Insect Pests in Museums NHM External Course

A review of the two day course at the Natural History Museum 14th-15th March 2000 taught by David Pinniger, Consultant Entomologist

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Most people who work in museums will have heard of David Pinniger, his name being synonymous with museum pest control, so it was with high expectations that I attended the two day course at the Natural History Museum. The course was well structured, the speaker was clear and precise and the slides presented were relevant and of good quality, there was also a strong practical orientation. The course included sessions on:

- Pests and Damage
- Insect Identification (inc. practical session)
- Pest Environments
- Pest Monitoring and Control Options
- Pest Monitoring: Results
- Practical observation session
- Health and Safety, Risk Assessments, COSHH

As an entomologist, I found the first day sessions on pest life histories and identification a little basic, and with a few strange omissions. In particular, some pest species were not mentioned, e.g. the recent outbreak of the new pest beetle in Scotland (this issue) and some of the available literature not mentioned either. However, other members of the group I spoke to found this level pitched perfectly as they had little or no experience of identification. The pest identification was brought to a close with a small practical exercise. With samples of insects placed out we set about to try and name a dozen or so pests, with our notes and experts at close hand (3 in all), this proved a successful and very useful exercise .

The pest monitoring session gave us an idea of the type of traps available and where to place them, this was helped with real-life examples and results. The pest management and control options went into detail of the ways and means of getting rid of pest problems. The use of Integrated Pest management was advocated and explained concisely. This was a real delight as the chemical barrage we are able to use is disappearing fast, and

The Ten Agents of Deterioration

An issue guide to the risks facing museum collections

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with health and safety issues of some chemicals coming under scrutiny the sooner we can find, learn, and use alternatives the better. The section on Health and Safety was the least satisfying part of the course, this could have been improved with more time and some handouts. The course finished with a practical observation session in the NHM stores and galleries and a discussion on the problems we found and the possible solutions.

Overall a very good course for beginners, although those with a few more years experience may find the course a little basic, it acted as a good refresher. However, I thought that more was needed in terms of course literature and handouts, with more in-depth details.

Further Reading

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Rossol, M. & Jessup, W. C. 1996 No magic bullets: safe and ethical pest management strategies. Museum management and curatorship 15 (2).

Rust, M. K. Daniel, V., Druzik, J. R. & Preusser, F. D. 1996. The feasibility of using modified atmospheres to control insect pests in museums. Restaurator 17 1).

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Introduction.

The eighth in our series of *The Ten Agents of Deterioration* is **Pollution.** A subject for which the literature is sparse and the science within the natural history collection environment is still in its infancy. The traditional concept of pollution as being merely a particulate deposit or some problem of air quality has been extended to include the affects of storage material off-gassing and residual traces of pollutants from previous treatments.

The effect of pollution on natural history collections is now widely acknowledged as a serious threat and conservators are beginning to give this the research it deserves For example the first prize for Research and Innovation at the Jerwood Foundation and MGC1998 awards was won by Stuart Adams with the re-developed gloss meter that can indicate the levels of particulates settling within a store, thus determining whether the collections are at risk.

The use of new materials in collections should be done with caution, one should always try to use conservation quality materials or those listed in an 'acceptable materials' list. If a new material (i.e. its conservation quality unknown) is to be used, it should be tested by standard practices. For information on these see Lee, L.R. & Thickett, D. 1996 *Selection of Materials for the storage or Display of Museum Objects*, British Museum Occasional Paper 111: 60pp.

The contents of this issue have enlightened me about the problems of pollution, I hope that the same will be true for you.

Darren

Next Issue

The next in our series of *The Ten Agents Deterioration* is: **Physical Forces**. A subject for which I'm sure there are plenty of potential authors, especially with all the collection moves that are happening around the country at present. So, get your pens and keyboards going, and send me some articles.

Introduced Pollutants -
The Risks of Treating Mineral Specimens with Ammonia

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Most pollutants are not deliberately introduced into collections, however, I feel that I ought to write of an unhappy experience I had last year whilst treating mineral specimens with gaseous ammonia (based on Waller, 1987), as part of an ongoing pyrite treatment programme.

There is a lack of published information on the consequences of treating pyrite decay in mineralogical specimens, especially where more than one species of mineral is present on one specimen. As a result, I have been cautious in treating only one of each type of specimen at any one time, especially if the localities from which they were obtained are no longer producing specimens.

