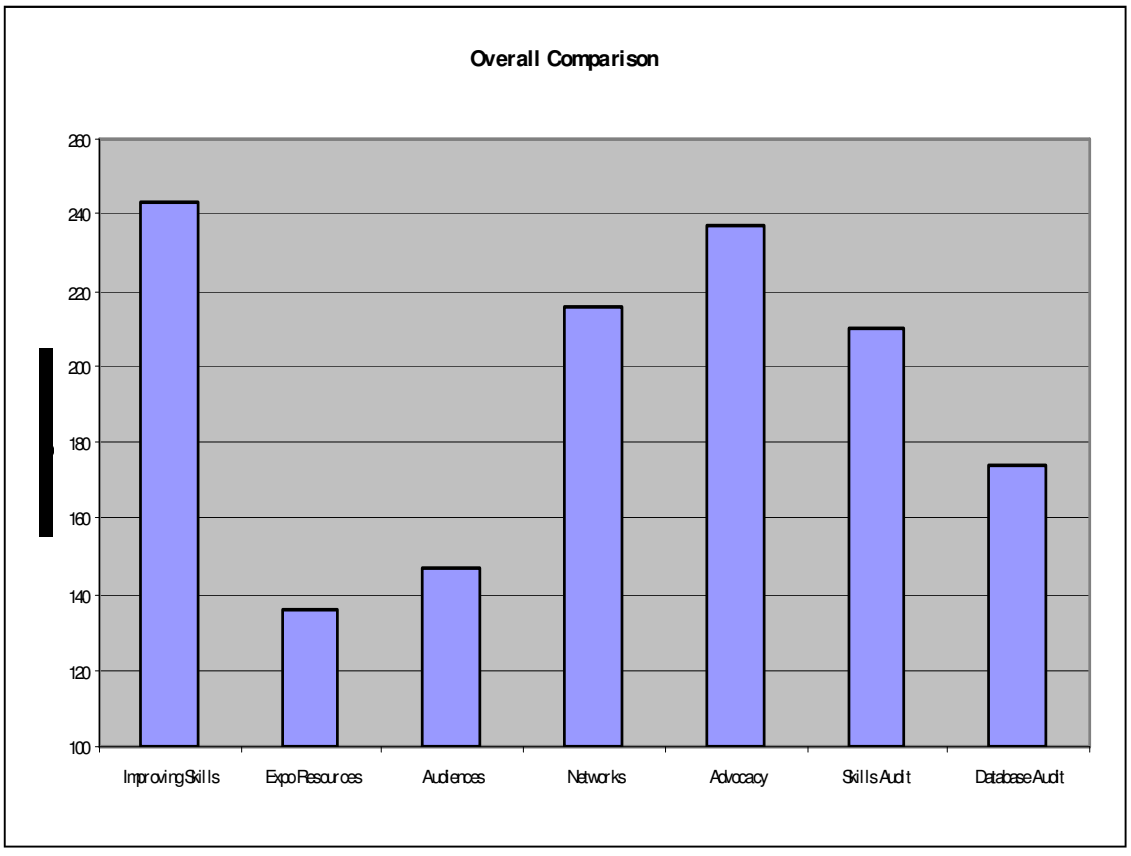
View From The Chair

I'd like to welcome all the new members and committee members that we have serving this year – it's a good influx of new blood and it's what keeps us vital.

We've spent a great deal of committee time this year talking about the Subject Specialist Network and whether we thought this was an appropriate direction for NatSCA to pursue. We've felt that we are already representing the various natural science institutions across the UK and were worried that the institutional-based nature that MLA was asking for from these networks would constrain us as an organisation. Thanks again for those of you who organised and attended the meetings – they gave us a good understanding of people's opinions about our function and, I think, showed a real willingness on a regional level for some cooperation.

Meetings were held in London, Yorks & Humber, North-East, North-West, Scotland, South-East, South West and West Midlands. The table below shows the results of the questionnaire sent out at around the same time as the meetings.



The development of this network, either through the MLA or simply the growth of the group will inevitably mean a lot of hard work for us – please do try to become as involved as possible as this helps us to best reflect the diverse opinions and needs of our membership.

- Vicki Papworth

The Stockholm beetle [*Trogoderma angustum*] – A new risk to herbarium collections

- David Pinniger, 83 Westwood Green, Cookham, Berks SL6 9DE
&
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In 2006 and 2007 we have found established populations of *Trogoderma angustum* in the herbarium and mycology store at Royal Botanic Gardens Kew. Where have these pests come from, and what threat do they pose to collections?

Some species of pests are well known to botanists as major risks to their collections. Biscuit beetle *Stegobium paniceum* and cigarette beetle *Lasioderma serricorne* are two of the most notorious. Other species which have been found causing damage over the years are spider beetles [*Ptinus* sp], odd beetle [*Thylodrias contractus*] and carpet beetles [*Anthrenus* sp]. In 1999, Shaw reported the occurrence of an apparently new pest to the UK, identified as *Trogoderma angustum*. He had found these beetles infesting mounted bird specimens in a gallery at the Royal Scottish Museum in Edinburgh in 1998. His subsequent investigation revealed that an infestation in the herbarium of the Royal Botanic Gardens, Edinburgh, initially identified as being *Reesa vespulae*, also included specimens of *Trogoderma angustum*. It had probably been present in the herbarium since 1986 but the similarity between the larvae of this species and *Reesa* had caused some confusion.

The origin of the infestation in Edinburgh is still not clear. *T angustum* was first described from Chile and was first collected in Europe from Poland in 1921 [Mroczkowski 1960]. It is now a well known and established pest in Sweden [Akerlund 1991] and Denmark [Anon 1997]. More recently, it has been found in domestic houses and infesting a wide range of herbarium, entomological and vertebrate collections in Scandinavia [M Akerlund and L Stengard Hansen, pers com]. It has also been found in the Museum Ludwig in Germany [Y Garboroni, pers com]. The only other recorded infestation in the UK was from Glossop in Derbyshire when beetles were collected from a windowsill of a private house in 1996 [Shaw 1999].

In 2000, a few adult beetles were found on sticky traps in the main herbarium of the Natural History Museum in London [A Paul pers com] but an infestation of larvae in collections has never been found. In February 2000, a few larvae were found in the collection areas at the Royal Botanic Gardens, Kew, which were thought to be possibly *T angustum* or *R. vespulae.* In May of that year, adults were found in the main herbarium which were clearly *T. angustum* and subsequently, adults have been found on sticky traps (and also a few walking) in a number of areas in the main collection. Between 2000 and 2006 there has been an increase both in the frequency of the sightings of this beetle and also in the number of locations discovered in the building. They seem to be particularly attracted to flea light traps which were used in the basement to monitor populations of *S paniceum*. Damaged plant specimens were found with heavily chewed flowering and/or fruiting parts covered in frass and discarded larval cases.

In 2007, an inspection of the new Mycology store at Kew revealed live *T angustum* larvae and cast skins and a few adult beetles. A number of specimens of *Boletus* and slime moulds [*Myxomycetes*] had been particularly badly damaged. Some of the collection had been previously stored in the basement of the main herbarium and had almost certainly been transferred when collections were moved into the new store.

How to recognise *T angustum*

The beetles [Figs 1 and 2] are about 2-3mm long and are more elongate than *Anthrenus* or *Attagenus* sp or the other *Trogoderma* sp. They are dark with three distinct bands of whitish hairs on the elytra. In some specimens, the two bands at the rear of the elytra may seem to merge into one. The female beetles are larger and their elytra are wider towards the rear end, whereas the male elytra have parallel sides.

The larvae [Fig 3] are hairy but longer and less rotund than *Anthrenus* sp. They are very similar to the larvae of *Reesa vespulae*, with which they may easily be confused. The arrow hairs of the *T angustum* are however brownish and not as many, compared to the golden hairs of *R vespulae.*

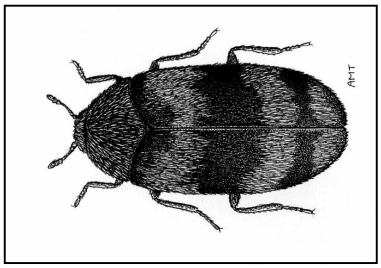

Fig 1 *Trogoderma angustum* Adult [Drawing by Annette Townsend]

Fig 2 *Trogoderma angustum* Adult female

Fig 3 *Trogoderma angustum* larvae and cast skins [Photo D Pinniger]

Where next?

As there are populations in Edinburgh, South Kensington and Kew, *T angustum* may be present at other locations. If anybody finds beetles which resemble this species, either on sticky traps or near their collections, please get them checked by your local entomologist. If they are indeed confirmed as *T angustum*, could you please let us know the location, if there was any damage to collections, and who did the determination. It is hoped that we can then build a picture of the distribution of this potentially damaging pest.

Why Stockholm beetle? *T angustum* does not have a common name, apart from being a "cabinet beetle", and the Natural History Museum in Stockholm was the first museum to describe problems with this pest.

References,

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Anon 1997. Danish Pest Control Laboratory. Annual Report 1997. 44.

Pinniger, D. B., 2001. New pests for old: the changing status of museum pests in the UK. In: Kingsley, H. *et al* (Ed) Integrated Pest Management for collections. Proceedings of 2001 - a pest odyssey, James and James, London, 2001. 9-13.

Shaw, M R. 1999. *Trogoderma angustum:* a museum and herbarium pest new to Britain. Entomologist's Gazette 50: 99-102

Addendum: A preliminary investigation into using Tyvek® bags for short-term storage as a means of protecting herbaria from damage by insect pests such as *Stegobium paniceum*

- Rita Owen[a] and Adrian Doyle[b]
The Natural History Museum, London

Suppliers:

Crossweld® heat sealer
Preservation Equipment Ltd
Vinces Road
Diss
Norfolk 1P22 4HQ

Plastazote®
Zotefoams plc
675 Mitcham Road
Croydon
Surrey CR9 3AL

WeLoc® clips
Scandinavia Direct Ltd
18/19 Millbrook Business Park
Crowborough
East Sussex TN6 3JZ

Escal® strips
Conservation by Design Ltd
Timecare Works
Singer Way
Woburn Road Industrial Estate
Kempston
Bedford MK42 7AW

Tyvek® types 10 and 14 (1443R)
Conservation Resources (UK) Ltd
Unit 2, Ashville Way
Cowley
Oxford OX4 6TU

Choosing A Microscope Slide Sealant: A Review Of Aging Characteristics And The Development Of A New Test, Using Low Oxygen Environments

- Lu Allington and Emma Sherlock, NHM, London

Abstract

Glyceel has been traditionally used to seal zoological mounts at the Natural History Museum (NHM), London. Production of this polymer has recently ceased and an alternative must be identified. A review of chemical composition and testimonies from the published literature have been combined with a new experimental method to achieve this goal. Of the 13 polymers tested, Canada balsam was found to combine mechanical stability, excellent barrier properties and good aging characteristics. It has also been found that Canada balsam does not react with glycerine, wax, saliva, phenol, or immersion oil. Canada balsam is therefore recommended as a ringing sealant for microscope slides. The new experimental method, developed for this investigation, utilises anoxic environments and has a wider application as a low-cost test of polymer mechanical stability and barrier properties.

