' of specimens at low ethanol concentrations. The bulk of the collection shows a similar distribution.

The results discussed in Simmons and Waller (1994), for measurements of 62 jars, show a mean ethanol concentration of 59.1%, lower than that found in Oxford and by Cato. The range of measurements, from 40.1 to 74.1%, is similar to Cato, but again lacks the 'tail' found in the Oxford collections. This, again, is probably because a greater proportion of the collection was measured in Oxford plus the collection is much older. Work carried out by Palmer (1996) on 272 jars in the mammal collections at the National Museum of Natural History, Smithsonian Institution, gave a range of 39 - 94% ethanol concentration which is more in line with the Oxford results. Like Cato, she also concluded that those jars with more specimens and, in particular, with a low specimen to fluid ratio were most at risk of low ethanol concentration.

The study succeeded in its aims. Those specimens with very low (and very high) ethanol concentrations were identified and the programme to replace the fluid in these jars has started. The overall collection profile also gives an indication as to the effect of current collection management practice on the condition of the collection. Lincoln (1989) recommends a brief annual inspection of all 'wet' material, backed up by a 3-4 year cycle of comprehensive respiriting. These results suggest that if collections are stored in good environmental conditions, in suitable glass containers, comprehensive respiriting need not be done so frequently. Whilst the number of specimens in low ethanol concentrations supports the need for annual checks to ensure such specimens are dealt with, the proportion of these jars of the whole suggests comprehensive respiriting need only be done on a much longer time scale.

However, as Cato (1990) remarked, studies such as this one raise many questions. There is no information on acceptable risk levels for alcohol concentration or the degree to which specimens are harmed by, say, 65% ethanol. Different authors recommend ethanol concentrations of 60-75% (Simmons, 1992) but none of these recommendations are based on experimental data. Information on the condition of such specimens is needed, building on initial studies such as those described in Moore (1989). It would also be interesting to compare this profile with a similar collection stored in poor-quality environmental conditions to see the effect of storage conditions on ethanol concentration. If it is significant, there would be considerable long-term savings on staff time and fluid costs in improving those conditions.

Acknowledgements

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Suppliers

DMA 35 Digital Density Meter

Paar Scientific Ltd. 594 Kingston Road, Raynes Park, London. SW20 8DN. Tel : 0181 540 8553.

Ethanol Concentration Conversion Programme

Tom Strang, Canadian Conservation Institute, 1030 Innes Road. Ottawa, ON. K1A 0C8.

IMPORTANT - NEW EC REGULATION AFFECTING TAXIDERMY

On 1st June 1997 the **Endangered Species (Import and Export) Act 1976** and **EC Regulations 3626/82 and 3418/83** were superseded by **EC regulation 338/97**. This new regulation is likely to affect most museums with natural history specimens.

The spirit of regulation 338/97 is : '*to protect species of wild fauna and flora and to guarantee their conservation by regulating trade therein*'.

We have, on behalf of BCG, been talking to the DoE about how the new regulation affects museums. Firstly it should be noted that the species covered by the regulations includes foreign species covered by CITES but also many European birds of prey and owls. Secondly it should be noted that it relates to material set up after 1947. So old taxidermy is not affected. The legislation basically covers the import and export of such specimens and also "*the purchase, offer to purchase, acquisition for commercial purposes, display to the public for commercial purposes, use for commercial gain and sale, keeping for sale, offering for sale or transporting for sale*". Each individual specimen used in any of these ways needs an individual licence. A possible scenario for being in breach of this regulation would be the setting up of, say a barn owl, on display where the Museum charges admission. Also since *sale* includes hire, the loan of a specimen for which a charge is made e.g. school loans.

However it is possible for "*scientific institutions*" to register with the DoE to be exempt from the legislation. The DoE can issue a one-off certificate, covering all species, to a Museum which is involved in research and/or education which "*is aimed at the preservation and conservation of the species*". Currently BCG are working with the DoE to try and see if MGC Registration can provide a short-cut to the provision of such a certificate and avoid long, tedious paperwork. In addition those institutions which regularly loan and/or exchange specimens for scientific research can apply for accreditation to use the new labelling system for such movement of specimens. This is likely to apply only to those scientific institutions already registered with the DoE (currently about 17), and other national and university museums.

The DoE are producing an advice sheet for museums which may be affected by this legislation. This will be sent