My caution turned out to be fully justified when I discovered to my horror that what had been a rather nice green crystalline pharmacosiderite [$KFe_4^{3+}(AsO_4)_3(OH)_4$ 6-7H_2O] on a pyritic matrix had, upon treatment in gaseous ammonia, become a red crystalline specimen. Whilst this was rather attractive, it was obviously no longer pharmacosiderite.

After one week in a dry environment (to allow the ammonia to dissipate) the colour changed from red to pinkish brown, which is how it has remained. I suspected that the potassium (K) in the formula had been replaced by NH_4, as potassium is an exchangeable base. According to Hey's Mineral Index (1993), pharmacosiderite containing NH_4, as an artificial compound is known, and I had just produced it. I was interested to know if this was only a surface phenomenon , so I looked at a small piece under the microscope, unfortunately it was a uniform red all the way through.

The next step was to check for the presence of the ammonium group using a Fourier Transform Infrared (FT-IR) Spectrometer, making a comparison with an untreated pharmacosiderite from the same locality. In the treated specimen, the peaks in the spectrum signature did appear to correspond

with those expected if the ammonium group was present, and these were absent in the untreated specimen, thus confirming my suspicion of a complete replacement. I thought that I should bring this to other people's attention, although I suspect that others may have had a similar experience but not published.

The questions that now arise from this are: Has anyone else had similar problems with ammonia when treating mineralogical specimens that contain other important minerals in addition to pyrite or marcasite? Is this reaction reversible? Does anyone know of any research in this area, and if so, where it is published?

Acknowledgements
My thanks to Monica Price, Assistant Curator of Mineralogy, OUMNH for help in using the FT-IR.

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Clark, A. M. 1993 *Hey's Mineral Index*. Third Edition. Pharmacosiderite. p.539. Chapman & Hall.

Pollutants in Museums

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Pollutants take two forms, gaseous and particulate - or simple terms: smells and dirt.

Prevention of contamination by particulate pollution and the removal of such contamination is perhaps the most common concern amongst conservators. Strangely, gaseous pollutants have tended to receive less attention

and were, at least until the last twenty years or so, perhaps perceived as less of a concern.

The Oddy tests were developed at the British Museum (see Lee & Thickett, 1996 *Selection of Materials for the storage or Display of Museum Objects*, British Museum Occasional Paper 111: 60pp.) as an accelerated test to determine if materials to be used in the construction of displays would give off copper, silver or lead tarnishing compounds, principally hydrogen sulphide, other sulphides and carboxylic acids. Modifications and assessments of these tests indicated that they are a valuable testing method, provided the test is carried out correctly.

The Oddy test combined with a range of other test strips provided the basis for my own research project done in 1991 in Canada on pollutants in mineral collections. The findings of this research project, carried out in conjunction with Rob Waller of the Canadian Museum of Nature and Jean Tetreault of the Canadian Conservation Institute will appear in the next edition of Collections Forum, spring 2000. A summary of the method employed was published by SSCR in Vol 4, no 1 Feb 1993, one of three papers concerned with gaseous pollutants in the museum environment. The project detected a range of pollutants within systematic mineral collections and set out to compare the effects of cabinet furniture on internal pollutants. Some of the pollutants were generated by the specimens themselves: mercury and sulphur vapour due to the low vapour pressure; reduced sulphide gasses by decaying sulphide minerals and carboxylic acids emitted from the wood of cabinet furniture.

For biological specimens, Brimblecoome, who spoke at the very first Natural Science Conservation meeting in Ipswich, gave a paper on biological materials as sources of air pollution in museums, which was written up in Life after Death. The very first recorded natural science conservation problem was Byne's disease; the papers describing the efflorescence on modern mollusc collections were published in the 1880s. It was not until 1985, when Norman Tennant, working initially with Baird, started to analyse the efflorescence's that the were cause of the problem - thus, carboxylic acid emission from wood cabinets was identified.

For those interested in choosing wood products to avoid acidic emissions, or to reduce emissions through coatings, CCI's 1999 technical bulletin provides all the information you need. (English oak generates a pH of 3.3 to 3.9). Coating for display and storage in museums, Canadian Conservation Institute Technical Bulletin no 12, by Jean Tetreault. ISBN 0-662-27955-7

Pollutants in Collection Stores-

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Pollutants can manifest in collection stores in two main forms: -

- *Gaseous*
  - *From the outside environment* e.g. sulphurous and nitrous oxides, ozone, hydrogen sulphide.
  - *From the storage* e.g. carbonyl volatiles such as formaldehyde.
  - *From the specimens* e.g. acetic acid, formic acid, radon, mercury vapour, sulphur dioxide.
  - *From pesticide residues* e.g. mercuric chloride, naphthalene, dichlorvos.