Introduction

The prompting of this project was the discontinuation of the sealing solution Glyceel (a solution of linseed oils, alcohol, nitrocellulose, butyl acetate, and toluol). This was the most commonly used sealant (although certainly not the only one) in the nematode and copepod research groups in the Zoology Department at the Natural History Museum (NHM), London. The discontinuation of Glyceel has brought concern and heated discussion within the international nematode research community as a whole (Psmallion). An alternative needs to be found which would be at least as effective as Glyceel. Although it is commonly recognised that sealing permanent slides is very important, particularly those slides using mountants such as glycerine, there appears to have been very little work done to test the products available. The impact of this is that, when working with slides from the collection, it is often very hard to tell what products have been used. To have a universally accepted sealing medium for glycerine slides in the Zoology Department, would be highly advantageous for the curation of the collection. Additionally the mountants and sealants used for the slide making should be routinely entered into the database when accessioning new slides. This means that the longevity of different media could be assessed and, when breaking open slides in the future, we will know the ringing media used and therefore the best solvent or best method for opening the slide.

A vast array of different sealing products has been used by the scientific community as a whole. Overall this appears to be quite a controversial area, and the amount of actual research done appears to be scant. This paper aims to bring some firm answers to this subject.

This paper assesses the suitability of the available sealants through innovative experimentation. Oxygen sensing equipment is used to test mechanical stability and barrier properties of 13 polymers, used in conservation, entomological and zoological slide preparation. The results are compared with known aging characteristics of the sealants or their chemical constituents, through a review of published literature.

The polymer with the best barrier properties, aging characteristics and mechanical stability is identified. Before the appropriate polymer is recommended as a suitable alternative to Glyceel, it received more thorough testing, in simulated situations, to ensure that it does not react with other chemicals used in slide preparation and use, and also to establish best practice.

This paper will have relevance to all scientific workers who prepare or conserve slides, by identifying an alternative to Glyceel. It also contains a review of aging characteristics and a new method to test the mechanical stability and barrier properties of polymers. This has relevance to the use of adhesives, lacquers and consolidants in conservation.

1. Slide Storage at the NHM

Slides housed in the Zoology department at the NHM are normally stored horizontally. This is an important consideration when choosing mountants in particular but also sealants, as products such as Canada balsam will always be liable to move if stored vertically. The slides lie on wooden felt lined trays, or in hard cardboard folders within wooden cabinets in specially designated rooms. The recommended conditions for slides in collections are an ambient temperature of 18^{o}C and an ambient relative humidity of about 60% (MGC 1992b). This, however, is very difficult to maintain without special environmental controls. The Zoology Department at the NHM is air conditioned, but occasional malfunctions and power-cuts are unavoid-

able. Monitoring the conditions over a year in one of our slide rooms recorded temperature ranges of 18-27°C and humidity ranges between 37-67%RH.

The slides made for housing the free-living nematodes (round worms) are glass slides. A wax ring is made on the slide and within this the nematodes are mounted in glycerine, glass beads are added for support, a glass coverslip is placed over the wax ring and the slide is then placed for a few moments on a heat tray to melt the wax. It is after this process that the slide is sealed with a ring of the chosen polymer.

The importance of sealing the slides, particularly when using glycerine, has long been known: 'No matter how careful may have been the arrangement of the specimen, if the last act of sealing the cover is carelessly done, not only will all the previous labour be lost, but the specimen as well' (Pike 1890: 268). 'The troublesome leaking of glycerine cells is due in part to the penetrating character of the fluid and partly to its expansiveness in warm weather and therefore a very strong cement is required to hold them' (King 1889). Figs. 1-2 show some examples of failed slides, discovered within the zoology collections at the NHM.

Fig. 1 A - Sealant has become brittle and chipped away leaving the mountant exposed. B - A reaction has occurred within the slide. Possible cause oxidation, indicating the slides sealant has been breached.

Fig. 2 A - Sealant breakdown evident as air has entered the slide, also possible reaction between mountant and sealant evident. B - Wax sealant has broken down. A reaction in the bottom corner is also now evident, if this were to continue it could cover the slide obscuring the specimen.

2. Sealants within the Literature

The major fault with many of the products which have been used in the past is their propensity for cracking. Fluctuating temperatures is probably the largest strain contributing to this. According to Morse (1992) 'Most known mounting media and ringing materials have unsatisfactory characteristics'.

Brown (1997) produced a comprehensive paper reviewing microscope slide techniques. He also states the importance of sealing glycerine mounts. His suggested sealants were Euparol, Glyceel, Glyptal (stated as being only red alkyd enamel resin insulation paint produced by General Electric) and Murreyite. He also mentions the use of nail varnish. He later notes, however, that Murreyite reacts with some mountants and that 'Disney advocates Glyceel, Trycolac and 'ladies' nail varnish with or without colour'.

Disney (1983) mentions using Glyceel, but by 1994 had changed to using nail varnish. B.Georgiev (pers. comm. August 2005), a parasitic worm researcher at the NHM, believes that cheap nail varnish does not work particularly well, but expensive nail varnish is very good. Other entomological journals mention Euparol (Freeman, 1983) and Polyvinyl lactophenol (Gurr) or PVLP (Fink, 1987). Huys and Boxshall (1991) state that preparations have to be sealed and that many commercial sealants such as: Araldite, Murrayite, Bioseal and Glyceel are available (Araldite is Bisphenol A epoxy resin plus Beithylphthalate).[1] Although glues are highly accessible and cheap, it is unknown how they react to stress and age. Morse (1992) suggests that Paraloid (Acryloid) B72, a common conservation glue, may be a good mounting medium.

One of the earliest records of Glyceel is written by Thorner (1935). It was meant to be 'especially good for glycerine mounts'. Wagstaffe and Fiddler (1968) recommend nail varnish (used extensively by researchers for its cheapness and accessibility), or Glyceel for lactophenol mounts and Goldsize for glycerine jelly, glycerine and aqueous mounts. 'Nail varnish is suitable for ringing lactophenol, glycerine, gum, Canada

balsam and most other types of mounts' (Wells 1978).

Much more analysis and discussion has been conducted about mountants than about sealants. At the NHM Canada balsam has been used for over 150 years as a mountant and, in some cases, a sealant as well, to great effect. Problems have been experienced at the NHM with some of the new synthetic mountants: they have a tendency to 'craze' over the years. Upton (1993) claims that 'Resin-based mountants such as Canada balsam and Euparol, which have stood the test of time, are probably the best option for permanent mounts, although it is possible that some modern synthetic mountants will prove to be of archival quality'.

Testing Sealants

1. The aim of developing a new test method

A suitable replacement must be found for Glyceel. Most bacteria require oxygen to decay organic matter so sealants must form impermeable barriers. A new, low-cost method has been devised to test the barrier properties and mechanical structural integrity of sealants on the market.

The new test was based around anoxic environments, recently incorporated into preventive conservation practices at the NHM. It was surmised that without anoxia the specimen on the slide cannot decay. For this reason a sealant should form an oxygen impermeable barrier. If the sealant does not form an initial impermeable barrier then it is not performing correctly. If the sealant subsequently becomes permeable, it can also be dismissed as a failure: oxygen and pollutants potentially flowing in, to damage the specimen, and glycerol, phenol or other mounting media being lost. To remain intact the sealant must not peel away from the glass substrate and it must not crack or lose integrity.

The new test attempts to simulate environmental stress over time by accelerated expansion and contraction of the media, using alternating temperature fluctuations. High humidity may encourage plasticity in the resin, and would not reflect realistic storage conditions, so water was not incorporated. Relative humidity will automatically have varied slightly during the test as temperatures fluctuated.

The results of this test are compared with known aging properties of sealants, and predictions based on chemical composition, to identify the most suitable sealant resin to be used to seal a cover glass over specimen sample slides.

2. Development of the new test method

Due to the large size of sachets of oxygen-scavenging chemicals (RP System™), relative to the size of slides, the microenvironments were created in reverse: oxygen sensors were placed within a small glass vessel, which was then sealed with a coverslip and the polymer being tested. The glass vessel was then placed within an oxygen-free microenvironment, constructed from a heat-sealed transparent barrier film (Escal ™) containing oxygen-scavenging chemicals.[2] If an impermeable barrier was formed by the polymer, the oxygen would remain within the glass vessel. If the seal was compromised, the oxygen would flow out of the vessel, to be scavenged by the chemicals. Two types of oxygen indicator were used: RP System ™ "Ageless Eyes" (which turn from purple to pink when oxygen falls below 0.1% and returning to purple at above 0.5%) and SensiSpots ™ (which can be read electronically to give more precise oxygen levels).[3]

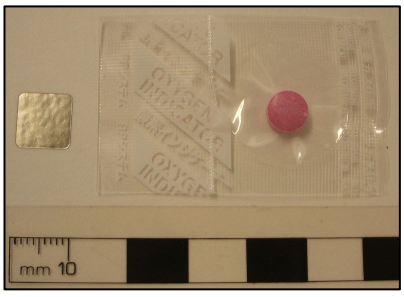


Fig.3 Oxygen indicators: on the left is a SensiSpot™ and on the right an "ageless eye".

Various permutations were tested, before a final experimental design was developed. Problems to overcome included scratching of the barrier film by the cover glass, ease of reading sensors, and pressure being applied to the coverslips by the sealed bags. Experiments were also conducted using more than one layer of sealant, but this was not found to affect the results. Thermal expansion was induced by placing the vessels within an oven at 40 degrees Celsius. The barrier film bags were not compromised by the heat, but the "Ageless Eyes" ceased to change colour, due to thermal alteration of the reactive chemicals. SeniSpots ™ must therefore be used if microenvironments are heated. The combination of light, heat and oxygen often react with a polymer in an uncertain manner (Horie, 1987: 31). The additional problem with heating in accelerated aging tests is that different reactions are accelerated differentially. Deterioration may also be af-

fected by more than one factor e.g. heat plus light or light plus oxygen (MGC, 1992a: 106). The heating only caused failure in one polymer, so was abandoned in favour of alternatively placing the environments in a freezer and then at room temperature, which was far more effective.

Attempts were made to assess the performance of sealants in more realistic circumstances: by sealing coverslips onto glass slides. The "Ageless Eyes" were too large for this experiment, and SensiSpots ™ failed to give correct readings. In light of this, the most suitable vessel was found to be a flat-bottomed glass sample vial with a flat rim.

3. Recommended test method:

After a series of trials the following methodology was developed: inside a glass vial, place an "Ageless Eye" or a fluorescing oxygen indicator (Sensispot ™) on a small cube of inert foam to decrease the distance from the edge of the tube (measurements are most accurate at approx. 10mm). Seal a glass vial with a circular cover glass and the sealant to be tested. There will be oxygen in the test tube and the oxygen level will be approximately 20%.

Place each glass vial in a hole cut into inert foam. Place this in turn in an acid-free cardboard tray which is deeper than the height of the vials. This keeps the vials upright, prevents the outer bag being scratched by the cover glass, and also prevents pressure being applied to the cover glass.