- *Particulate* e.g. spores, dust, dirt or chemical deposits.

Within the older parts of the NMGW, in this case the east wing where the botany stores and offices are located, the air conditioning is controlled and maintained by the air-handling unit. This provides environmental control but does not incorporate a filtering system. The remainder of the building is air conditioned and filtered to the standard 80% efficiency. There are dust filters and carbon filters installed within the vents that the air passes over, which removes the greater part of the pollutants. The standard filtration recommended for a museum collection is Eurovent 4/5 with coarse and fine filter grades in the categories EU1 to EU9 (Cassar, 1995). For more sensitive collections a higher specification is required. The ARC,

which is a custom designed archive store situated approximately five miles from the main building, is installing a filter of Eurovent 8/9 which will filter material down to 90-95% efficiency.

Dust and dirt within the botany stores is a problem, collections are always boxed or bagged, and good housekeeping is implemented to keep dust from building up. Sensitive collections are housed within filtered and air conditioned environments.

Botanical material brings with it its own supply of dirt, which has usually been accumulated at the time of collecting. This can spread onto the herbarium sheet or packet and can often obscure the data. Dust and dirt will also provide an hygroscopic environment to attract mould growths that are far more difficult to remove. Loose, dry dirt can be brushed away using a soft bristle brush, and this will remove a surprisingly large amount. Old, ground in dirt can be removed quite easily with a rubber, but it must be stressed that plastic erasers are best and Staedtler Mars Plastic are recommended (available from most good stationers). This method of cleaning paper is termed surface or mechanical cleaning. It is recommended that the back of the label or paper article is cleaned first so that the upper surface is not introduced to further dirt once it has been cleaned. The dirt can be removed using small, gentle circular movements remembering to clean the rubber frequently against a clean surface so as not to introduce more dirt on to the paper. Old and dirty paper is usually quite delicate and to protect friable edges it is often advisable to hold the paper down with a clean piece of melinex that is inched along as each small area is completed at a time. Particularly delicate labels can be cleaned using grated up rubber, this is a very gentle method that will not damage the paper, but may not be as effective as basic surface cleaning. Paper tears should be tackled by cleaning from where the tear ends down to the edge of the paper. This is working with the paper grain and will prevent further stress.

Gaseous pollution from storage, specimens and from the outside will be reduced by filtering. 10% of clean air is incorporated hourly and within this hour there will be 6-8 complete air changes. Gaseous pollutants such as nitrous and sulphurous oxides should be kept below $10\mu g/m^3$ (this should be reduced to $5\mu g/m^3$ and $1\mu g/m^3$ respectively for sensitive collec-

tions) and ozone should be 2µg/m^3. Fine particulates (dusts) should not exceed 75µg/m^3. Pesticides that have been applied to collections will also be present, some such as naphthalene and mercuric chloride are extremely stable and will continue to form vapour around the specimens for an extremely long period of time. Air quality sampling is recommended for botanical and zoological collections, bearing in mind that the chemical species to be monitored must be known before analysis begins. The TWA (Time weighted average over a period of 8 hours) applies for the following three chemicals. Mercuric chloride should not exceed 0.025mg/m^3, naphthalene should not exceed 53 mg/m^3 or 10 PPM and dichlorvos (Vapona™) 0.92 mg/m^3. If the area in question is not air-conditioned then installing or increasing ventilation is essential to improve air flow and thus reduce toxic build ups.

Cassar, M. 1995. *Environmental Management; Guidelines for museums and galleries*. Museums and Galleries Commission. Routledge London and New York

Dust

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Dust, depending on its consistency can be a very harmful contaminant and cause specimen deterioration. Although we are aware of its damaging properties and try to exclude it from our work area, it still manages to seep in through the smallest of gaps.

In my experience, white-plumaged birds have been the most susceptible to the normal and everyday grey household dust. Once it gets into the feathers it is (so far) impossible to remove entirely, resulting in a pale grey bird. Specimens of coral, especially the larger colonial madrepores, once

bleached of their natural colour often fall victim to dust, thus appear drab. If the dust is at all acidic in nature, then feather proteins and coral aragonite may become corroded.