Construct an oxygen impermeable plastic bag, large enough to enclose the tray, using a crossweld heat sealing machine to create double-seals. Place sufficient packets of oxygen-scavenging chemicals into the bag and seal it.

Leave the bag at room temperature for a few days until the first measurements are taken. The bag should then be placed into a freezer at –20 to –40 degrees Celsius for at least 24 hours. When the bag has returned to room temperature the oxygen levels should be recorded. In the case of the "Ageless Eyes", if the oxygen barrier is intact the "Eyes" will remain pink (<0.1% Oxygen present). This process will be repeated until all of the seals have been compromised, or do not appear to be affected. Fig. 4 shows the microenvironment containing vials with SensiSpots ™.

Fig. 4 Glass vials sealed with 13 sealants, plus one control, each with a SensiSpot on inert foam. The tray is in a microenvironment created with

Materials:

Sealants to be tested – small amounts
One glass vial per sealant plus one for control
One cover glass per sealant plus one for control
One SensiSpot or "Ageless Eye" per sealant plus one for control
Inert foam
Cardboard box with sides slightly greater than height of the vials
Oxygen impermeable barrier film
Freezer
Oxygen sensing machine (if using Sensispots)

13 sealants were tested within this project: Canada balsam; Histomount; Euparal; Japan gold size; Clinique All-In-One nail varnish (aka "Clinique"); Sally Hansen® Hard-As-Nails™ nail varnish (aka "Sally"); DPX; Zaponlack; Loctite® Superglue; polyvinyl lactophenol Gurr (PVLP), Paraloid B72, Polyvinyl Acetate (PVAc), Glyceel.

Results

Fig. 5 shows typical failure patterns for the 13 sealants tested, Fig. 6 contains the results of 18 experiments. "Sally" nail varnish, DPX and Canada balsam retained a barrier to migrating oxygen for the longest periods and under the greatest thermally-induced mechanical stress, exhibiting the greatest mechanical stability and

barrier properties. PVAc, Paraloid, Goldsize and Superglue did not generally form an oxygen barrier even at room temperature. A sealant could fail immediately because it is permeable or due to initial shrinkage as it cures. PVLP leaked slowly, independent of environmental conditions. A slow leak could be due to diffusion between the molecules of a polymer. The remaining sealants failed during periods of induced thermal stress.

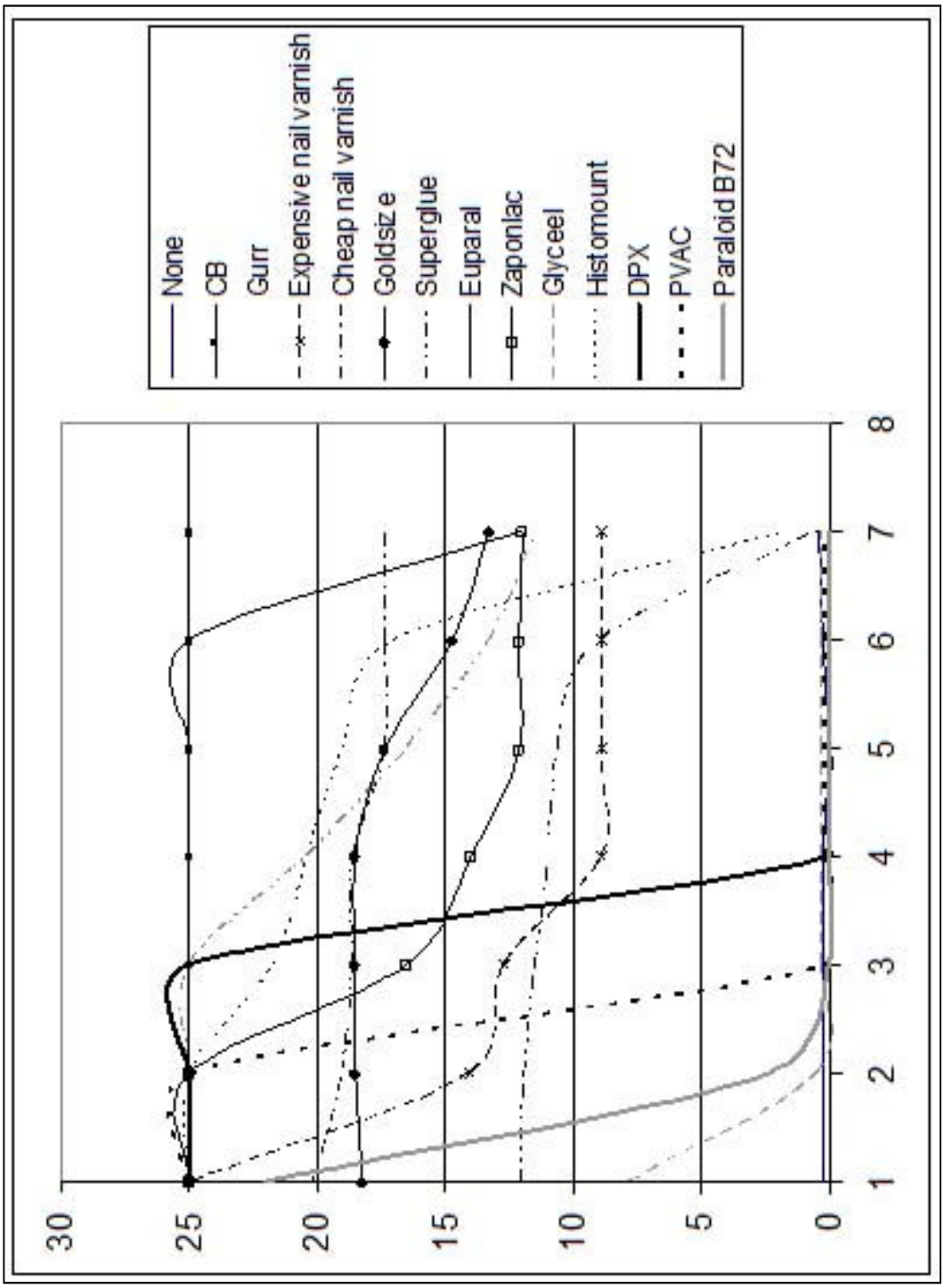
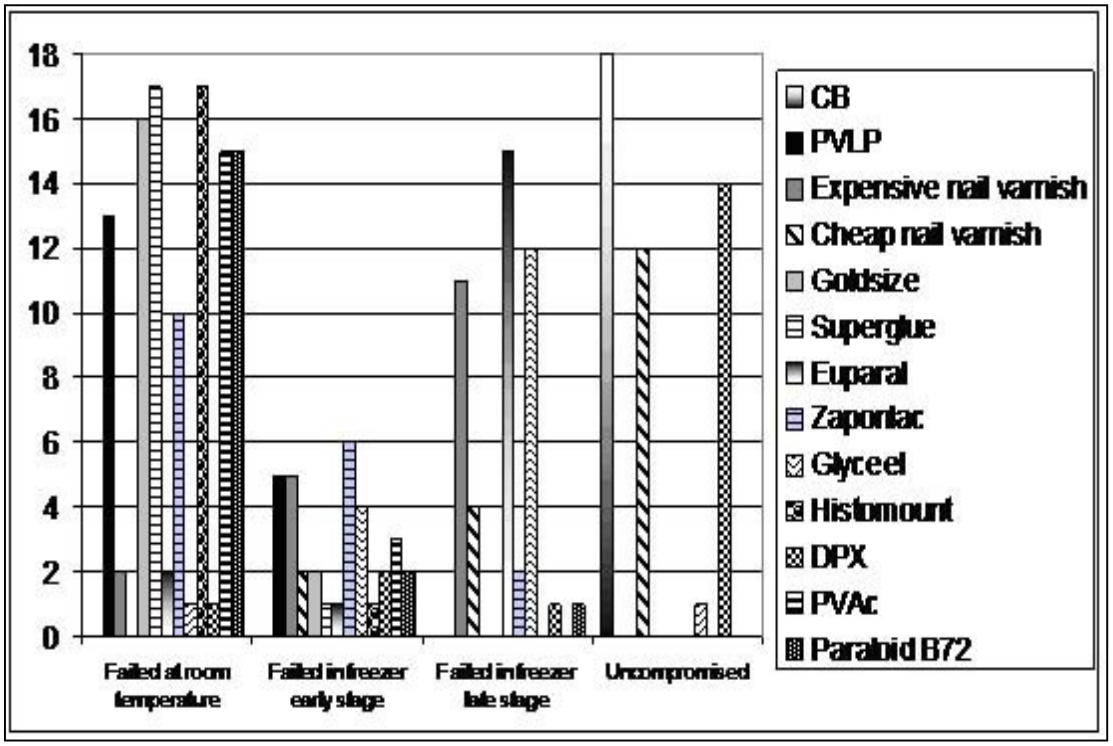


Fig. 5 Shows a typical graph of performance. In this example Canada balsam remained uncompromised whilst Paraloid failed at room temperature. Euparal failed in the last stage, cheap nail varnish and goldsize leaked slowly, expensive nail varnish, zaponlac, PVLP (gurr), histomount, DPX and PVAc failed in the early stages of freezing. (Stage 1 represents testing after 2 days at room temperature; subsequent stages represent 24 hours in the freezer at -40 degrees Celsius).



Chemical Evaluation of the Sealing Media Tested

Polymer degradation can manifest as crazing, chalking, discolouration, tackiness, embrittlement and loss of surface gloss. Polymers change when they age, as internal stresses relax or chemical reactions take place (Horie 1987: 23). Polymers can degrade due to high temperature, light radiation, hydrolysis, biodegradation (natural polymers), oxidation and the effects of sulphur dioxide and nitrogen dioxide in the atmosphere (Mc Neill 1992: 14; 18).

Adhesives used in preparation and conservation should be chemically and physically stable so that their initial mechanical properties and solubility are retained. They should have sufficient flexibility so that they do not crack. Resins with higher molecular weight are more flexible. Extensive hydrogen bonding between polar oxidation products, however, can cause embrittlement in natural and ketone resins with age (De la Rie 1992: 63). Additionally, if the solvent-free adhesive is weak and brittle then the loss of the solvents +/- plasticisers over time leads to embrittlement. Shrinkage can also create internal stresses (MGC 1992a: 104).

A polymer which is too soft will flow and pick up dirt. If it is too hard, it will crack when stressed and not be able to respond to movements within the object. Above the glass transition temperature (Tg) large sections of polymer chains are able to move cooperatively and adjust to stress. Internal movements can also be limited by intermolecular forces such as hydrogen bonds and the interlocking of bulky side groups (Horie 1987: 18).

A barrier to oxygen, water, hydrogen sulphide and sulphur dioxide must have closely-packed molecules and be below its Tg (MGC 1992a: 115). Impermeability increases with higher Tg and greater crystallinity (De la Rie 1992: 66) but flexibility decreases. Plasticisers can lower the Tg of more rigid, closely-packed polymers, but these decrease the purity and are lost over time.

1. Nail varnish

The resin dubbed "Sally" was Sally Hansen® Hard-As-Nails with nylon, clear. The ingredients are: Butyl Acetate – solvent; Ethyl Acetate – solvent; Nitrocellulose – carrier; Isopropanol – solvent; Adipic Acid/ Neopentyl Glycol/Trimellitic Anhydride – plasticizer/hardener/intermediary; Trimethyl Pentanyl Diisobutyrate – plasticizer; Triphenyl Phosphate – plasticizer; Nylon-66 – plasticizer; Acrylates Copolymer – dispersant; CI 60725 – violet colour.

The commercial advertisement claims that the Nylon formula, fortified with silk proteins, helps strengthen and protect nails against chipping, splitting and breaking, protecting against everyday hazards such as wa-

ter, detergents and housework.[4]

The sealant dubbed 'Clinique' was Clinique All-in-one base and top coat. The ingredients of this are: butyl acetate – solvent; ethyl acetate – solvent; nitrocellulose – carrier; phthalic anhydride/trimetallic anhydride/ glycols copolymer – plasticizer/epoxy resin/solvent; isopropyl alcohol – solvent; trimethyl pentanyl – curing agent.

Both types of nail varnish are nitrocellulose-based and contain plasticizers. The main difference is that the "Sally" nail varnish includes Nylon-66 as one of these plasticizers.

2. Plasticisers

A plasticiser is a substance which, when added to a material, makes it flexible, resilient and easier to handle. Modern plasticisers are man-made organic chemicals; the majority of which are based on esters of polycarboxylic acids with linear or branched aliphatic alcohols of moderate chain length, such as adipates and phthalates.[5] Plasticisers are non-volatile liquids with low molecular weights (Horie 1987: 20). They increase the flow (plastic deformation) capability of polymers, and reduce stiffness and Tg (MGC 1992a: 100). Plasticisers separate long chains and facilitate relative movement, but they are incorporated between the molecules of individual polymers and so weaken the intermolecular bonds, causing aging problems (MGC 1992a: 43). Plasticisers are added to decrease shrinkage during the transition from liquid to solid state. They can, however, diffuse over time and therefore cause shrinkage and cracking later (Horie 1987: 38; MGC 1992a: 43).

3. Nitrocellulose

Nitrocellulose is a cellulose ester formed from the reaction of nitric acid with some of the hydroxl side-groups of the cellulose molecule (MGC 1992a). It has a high Tg (glass transition temperature) of 100^{o}C making it brittle at room temperature, so it usually contains plasticisers to reduce the effective Tg (MGC 1992a: 44). It rapidly releases solvents to form a dry, strong, film (Horie 1987: 132). Solvents include acetone, ethanol and butyl-acetate (MGC 1992a: 50).

Nitrocellulose was first used in conservation in the late 19th Century (Horie 1987: 133). It is still used in conservation but it is unstable, sensitive to photo-oxidation and acid catalysed hydrolysis. Initial degradation of nitrocellulose is seen as an acidic surface bloom, followed by crazing and complete degradation (Williamson 1992). The primary mechanisms for degradation are acid catalysed ester cleavage, homolytic scission of the nitrogen-oxygen bond and ring disintegration (Selwitz 1988). Nitrocellulose is unstable, decaying in a process that is exothermic, accelerated by increasing temperature, and auto catalyzed by its own acidic nitrate products (Johnson 1977; de la Rie 1992: 76). This causes a decrease in molecular weight (Mw) and the production of nitric oxides and acids (Miles 1955; Ferreira and Combs 1951).

Cellulose nitrates are stronger and more rigid than Paraloid B72, which is in turn stronger than PVAc (Horie 1987: 22). Cellulose nitrates, however, are considered less stable synthetic resins than PVAcs. They are especially unstable when exposed to light (de la Rie 1992: 76). Better chemical and mechanical stability is achieved from acrylic lacquers such as Paraloid B72 (MGC 1992a: 115).

4. Nylon

Nylon represents the generic name for all synthetic fiber-forming polyamides and is characterized by great toughness; strength and elasticity; high melt point; and good resistance to water and chemicals. Nylon is a simple, small, heterochain synthetic thermoplastic polymer (McNeill 1992: 16) which is used as a plasticiser because it has a Tg around room temperature (Horie 1987: 122).

Nylon-66 - poly[imino(1,6-dioxohexamethylene)iminohexamethylene] (Horie 1987: 122) is considered to have excellent barrier properties with respect to oxygen and organic solvents.[6] Other nylons are discouraged in conservation because they pick-up dirt and lose strength and solubility with aging (Horie 1987: 123). Nylon is also particularly susceptible to photo-oxidation. Acrylics are much more stable (MGC 1992a: 102; Horie 1987: 122). Adhesives containing Nylon can also swell as it absorbs atmospheric moisture, which causes internal stress (MGC 1992a: 93). Nylon is also sensitive to cross-linking in contact with mildly acidic water (Horie 1987: 49).

5. Paraloid B72

Paraloid B72 is a copolymer of methyl acrylate and ethyl methacrylate 30/70 (MGC 1992a: 30; Horie 1987: 111). It is a heat and water-proof adhesive for repairs to pottery, wood, metal, ivory, glass and all porous surfaces except rubber. It is virtually colourless and tends to resist yellowing for several years. It does not

set instantly so fragments can be easily re-adjusted and surplus adhesive removed with acetone, thereby making any joint virtually invisible.[7] It is the adhesive/consolidant that is used the most in conservation (Borgia *et al*. 2001: 513; Cappitelli *et al*. 2004: 399). Paraloid B72 is an extremely stable polymer (Horie 1987 35). It does not become insoluble or degrade significantly in normal conditions of exposure (Feller 1978; MGC, 1992a:115; Horie 1987: 104) although slow oxidation does occur (Ciabach 1983) and it has been tested and recommended for conservation (De Witte 1983: 1.5; Blackshaw and Ward 1982: 2.11; Cruickshank *et al*. 1996: 877; Thickett *et al* 1995: 202). Paraloid B72, however, is brittle and prone to cracking under internal stress (MGC 1992a: 116) even though its Tg is 40^{o}C.

6. Canada balsam and Euparal

Canada balsam is a turpentine semi-fluid resin from the *Abies balsamea* (L.) P.Mill fir (Mills and White 1987: 89). This viscous, sticky, colourless (sometimes yellowish) liquid turns to a transparent yellowish mass when the essential oils have been allowed to evaporate. It is insoluble in water but soluble in a number of organic solvents (Coppen and Hone 1995: 62). Canada balsam was of importance in optics because its refractive index (1.53 for the sodium D lines) is close to that of glass (Liu 1971) and has been used as a mounting medium since 1830s. 150 year old entomology slides at the NHM have not crystallised or absorbed moisture (Brown 1997: 7). Canada balsam is considered by Mound and Pitkin to be the only mountant that can be kept in a variety of climates without deteriorating (1972: 122). It does yellow with age, but most researchers do not see this as a major problem (Brown 1997: 7).

Euparal is a mixture of eucalyptol, sandarac (a resin from the tree, *Tetraclinis articulata* (Vahl) grown in north west Africa), paraldehyde and camsal (camphor and phenyl salicylate). Contributors to an online discussion have differing opinions on the longevity of Euparal.[8] One contributor claims that properly prepared specimens mounted in Euparal "do not crystalize, fog, shrink, crack or do anything but last in good condition for a very very very long time". Another contributor, however, stated that "Euparal slides of chigger mites were made in 1987, and they're starting to polymerize and craze around the edges."

"Resin-based mountants such as Canada balsam and Euparal, which have stood the test of time, are probably the best option for permanent mounts" (Carter and Walker 1999: 45). This is echoed by other workers: Halliday (1994) found that most workers consider Canada balsam to be the most suitable mounting medium.[9] Galtier and Phillips (1999: 68) state that "natural balsam remains unaltered by oxidation over long periods of time". After an extensive survey of the microscope slide mountants within the entomology collection at the NHM, Brown (1997: 10) also concludes that Euparal and Canada balsam are unsurpassed by modern materials. Euparal is the best alternative to Canada balsam since it does not need carcinogenic xylene and does not yellow with age (Brown 1997: 8). Euparal, however, can damage fine structures due to early development of a meniscus and can also craze if poorly prepared (Hood 1940: 57).

Crazing of Canada balsam seems to occur quite rarely, but has been noted by other workers (Green 1995: 162). Cedric Shute at the NHM believes that Canada balsam only crazes if it has been poorly prepared (personal communication, 12 November 2005). Early slides were made from melted resin. If the resin was heated slightly too much the balsam would crack within a few years of preparation. Canada balsam slides are now made using resin dissolved in xylene instead of heated resin. Clare Valentine at the NHM has identified Canada balsam slides from 1840 which have survived intact ((personal communication, 10 November 2006). This is supported by Brown and de Boise (2006) who state that "Canada balsam is known to be stable over 150 years."

7. Glyceel

Glyceel consists of linseed oil, alcohol, nitrocellulose, butyl acetate and toluol. Some early recipes contained ADM (Sunflower oil esters with propylene glycol).[10] Slides created in 1960 have been found to have dried out, with air penetrating the medium.[11]

8. Goldsize

Goldsize is an oil copal varnish with turpentine and driers. Copal is a hard, natural resin obtained directly from trees such as *Trachylobium* species (Gartner) Oliver (Africa), *Hymenaea courbaril* (L.) (South America) and *Agathis australis* (D.Don) Steudel (New Zealand). Copals are also obtained as fossil resins from Zaire and Zanzibar. Copals are diterpenoid resins that contain communic acids, communol, resene and volatile oil.[12]

Ageing of copal resins may result in the condensation of the low molecular weight compounds to form

larger molecules which could affect the solubility. In addition, resins added to drying oil may be incorporated into a polymeric structure. van den Berg and Horst (2006) discovered that the polymers were relatively unstable to air after isolation; in the drying and ageing process, the remaining characteristic diterpenes were found to disappear completely, probably as a result of oxidative degradation and cross-linking.

Ageing of triterpenoid varnishes leads to yellowed products which can craze, become very brittle, and show a change in solubility. These physical changes are the consequence of molecular changes in the varnish, and it is likely that oxidation and possibly isomerisation and polymerisation reactions occur during ageing (van der Doelen 2006).

9. Histomount

Histomount is a piccolyte polyterpene hydrocarbon resin with toluene, produced by the polymerisation of betapinene (a polyterpene consists of isoprene molecules linked into loosely-twisted chains).[13] It is a synthetic mounting medium which is manufactured to be a pH neutral, UV stabilized preparation with a refractive index matched to glass.[14] Polyterpene resin is considered more stable to oxidation than most natural resin-based products.[15] Permount is a similar mounting medium (Piccolyte B-pinene polymer plus Toluene). This has gone through several formulations, however, because the earlier formulas tended to polymerize and craze over time (>5 years). Contributors to an online discussion reveal that this medium crystallizes within 20 years.[16]

10. PVAc - Poly(vinyl acetate)

PVAc is a copolymer of vinyl acetate and esters of maleic acids such as dibutyl maleate (MGC 1992a: 115). It has high resistance to heat, light, water, dilute acids and alkalis. It is considered to be a thermoplastic (heat setting polymer) of good chemical stability (MGC 1992a: 51). It dissolves in ethanol and acetone but also comes as an aqueous emulsion. Emulsions have advantages over ordinary solvent coatings because the carrier is water. They are, therefore, less toxic and are non-flammable. They also retain a more uniform thickness when set (MGC 1992a: 116). In the experiment detailed earlier in this paper, however, the increased surface tension, created by shrinkage during drying, may actually be beneficial because it pulls the two pieces of glass together.