As always, we try to exclude dust from specimens and displays but we end up generating even more through our normal working procedures. Building and building fabric renovation generates masses of dust and despite precautions of moving specimens or covering with sheets, using dust traps and static electricity it still plagues us.

Reduction by prevention seems to be the only cure but how many of us have suddenly discovered that builders are in an adjacent room drilling through the wall (*didn't you get the memo*?) and it is back to square one.

Despite this rather depressing tone, I hope that contaminant analysis will continue and might produce some more detailed articles in the newsletter.

Dust Monitoring

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Introduction

Dusts deposited onto the surface of artefacts within museums can not only potentially cause harm by absorption of moisture or abrasion of fibres etc. but also may dull the visual appearance. Ambient dust levels are readily determined using a combination of gravimetric procedures and laser techniques such as the Grim Real Time Dust Monitor. Armed with this information it is possible to calculate the deposition time (see Ligocki *et al.*, 1990 and Nazaroff *et al.*, 1990). However, simpler techniques such as the glass deposition gauge (glass microscope slides) determine what is actually settling onto surfaces, and whilst glass may not

exactly mirror the object surface because of different electrostatic characteristics, it does provide a good approximation. The dusts on the glass slide represent a weeks deposition and encompass changes in airflows, Brownian movement and access by staff and/or public alike.

Technique

Monitoring of dust deposition is determined by measuring the reduction in reflectance of a shiny surface, in this case a glass microscope slide. The original idea was developed by Brooks and Schwar (1987), and later Schwar (1994) produced a dust monitor for measuring the loss in gloss of a microscope slide. However, in both papers only one point on the slide was monitored. Adams (1997) designed a jig, which would allow measurement in same three places before and after exposure. This improved approach reduced errors. The results are expressed as "soiling units per week" (su wk^{-1}) where 1 su is equivalent to a one percent reduction in surface reflection (Schwar, 1994).

A meter was designed to measure the reflection from glass surfaces simultaneously in three places and the deployment of the technique won myself and David Ford (formerly of the V & A) the Research and Innovations Award from the Museums and Galleries Commission in 1998. This was sponsored by the Jerwood Foundation.

The external environment

The technique was originally applied to determine if dust deposition could be classed as a nuisance. The term nuisance here has legal implications and whilst no "legal" level as been set, the work of Moorcroft and Laxen (1990) suggested that levels greater than between 20 and 25 soiling units per week would constitute cause for complaint. It is important to determine the source of the particulate material and if, for instance, the origin is a building site then damping down at the works or providing wheel washes for lorries taking away debris can be encouraged, once the data is presented. The determination of background levels is equally important for without this there is no benchmark.

Sometimes when an external monitoring survey is being made birds may leave 'messages' on the glass slides! There have also been occasions when the slides have been returned broken mainly through accidental damage or vandalism but the technique often allows two readings to be made in these instances, thus retaining a weeks worth of data.

The internal environment

The application to the internal environment was first made by Laxen (1990/1) when, as part of a study about Sick Building Syndrome, the soiling rate was correlated with the percentage of unhappy staff. The use in the museum environment and historic houses has since been studied by the author and co-workers. A year long dust deposition survey (Ford & Adams, 1999) made at the Victoria and Albert Museum found that mean value at the entrance was 5 su wk^{-1} and within the body of the Museum 3 su wk^{-1}. This is relatively low compared with the mean of 16 su wk^{-1} recorded outside the Museum. The levels recorded internally tend to vary with location and consequently it is difficult to recommend a criterion. In many cases studied, remedial work or re-building is to take place and the method has been used to monitor the ingress of dusts from one area to another. In most cases the "background" levels were determined prior to works being carried out.

At Canons Ashby, a National Trust property, the effectiveness of down proofing during refurbishment was monitored using dust slides (Lithgow & Adams, 1998) and successfully showed how well the covering of artefacts worked.

Other considerations

Whenever these studies are undertaken, a number of other factors are recorded. The effect of temperature and relative humidity is currently being assessed and will be published in a forthcoming paper (Adams & Ford, *in prep.*). Also in this paper is the effect of the number of visitors entering a building and the associated dust deposition rates.