Of several solvents tested, Thomson (1963) found PVAc to be the most resistant to light aging. De la Rie specifies this is true for soft, low molecular weight (Mw) PVAcs, which pick up dirt easily, but high Mw PVAcs are prone to cross-linking and chain-scission due to the loss of acetate side groups and the formation of conjugated polyenes during photodegradation (de la Rie 1992: 76). PVAc contains stabilisers and sometimes plasticisers that increase its susceptibility to oxidation and cross-linking (which decreases solubility and flexibility). Volatilisation of these chemicals, accompanied by acetic acid production, can lead to corrosion of metal objects and also leads to embrittlement over time (MGC 1992a: 52, 105, 93; Oddy 1975; Feast 1982).

11. PVLP - Polyvinyl lactophenol (Gurr)

PVLP is made by the combination of phenol, lactic acid and glycerol. Williamson (1992: 10) states that phenol is affected by photodegradation – but only changes colour. One contributor to an online discussion found some favourable short-term results (ca. 4 yrs.) with a PVLP-based series of mountants. Another, however, revealed that PVLP mounts used in the 1950s (for *Collembola* or springtails) proved disastrous, having shrunk greatly after about 5 years.[17]

12. Superglue

Superglue is an alkyl cyanoacrylate. These adhesives form by chemical reactions *in situ*, so they do not shrink as much as solvent adhesives and give stronger bonds (MGC 1992a: 15, 103). Superglue is sold as a monomer mixed with an acid which inhibits polymerization. The hydroxl groups, found on most surfaces in the presence of water, neutralize the acid and curing begins on contact (MGC 1992a: 56). Cyanoacrylates require clean, well-fitting surfaces and they are irreversible (MGC 1992a: 55). Darmon (1975) states that, although initial bond strength of cyanoacrylates is high, over time there is deterioration of bond strength in the presence of moisture. Cyanoacrylates cross-link under exposure from ultra-violet light and can also lose strength (Horie 1987: 105). They also degrade severely in alkaline conditions by hydrolysis (Leonard et al 1966).

13. Zaponlac

Zapon is a cellulose nitrate/camphor (plasticiser) solution in amyl acetate. It was largely displaced by cellu-

lose acetate and PVAc in the 1920s and 1930s, but it is still used by some conservators (Horie 1987: 132). It has been found to be soluble even after long aging (Horie 1987: 133) but does discolour (Doerner 1934). Smith et al (1984: 102) discovered that it becomes embrittled and yellow, and detaches from its substrate as it ages.

Cellulose nitrate, as discussed elsewhere, is inherently unstable and slowly decomposes at room temperature. Ultraviolet light, heat, and/or high humidities hasten its decomposition.[18]

14. DPX

DPX is a colourless, synthetic resin mounting medium, introduced to replace Xylene-Canada balsam mountant. It is composed of Di-n-butyl phthalate (plasticiser) and Polystyrene.[19]

Polystyrene, or Poly(1-phenylethylene), has a Tg of 95ºC. This makes it very rigid at room temperature and will build up stress during curing. As the plasticiser is lost over time, DPX becomes very brittle. Polystyrene is resistant to water and acid but it is highly unstable (Horie 1992: 114-5). It degrades by photolytic oxidation, causing backbone homolysis, followed by various cross-linking reactions of the terminal macroradicals (McNeill 1992: 21).

Discussion

Euparal, Canada balsam and Histomount appear to be the most stable, and least likely to degrade, according to the chemical discussion and the testimonials of professionals working with slide collections.

Personal experience by the authors, regarding ease of use for ringing slides, revealed that PVLP and Zaponlac, due to their low viscosity, did not ring properly. PVAc emulsion proved very difficult to apply, Glyceel created a very thin layer and would need two coats. Histomount, Goldsize, Euparal, Superglue and the nail varnishes worked well but the most satisfactory result was achieved by Paraloid B72 due to its high surface tension. Canada balsam varied in performance depending on consistency of the mixture with xylene. A 1-part-xylene to 20-parts-Canada balsam mixture was more effective than most sealants but was not as effective as Paraloid B72.

"Sally" nail varnish, DPX and Canada balsam retained oxygen impermeability in the experiments to test mechanical stability. DPX, however, becomes brittle over time, as its plasticiser is lost, and nail varnish is based on unstable nitrocellulose, plus plasticisers which again can be lost with age.

As the most appropriate alternative to Glyceel, Canada balsam was subjected to further tests: following standard procedures, nematode and copepod (crustacean)-style slides were created using Canada balsam plus lactophenol or glycerol, with and without a wax ring. Reactions at room temperature were observed over 2 weeks. The slides were also subjected to the application of immersion oil (Olympus and Leica, but also produced by Merck and Gurr and available from VWR) plus removal of the oil using saliva or Histoclear II (available from VWR, Histoclear II is flammable and irritating to skin, but less hazardous than xylene). It was found that Canada balsam does not react with any of these products.

Conclusion

The polymer recommended for sealing coverslips onto microscope slides is Canada balsam (available from VWR International). It combines mechanical stability with chemical stability and it has stood the test of time.

Care should be taken when wiping immersion oil off with xylene, because Canada balsam could become tacky if prolonged contact occurs. It is preferable to use saliva or Histoclear. Xylene is flammable, harmful by inhalation and irritating to skin.[20] COSHH and risk assessments must be carried out before use.

1. Limitations

In an environment with normal atmospheric oxygen levels, the sensor read 22-23% from uncovered indicators, but 25% behind escal and through glass. The oxygen-free control registered 1.4% behind Escal and 0.4% behind glass. Clearly the readings are affected by transparent barrier media and must be adjusted accordingly, or considered relatively. A difference of 1-5% was observed depending whether the SensiSpot™ was held <1cm or 6cm away from machine. Repeat readings of the same SensiSpot™ also varied by a few tenths of a percent, and readings were also affected by temperature (lower values when still cold from the refrigerator or freezer). Some SensiSpots™ detached from the foam base, some curled (e.g. Zaponlac and Clinique nail varnish), some became dimpled (e.g. PVLP Gurr) and in others the silvery layer deteriorated

and became transparent. It was notable that within the vials sealed with PVAc the SensiSpots™ always lost their silvery layer. This is probably due to devolatisation of the polymer and the production of acetic acid which can corrode metal. The "Ageless Eyes" were also adversely affected by the PVAc fumes, turning a dark pink colour. The SensiSpots™ in vials sealed with Superglue sometimes developed a white film, possibly due to a reaction with surface condensation. All these factors made the SensiSpots™ difficult to read and suggest that these particular sealants off-gas damaging volatiles. The SensiSpots™, although giving precise readings, were also more time consuming to read and more expensive than the "Ageless Eyes".

2. Other Aging Tests

The Oddy Test is designed to determine the off-gassing potential of display and storage materials (Green & Thickett, 1995), but would not test the stability of resins. International standard tests and scientific investigations are usually unconnected with conservation and require considerable time and expense (Horie 1987: 39). Less expensive tests involve accelerated aging using light, heat and water (Horie 1987: 44-9). Blackshaw & Daniels (1979) outline some useful tests.

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3 SensiSpots™ and GSS 450 Oxygen Analyser are available from Gas Sensor Solutions.

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The Historical Repairs Of Butterflies And Moths From The Eighteenth Century Collection Of William Hunter, University Of Glasgow

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Introduction

The eighteenth century insect collection of William Hunter (1718-1783) was left to the University of Glasgow in 1783, being part of his museum in Windmill Street, London (Bynum & Porter, 1985). This bequest has been housed in the Hunterian Museum since 1807. The collection numbers around 7,600 specimens and is of significant historical interest with many specimens collected during the voyages of Captain Cook, for example, and other explorers (Hancock, 2005a; 2005b). In 2005 the Leverhulme Trust provided funding for research to be carried out on this extensive insect collection.

Part of the project involved the transfer of insects from their original drawers into new conservation-grade drawers and cabinets. A substantial part of the importance of Hunter's collection lies in it having been in the original drawers and with a contemporary manuscript catalogue of the specimens. The arrangement of the individual insects within the drawers, in relation to each other and the cabinet labels, has been recorded in detail. As a result of examining each specimen and photographing it *in situ* it could be seen that some specimens had been attacked historically by insect pests or otherwise damaged to varying degrees. However, one of the noticeable features of the collection is the numbers that are in a good state of preservation given their age of at least 200 years. In several instances this appearance was superficial and relied on some remarkable and effective repairs that have been carried out.

Background

William Hunter's collection contains many specimens that were collected geographically distant to Britain including places in Africa, Madagascar, China, India, South America, the West Indies and Australasia. Hunter was neither a practicing entomologist nor did he travel to any of these places. He obtained his specimens either by commissioning collectors or indirectly as gifts, purchases or exchanges with other collectors. He and some of the other collectors in London relied on a network of European naturalists and explorers, ships' captains or surgeons to collect specimens during their travels. Hunter had former pupils from his school of anatomy in London. After qualifying as doctors some of them traveled widely with the navy or army.

The wings of insects are thin structures, mostly composed of chitinous epidermal layers supported by veins. The surface structure of butterfly and moth (Lepidoptera) wings are of a powdery appearance due to overlapping scales (modified hairs) like microscopic roof shingles (Scoble, 1995). These scales are responsible for species characteristic colouration and pattern. The delicate nature of scale attachment to the wing and vein surfaces means that any physical contact irreversibly removes them. It has been noted that several butterflies and moths in Hunter's collection have very obvious fingerprints on some wings, acquired either during the act of capture or from later handling. Catching by hand would usually leave evidence such as the finger or thumb print on opposing surfaces of the butterfly's wings as it is gripped to prevent escape. Damage of this nature on one surface may be more likely to occur during spreading the wings on a board during pinning or any time thereafter during handling the preserved specimen. It is intriguing that in more modern times a collector could be identified from this evidence. Could the Hunterian specimens from Australia bear the fingerprints of the great Sir Joseph Banks? He was collecting there between May–August of 1770 when the Endeavour was on the east coast, the first expedition to collect insects from that continent.

Types of repair

The repairs can be divided into a number of categories, depending on the damage or problem with the specimen.

Reattachment of existing parts

Various insect parts such as the legs, antennae, head, thorax or abdomen that had broken off have been reattached using water soluble glues. Sometimes this was used to excess and occasionally the wrong bits were glued together or re-attached wrongly. The same method was used if the entire wings had broken off at their bases. The glue has not been analysed but has the appearance of animal glue and may have been used hot

which might have been difficult to apply in small quantities.

Replacement of missing parts

Missing parts were carefully replaced in some of the insects in Hunter's collection and this was carried out with some expertise. In one butterfly the entire body (thorax and abdomen) has been replaced by one constructed from an unknown material, possibly cork or wood, painted black. The wings and head of this *Morpho* butterfly were then reattached to the false body and the whole then pinned in the usual way for display (Fig. 1).

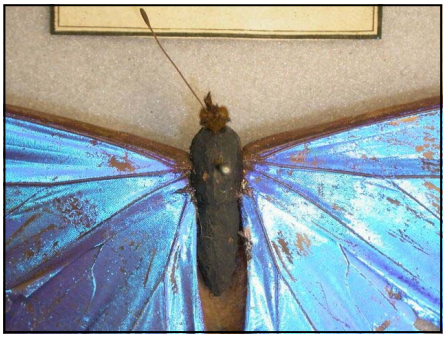

Fig. 1. *Morpho* butterfly showing false body.

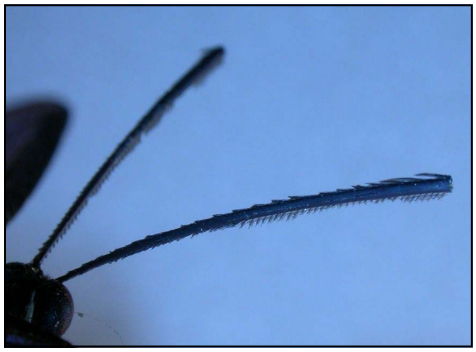

Fig. 2. *Morpho* butterfly with antennae made from feather quills

Another interesting historical repair has been found on a different *Morpho* specimen, although this example is later in date and not from Hunter's collection. A replacement set of antennae has been created from fine feathers with the barbs trimmed from the shaft. The thinner ends of two prepared shafts have been carefully attached to this butterfly's head giving an acceptable representation of antennae (Fig. 2).

Patching

Missing sections or holes in the wing membrane required more complex procedures. Several Lepidoptera from Hunter's collection exhibit such repairs to this damage. Such a situation could have occurred from rough handling during collecting, transport or when specimens were later swapped or sold. The commonest way to repair damaged wings was to make a patch and the material used for these old repairs consisted mainly of pieces of butterfly wing. These might be cut from the wings of the same or similar locally found species. They were selected and cut out with great care in order to match the shape of the damaged area and the surface colour(s). In the example shown in figures 3 & 4, there are several patches that have been carefully glued to the wing. Although these are obvious when seen from underneath, they are virtually invisible when the butterfly is viewed from its pinned position and so the specimen remains aesthetically pleasing in the cabinet.

Fig. 3. Underside of a *Papilio paris* wing showing patches

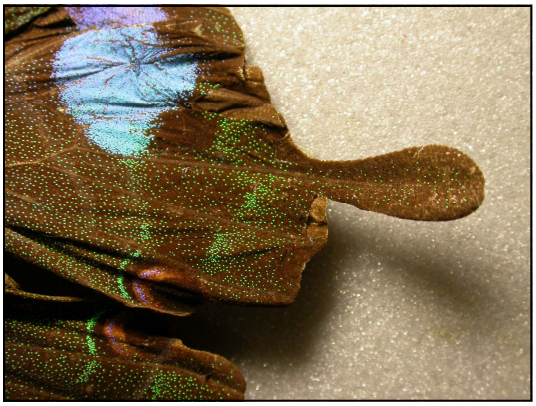

Fig. 4. Repairs on *Papilio paris* are almost invisible when viewed from the upper side

Support behind the patch was provided by other butterfly species of almost any kind, regardless of colour, shape or thickness. A pair of Madagascan Swallowtail butterflies from Hunter's collection (*Papilio antenor*) is of particular interest in this context as the entire wings of British butterflies, commonly found in or near London during that eighteenth century have been used for repair. One of these species is the black-veined white (*Aporia crataegi*), a butterfly that is now extinct in Britain but was then "plentiful and fine on the chase" according to Dru Drury (1725-1803), as quoted by Salmon (2000). The other is the silver-washed fritillary (*Argynnis paphia*). The details of these specimens of *P. antenor* and its discovery as a species are being investigated in more detail for a separate publication.

Fig. 5. Mica repair to the wing tip of the moth *Rothschildia hesperus*

Support to damaged wing membranes, using very thin plates of mica, have been found. These were either torn or cut to shape and glued into place, providing an almost invisible repair to a wing that was torn or had a small hole in it. Not only is mica naturally transparent, thus allowing the original wing colour to show through, but it also gives a very strong and flexible support to the wing (Fig. 5). It has been noted that early collectors sometimes preserved their Lepidoptera specimens between slips of mica sealed with passé partout. James Petiver (1663–1718) is well known for making use of this method of preservation and it was used also by Sir Hans Sloane (1660–1753) and others (Salmon, 2000). The use of mica for repairs does not appear to have been observed before and these examples in Glasgow remain unique for this purpose. What is interesting about this discovery is that it may not have been used before or since. Mica is light, strong, chemically inert, can be bonded with water soluble adhesives, occurs naturally and is extremely cheap to buy. Theoretically it can be split into sheets of ever decreasing thickness down to the molecular level, certainly beyond the needs of any conceivable application in the context of most kinds of repair. Perhaps today we are too ready to seek man-made materials, not having investigated natural ones.

Paper has also been used to repair the wings of Lepidoptera. A particularly skilled example of this was found in a large birdwing butterfly, although not from Hunter's collection. The undersides of one fore wing and one hind wing have pieces of paper that have been neatly cut to shape and glued onto the areas that required repair. The paper surface exposed on the upper wing surface was then painted in water colour to match exactly the patterns on the wing (Figs. 6 & 7). There are some specimens in Hunter's collection in which paper has been used to support damage which is not visible from above

Fig. 6. Paper repair to the underside of the birdwing butterfly *Ornithoptera priamus*.

Fig. 7. Paper repair of *Ornithoptera priamus* seen from above showing hand painted detail.

Supports

Several methods were used to support specimens that are loose on the pin or where gravity has become a problem. There can also be weakened areas when physical or pest damage has occurred and where splits or tears cause sagging. An extra pin was sometimes inserted laterally underneath the thorax at right angles to the main pin, the protruding ends supporting the wings from below. A small piece of resin, wax, cork or blob of glue was sometimes used to keep the specimen from slipping down or swiveling on its pin. Glue applied to the space between overlapping areas of wing keeps them together thus supporting each other.

Dates for repairs

Repairs are described for insects in William Hunter's eighteenth century collection. The time when these took place is thought to be within the period that the collection was in London and so before 1807 at least. As described earlier (Hancock, 2005a) after the collections were transferred to Scotland they do not appear to have received much curatorial attention until the beginning of the twentieth century. This apparent neglect may well have been an advantage as the original arrangement remained substantially undisturbed.

It was because obtaining exotic specimens was so difficult and often from places hazardous to collectors, that repairs would have been carried out to preserve the appearance of any specimens acquired in the cabinet. The possibility of replacing any insects with fresh or undamaged examples was effectively not feasible. The intricate repair work on the insect collections of William Hunter reflect the difficulty of obtaining some species, usually those from remote parts of the world. Considerable efforts were made, especially with the Lepidoptera, to repair and thus preserve these early specimens. Butterflies suffer damage which is immediately obvious to the collector mainly due to their large wing area and delicate nature. Their aesthetic value is paramount within a collector's cabinet. As the nineteenth century progressed fine quality specimens were more readily obtained and so the necessity to repair all but the rarest of species was removed.

Fig. 8. The millipede, *Scolopendra dorsalis,* before cleaning and repair.

Fig. 9. The millipede, *Scolopendra dorsalis* with segments separated.

Fig. 10. *Scolopendra dorsalis* after repair.

We have seen similar wing repairs in other contemporary collections such as that of Louis Dufresne (1752-1832) in the National Museums of Scotland, although none include the use of mica. In practice, the nature of the problems and the solutions are broadly similar to ones that an entomologist might use today. Although conservation grade substances such as Japanese tissue (e.g. Moore, 2007) and special adhesives are now marketed, found material can be very effective. One of the authors (EGH) has used dry grass stems for supporting dragonfly abdomens in recently collected material. The combination of lightness of the stems and the strength of a cylinder is ideal for the purpose. Such usage is similar to that of mica – opportunistic and effective.

Not all repairs found in Hunter's cabinets are equally effective, attractive or correctly executed. A specimen of a millipede was not only wrongly aligned but was actually an amalgamation of two different examples (Figs. 8,9 & 10) and its cabinet label had been transposed from another species. After the old glue was removed (it came away easily by physical means) and the broken parts were re-joined. The collection has now been catalogued as containing two syntypes rather than one. Neither one is now complete but each qualify as original examples of *Scolopendra dorsalis* Fabricius, 1781. They are from Coromandel, India *ex* T.P. Yeats' collection. Fabricius, in common with others at the time, classified non-insect terrestrial invertebrates as the Aptera and included them with Insecta. The Trustees Catalogue, a manuscript of 1783-1785, lists two specimens of this millipede which confirms that the repairs took place after this date. It is probable this repair was subsequent also to the time when Fabricius was active in London as he would hardly have approved of such a bad repair. His last visit was in 1791. The nature of this specimen compared to the quality of other repairs to the butterflies at least reinforces our opinion that it was carried out more recently. By collary, the high quality repairs of insects from distant countries were of earlier origin.

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Old Jar Sealants

- Simon Moore, Hampshire County Council Museums, Libraries & Archives Service

Abstract
Apart from storing fluid-preserved specimens in a multitude of different types of jar, there are also many different types of sealant. Most guardians of these do not have easy access to spectro-photometry and have to rely on more basic senses. This guide aims to help.

Introduction
In these days of preserving as much of the past as possible, people are often asking about re-sealing jars using the closest equivalent to the original jar sealant as possible.
Although these are also diverse and some are home-spun without any known provenance, a handful of recipes still exist but firstly require some basic analysis and recognition.

Until the marketing of the ground glass closure, sometime c. 1850, jars for displaying fluid-preserved specimens were cylindrical, of circular or oval cross-section and a few were rectangular or square. Later (c. 1900), the jars with right-angled corners became more commonplace. All of these had simple glass closures that fitted onto a ground glass surface to give key for the sealant, and were then sealed using a diversity of recipes according to the period favourite.

Fig 1: 19th century ground glass jar lids with attached glass

Fig 2: Neck of a very scarce, later 17th century preserving bottle with cork closure. Ashmole collection. *(Courtesy of Oxford University Natural History Museum.)*

Basic analysis of permanent sealants for jars
17th century jars are rare, not many having survived the long passage of time. These were hand-blown and would have been sealed with a plug of cotton waste and either tallow, candle wax, sealing wax or just a simple a cork.

18th century jars followed in much the same way, although some have 'luting' caps (sealing caps) of lead foil in between two pig bladders, which are ligatured on to the neck of the jar and extend over the glass lid giving it a tent-like appearance. By the end of the 18th century an orange paste, comprising a mix of Stockholm tar and red lead (lead sesquioxide) was being used. (See figs 3 and 4). Despite the obvious hazards of using a lead salt, this paste was effective for about 10 to 20 years, after which the viscosity of the tar dried out. This is recognisable as a dull orange-brown sealant (below left) with a resinous-tarry smell.