At the British Museum there are major building works in progress and

dust slide monitoring has been maintained throughout the project. A number of locations had varying deposition rates and a study has been made on the accumulation rates under these varying conditions (Adams and Kibrya, *in prep.*).

Summary

The use of glass microscope slides and the measurement of the reduction of surface gloss to determine dust deposition is an inexpensive and unobtrusive technique, which can be applied to a wide range of environments. This method allows monitoring of dust sources and where contractors are involved discussing ways of reducing the ingress of dusts: assessing the influence of visitors, pinpointing "leaky" windows and assessing cleaning regimes.

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Removing Mercuric Chloride Residues from Herbarium Labels

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Mercuric chloride or corrosive sublimate, as it is also known, has been applied to botanical specimens since the late 18th century. Over time, the chemical reacts with the paper medium and can produce a grey/black stain that can discolour the herbarium sheet and obscure data on labels. Catherine Hawks (Falls Church, Virginia) and Deborah Bell (Smithsonian Institute, Washington) have published a paper describing how to successfully remove these stains from labels.

The specimen itself does not become discoloured, so when re-mounting a specimen the previous discolouration (and therefore pesticide application) should be recorded onto the new sheet.

The authors found that the data was rendered illegible by the dark salt deposition. Analysis had shown that the stain contained mercuric sulphide and possibly a mercury oxide/sulphide compound. Un-reacted mercuric chloride could also be present on the paper.

The authors were familiar with the effectiveness of iodine in removing the colouration within mercury stained tissue (Natural History Museum, 1906) and so they experimented with varying concentrations of iodine solutions and found all to be successful. The following method was recommended.

A solution of 0.5g iodine, 1.0g of potassium iodide was dissolved in 50 ml de-ionised water. 2 ml of this solution was extracted and diluted in 10 ml of de-ionised water. The stained label was then placed over a piece of glass and a drop of this solution was placed over the darkened area. The droplet was then blotted with a piece of neutral, acid-free blotting paper. This procedure was repeated until the stain was removed. The slight yellow discolouration that remained was removed with de-ionised water and dried between two clean blotters.

The process takes about an hour and did not affect the inks below, but cleared away the discolouration so that the data was clear and able to be read. When handling mercury contaminated material it is imperative to work within a well-ventilated room, preferably working on the specimen within a fume cupboard. Nitrile gloves should be worn if the specimen is to be handled directly. Some specimens are dusty and to avoid breathing in loose particulates which may carry contaminants, a dust mask should be worn.

Hawks, C. & Bell, D. 1999. Removal of stains caused by mercuric chloride treatments from herbarium sheet labels. ICOM Committee for Conservation: Preprints of 12th Triennial meeting Lyon, Sept 1999 Vol. II. James and James (Science publishers) Ltd. London: 723-727.

Ask Before You Guess

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On starting at the Hope Entomological Collections I spent several hours 'drawer pulling' in the old Victorian cabinets of Coleoptera, this as well as giving me an idea of the material we held, also acted as an preliminary pest survey.

In one cabinet of foreign Cerambycidae (longhorn beetles), I came across some friable grey lumps of an unknown substance. Some of these had broken-up and covered a number of the specimens with a speckling of grey dust, which has proved quite difficult to remove and although not damaging (as far as we know), detracts from the aesthetics of specimens for display and photographic purposes.

The drawers in which I have so far found this deposit, have had reasonably tight fitting lids, which I thought excluded an external origin. Then, I remembered hearing that in the past camphor/naphthalene sometimes had contaminants, such as ash (whether this is true or museum folklore I do not know. Has anyone else heard of this?). This may have been the source of the material, problem solved, or so I thought. Later, I spoke to a colleague about this matter, on telling them my thoughts on the possible source of this material, he merely remarked "oh that's just Westwood's cigar ash". So, for all my detective work my hypothesis was wrong, the source was simply an old entomologists' bad habit. J.O. Westwood was the Hope Professor between 1861 and 1892, and was probably the last person to curate most of our foreign Coleoptera holdings, maybe I should exhibit the 100 year old ash. I have learnt that if I come across any new problem, it is always best to ask before you guess, as someone might actually know the answer, saving you both time and possible error.

Some Further Reading

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Thompson, G. 1986 *The Museum Environment* 2nd edn. Butterworth-Heinmann, Oxford, UK. 293 pp. [excellent chapters on pollution]