Fig 3: Dried out Stockholm Tar

Fig 4: Red lead sealant

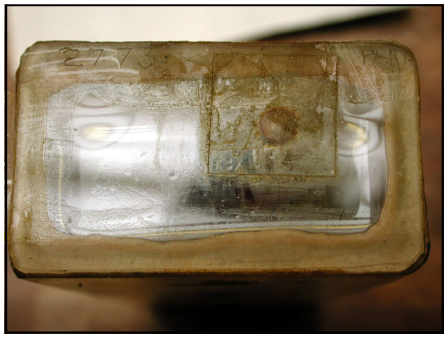

Fig 5: Gutta Percha seal on battery jar, applied c. 1930. The brown colour is from the brown-stained IMS that was in the jar.

By the mid 19th century the sealing arsenal had extended to include gutta percha adhesive (also used in the bookbinding and golf ball industries) and comestible gelatin, which is a favourite of mine. Gutta percha can be recognised as a whitish-grey and crumbly crust around the edge of the jar whereas gelatin is slightly yellow and more flakey.

A good GP seal will last for 30 or more years but can deteriorate quite quickly and without any change in appearance whereas gelatin has the advantage of 50 plus years if the seal is good. If a gelatin seal is not good it will form into a white mastic combining slightly with the IMS in the jar (fig 6). A good gelatin seal appears as if frosted (fig 6) since it has bound into the texture of the ground glass so it appears like the ground glass edge of the jar.

Fig 6: Gelatin seals on battery jars. Left jar has a good seal that will last at least 20 years. The right jar has a poor mastic-contaminated seal that is useless

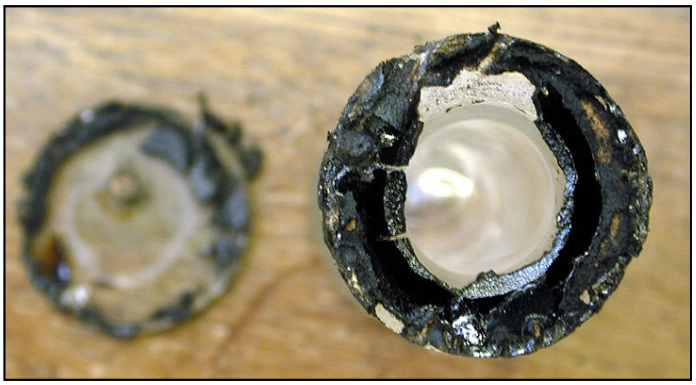

Fig 7: Remains of a rather crumbly bitumen seal about 80 years old.

Bitumen is another long-lasting seal used much in the early 1900s and throughout the latter half of the 19th century too. It is characterised by being black and hard but requires specialised knowledge for successful application and a heated spatula. (see fig 7).

Since the 1960s, silicone has come on the market. This can be a reliable sealant although I have not yet found a jar effectively sealed after 20 years. The IMS, like other low-density fluids, will eventually find a way (capillary action) through a weakening silicone seal since it does not bind itself so successfully to glass.

Semi-permanent jar sealants.
Most of these are vaseline-like in consistency and provide a useful leakproof seal to ground glass closures. Not all are reliable in the longer term however.

Vaseline itself is alright to use in the shorter term but it becomes denatured through molecular cross linkage with the IMS and starts to become granular or colloidal.

Murrayite is a sticky brown-ish grease that was used in the 1950s and 60s but discolours and can stain the IMS. It gradually loses its sealing capability after about 5 years.

Vacuum silicone grease can be effective in the longer term but will often solidify, making the lid impossible to remove!

Paraffin soft white is physically similar to vaseline and so far (up to 30 years) has shown none of the problems of the above sealants. It used to be obtainable through Merck but since that changed to VWR only commercially-viable products are sold and many of the minority saleable items are regrettably no longer available.

Jar containing preserved snake in IMS.
Note the floating blobs of lipid (centre of meniscus) or is it softened grease from the lid? The lid grease is also quite oxidised (left of lid).

Conclusions
Bearing all of this in mind, I still favour gelatine as a permanent jar sealant since it is clean, easily applied and the constituents can still easily be purchased. For semi-permanent closures I still use Paraffin Soft White and still have a reasonable stock. Once that stocks have gone I will have to find some suitable alternative.

Help please?

Palaeontological Casts in Collections and Museums in England: Materials - A History Of Use

- Bente Loudon

This was a dissertation submitted in partial fulfilment of the requirements for the MA, 2002, Department of Museum Studies, University of Leicester

This appendix is based on secondary literary sources reviewed for the main part of the dissertation and is included to give detail of some of the early materials used in preparation and casting. As there appears to have been considerable overlap and transfer of materials is seems to be important to examine all evidence and not artificially separate these two fields of operation.

The earliest reference to a material associated with casting that I have been able to trace is from Kurtz [1]: in the second century AD Lucian described a statue "all covered with pitch from the casts taken (*ekmattomenos*) every day by workers in bronze for sculptors", possibly the pitch could have been used as a separator. She also details what is commonly referred to as 'plaster': "Today the terms plaster and stucco (The Macmillan Dictionary of art, 1996) are often not distinguished". Stucco is a harder, slow-setting substance based on lime, whereas plaster, also known as *gesso*, is a quick-setting substance based on gypsum. Less durable than stucco it could be spread, "as in the medical practice of stabilising a fractured bone, or cast. Spreading over the face of the dead created the death-mask, over the face of the living a form of realistic portraiture. Casting the plaster in an elaborate system of piece-moulds created an accurate reproduction of a three-dimensional object. In Greece piece-moulds were also developed for casting large statues in bronze from the sixth century BC…The physical properties of gypsum (*gesso*) which made its powdered form ideal for mould-making are thought to have been 'rediscovered' in northern Italy, possibly in Padua, early in the fourteenth century." [1]

Chase gives a most thorough description of the casting process, and also recounts the prolonged use of plaster, as well as explaining how easily its setting properties can be controlled by adding commonly available chemicals such as potassium alum, borax and potassium sulphate, and colloids such as carpenter's glue, casein or citric, boric, and phosphoric acids and their salts. "Plaster of Paris has long been one of the most commonly used moulding and casting materials. Its use dates back to the early Egyptians who used it to mould and cast parts of the human body and statuary. Even today it plays some role in nearly every moulding and casting method described in this paper. Plaster is inexpensive, quick-setting, dimensionally stable, and universally available in a wide range of grades and formulations". "Occasionally it is necessary to prepare a water-soluble plaster which may be dissolved away after serving as a temporary mould. The addition of one part corn or potato starch to three parts plaster yields a plaster that will disintegrate in hot water." [2] Dextrin, purified corn starch, acts as a retardant and hardener when mixed with plaster. [3]

A more fragile, but highly detailed mould could be made using alginate powders made from algae or seaweed (originally developed for dentistry), here the primary concern was for the specimen on which the impact was minimal. "Plaster performs well with alginates for casting."[4] Plaster has then been used as a medium for both mould-making and for producing the cast. In 1884 Mr Budden (Curator of Saffron Walden Museum from 1880 to 1904) that he had found the most highly recommended casting material [I believe he specifically means mould here] for delicate structures to be …"a mixture of the finest gelatine dissolved in water thickened to the required consistency with whiting and zinc white." This he suggests using for fungi casts, and it could be used an infinite number of times by simply re-melting. [5] Many unstable materials such as glue, gelatin, and agar, were once used extensively for moulding purposes. [6] Up until the late 1940's there were only two materials in common use for mould-making, plaster of Paris and gelatine in some form, with occasional references to the use of gutta percha; glycerol, sorbitol and laundry soap being included in some formulae. Since heat is generated as the plaster set, although the gelatine was coated with oil before the plaster was poured, both the water and the heat tended to blunt very sharp detail, ornamentation was lost, thus making it seldom possible to get more than one or two casts which were up to the standard required by scientists from a gelatine mould. Clove oil, or a few drops phenol in water would inhibit the growth of mould. [7]

One early method of casting used on highly carbonaceous, and hence highly conductive, coal shales was galvanoplating, in which the coal shale and its contained mould was electroplated with a thin veneer of cop-

per. This method eroded the surface of the specimen being cast so badly that it limited the number of casts that could be made from the original.[8] Here the specimen was considered dispensable.

Separators are necessary to enable the cast to be removed from the mould: separators for plasteline or potter's clay can be a separating medium such as petroleum jelly dissolved in a small amount of methylene chloride, soap lathered in a small amount of water, or stearine (stearic acid dissolved in kerosene). This can be brushed on the surface of the rigid object and will keep the plaster from sticking.[9] Goodwin and Chaney recommend the best waxes for mold release are those containing carnauba wax. For the replication of a cave a plaster cast was made of the cavity which was the natural mould of and extinct rhinoceros and jellied soap was applied to the rock as a separator, followed by burlap strips dipped in plaster as a casting medium.[10] Rixon mentions that almost any type of oil or grease, commonly olive oil, but also chemicals used in the tanning process such as alum or potassium dichromate, were used between the alginate mould which took an excellent impression of fine detail and the casting plaster.

Separators between bone and latex have involved vegetable cooking oil, and Vaseline has been used as a separator between polysulphide rubber and plaster, and between plaster and plaster.[11] Slettebak used polysulfide rubber for moulds for plaster casts, the separator being a mixture of petroleum jelly and kerosene. If the original model was made from plasteline clay or wax this could be coated with shellac or lacquer to prevent oil from reacting with the mould rubber and causing distortion. [12]

One should be aware that until recently many recipies for modelling specimens and producing surface detail called for the use of powdered recipies for modelling specimens and producing surface detail called for the use of powdered asbestos (to add strength) which was mixed in with plaster of Paris' in 50% puantity along with other ingredients such as ground dextrine paste (British gum), finely ground perlite (a volcanic ash), or white casein glue. Paper pulp mixed with water, carpenter's glue, and plaster of Paris formed a commonly used maché which could be coated shellac to seal the pores and then airbrushed with lacquer paint. A final coat of (brown) paste was, buffed to a high polish, would give the surface a translucent, leathery appearance. [13]

During the nineteenth century plaster or lime, or a mortar with granules of charcoal and straw or horsehair was used to hold Ichthyosaur specimens in their mounting box. Nails would be hammered in for the plaster to grip on the internal sides, with wooden laths or wires strung between the nails at the back of the mount, and the specimen placed in the box which was then packed to the required height and position using wood, brick, horse hair or straw. Plaster, mortar or cement was then poured in. A final coat of plaster mixed with powdered matrix was then applied to match the colour of the surrounding sediment and to give a uniform background around the specimen.[14] On removal of plaster from fossil marine reptiles mounted in hardwood frames a variety of materials which included wood, string, hemp, cotton, horse hair, newspaper, iron nails, sulphur, sand, pebbles, and wax were found in association with the specimens, possibly as supports or gap fillers.[15] A mastodon skeleton was found to be restored with wood and plaster with thick lacquer applied to their surfaces. The wooden framework of the skull was built up with plaster and papier maché sealed with animal glue, and wads of coarse fiber used to give a rounded shape. The exterior had been modelled in thick layers of putty composed of powdered chalk and water-soluble glue, probably gum Arabic, the inner surface was covered with pink plaster with a 1881 newspaper underneath. The tusks were covered in a thin layer of plaster and their proximal ends had been covered in bitumen.[16]

Many different kinds of consolidant were also in use: "Until the 1940's the consolidants and adhesives used for the preserving and repairing fossils were mainly natural products plus early synthetic plastics. Many had their origins in contemporary trade techniques used for preserving antiquities during the seventeenth to nineteenth centuries; eg. linseed oil and litharge (used by sculptors) for the consolidation of fossil bone, shellac, various gums, gelatine and wax- based formulations as coating varnishes and adhesives (used by cabinet makers) were applied to fossil shells." [17] "Up until the Second World War, the materials used to harden bones in the field were invariably animal or vegetable glue". "In the United States, the earlier use of thin solutions of gum Arabic or acacia gum as consolidants was superseded by shellac dissolved in alcohol." [18] "To harden soft fossils … Bones found in gravel pits etc. are often in a very fragile state. In order to harden them they should be washed over frequently with a mixture of common glue and whitening…" [19] Paraffin wax was also used for stabilization of delamination of dry blocks of shale, but waxes have now proved to be unsuitable for geological material.[20] Shellac has also been applied in the misguided treatment of pyrite decay. [21] Bernard Ashmole (1894-1988), and his technician Mohamed Saleh, whilst working at the Ashmolean Museum in Oxford perfected a process of cleaning casts with potato starch, by pasting this over

the surface of the statues, leaving it for twelve hours or so to dry, and then peeling it off. If the cast had been in untreated plaster this solution would remove dirt and dust, "the result could be amazing". However, most of the older casts were treated with shellac immediately after being made, which partially sealed the pores and these could be sponged with detergent. [22] Another traditional sealant was asphalt and gutta-percha. [23] Other materials of repair included brown organic glue, shellac, celluloid, coloured sealing wax, tallow, paraffin wax, beeswax, and bituminous compounds, which were all used by early collectors as adhesives. [24] In the 1860's these ingredients were called for for cementing "large and pondrous specimens": "1 part beeswax, 4 parts resin, 5 parts powdered plaster of Paris. Warm the edges of the specimen and use the cement warm". Dr F. T. Buckland's "Cement for mending shells used at Paris gum Arabic one third, Sugar candy two thirds, White lead." [25] The jet workers glue used in Yorkshire was called Ockamatutt and was a mixture of marine glue, shellac, and lamp black. [26]

Endnotes:

1 Kurtz 2000:2
2 Chase 1979: 230-233, 249
3 Burke, Anderson, Weld and Gaffney 1983
4 Goodwin and Chaney 1984: 244
5 Entwistle 2001
6 Chase 1979: 26
7 Rixon 1976: 193- 195
8 Heaton 1980: 95, 96
9 Chase 1979: 232
10 Slettebak 1981: 90
11 Burke *et al*. 1983
12 Chase 1979: 234
13 Chase 1979: 225- 227
14 Riley 1991: 33, 35, 36
15 Cornish, Doyle, and Swannell 1995
16 Lindsay 1991
17 Howie 1995
18 Whybrow 1985: 19
19 Entwistle 2001: 5
20 Collins 1995: 55, 57
21 Cornish, Doyle and Swannell 1995
22 Kurtz 2000: 309
23 Mathias 1994: 137
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25 Entwistle 2001: 4, 5
26 Whitby Museum, pers. obs.

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Papers from the Conference

Sheffield Museums and Galleries Trust
April 25 - 26, 2007

"COLLECTIONS DEVELOPMENT"

A Sustainable Future for Collecting?
Nick Merriman, Director, The Manchester Museum

In this talk I am going to be presenting the results of research I undertook last year on the general topic of sustainability and museum collecting. It is not specifically oriented towards natural science collections, but I hope that it may at least stimulate debate for your conference. What I want to talk about today is the debate about collecting and disposal, and the need for an intellectual framework within which to talk about it. What I'd like to challenge, ultimately, is whether it is realistic for all museum collections should somehow be preserved for infinity.

Before I go into the substance of my talk, there's a brief bit of audience participation. While I'm talking over the next 5 minutes or so, I'd like you to think about an object, either one personally owned by you, or one in the possession of your museum, which you really wish you could get rid of – by passing on elsewhere or destroying – but somehow you are prevented from doing so, maybe for fear of offending someone, or because you feel professionally constrained. I'd like you to write what the object is on a piece of paper, together with the reason you'd like to get rid of it, and what's stopping you from doing this. Fold the piece of paper over and keep it until I tell you what we are going to do with it, at the end of my talk.

What I'll be doing this morning is arguing that the debate around collections development can only move forward sensibly if we cease to see museum collections as somehow an objective and cumulative contribution to the collective memory of the nation, region or locality. All recent work on collective memory shows that there is effectively no such thing: public memories are historically contingent. It also shows that forgetting is essential to the functioning of memory: individuals and groups simply cannot function without forgetting most of what is presented them. Yet museums are one of the few bodies which still subscribe to the notion of an inviolate collective memory, held in trust on behalf of the future. I shall be suggesting that if museums begin to embrace the notion that their holdings are not objective but are in fact partial, historically biased accumulations of the interests of previous individuals and that these 'memories' can legitimately be re-worked -- or even forgotten -- through disposal -- then a much more realistic and dynamic approach to collections development opens up.

Real concern about the management and development of museum collections dates back at least 25 years to the late 1980s. By then, through a combination of growing professionalism, particularly in the areas of conservation and documentation, and the growth of accountability in public management models, a concern was arising about the stewardship of museum collections. The principal catalysts were two critical reports, one by the National Audit Office in 1988 on a sample of English national museums and one by the Audit Commission in 1991 on local authority museums. The NAO report, in particular, discovered huge backlogs in documentation and conservation in the museums they reviewed, and expressed considerable surprise that they were still continuing to collect actively.

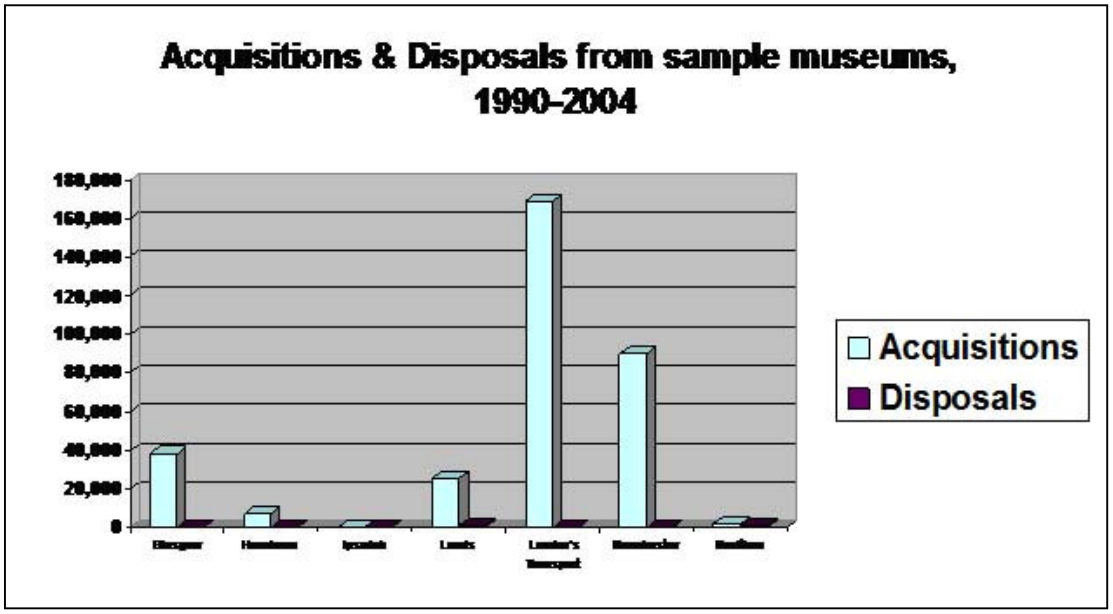
Nevertheless, it is still axiomatic in the museums profession that it is the role of museums to collect. In fact, the Museums Association report Collections for the Future says that current collecting is seriously underpowered, and that museums need to collect with more ambition and focus.

At the same time the document says that 'too many museum collections are underused -- not displayed, published, used for research or even understood by the institutions that care for them' (ibid: 14). One could perhaps forgive the government auditors if they still felt perplexed – why do museums want to continue adding to their collections when faced, still, with these kinds of problems? And they are very real problems. Benchmarking surveys by several of the regional agencies have shown considerable problems remain with museums meeting even minimum standards of environmental control, storage, and documentation. For example, a comprehensive snapshot of standards undertaken in 2000 for the South-East England Cultural Consortium shows that some 22% of the region's museums were below registration level in terms of environmental standards, 26% were below in terms of storage, 43% below registration for housekeeping and security.

The UK Museum Needs Assessment report, which summarised these surveys, produced for the Heritage Lottery Fund and MLA provides the most comprehensive overview of the state of the UK's museums, including standards in collections management and care. It showed, for example, that well over 90% of museums covered by the regional mapping projects had documentation backlogs; only around 45% felt their storage was adequate for their current needs, and only between 1 and 6% felt they had sufficient expansion space. What these surveys didn't show, however, was the rate at which museums were continuing to collect, and whether they were using disposal as a tool of collections management. It was this issue which I decided to address as part of the research I undertook earlier this year as part of my Clore Leadership Fellowship.

I surveyed a small sample of seven museums – the National Maritime Museum, the Horniman, London's Transport Museum, Glasgow Museums, Ipswich Museum, Leeds Museums and Manchester Museum (chosen, co-incidentally before I became Director). They were chosen to give a range of different museums in terms of scale, governance, collections and location. I looked at what they had accessioned over the last 15 years, and compared it with what they had de-accessioned. Now, I don't make any claims for statistical representativeness here, and there are some caveats about the data, but what I wanted was some kind of snapshot which would guide me as to whether there was really a problem here. If museums had really slowed down their collecting in recent years, or they were actively using disposal to keep their collections in balance, then maybe we didn't have as much of a problem as we think.

In fact, the results seem to show the opposite:



What is striking is that with the single exception of the National Maritime Museum where the number of acquisitions is not given on the same basis as the disposals, in every museum, the rate of acquisition far outstrips that of disposal. In five of the museums, the ratio of acquisition to disposal is over 745 to one.

It also seems that these seven museums are not unique. Search of the Internet shows, for example, that the Black Country Living Museum has 40,000 items, growing at an average rate of 800 items a year. The col-

lections of the Pitt Rivers Museum in Oxford comprise around half a million items, and grow at an average of 4000 items a year.

Taking all of this evidence together, it seems that, while clearly steady progress has been made in collections management and care since the introduction of the Registration scheme in 1988, some of the concerns highlighted by the National Audit Office report of the same year are as applicable today as they were then. Continuing to add to the collections in the numerical terms revealed in the sample is exacerbating the existing collection management problems facing the great majority of museums. In short, one is driven to the inescapable conclusion that museums are in a continuing state of denial.

For this reason, museums seem inherently unsustainable institutions, taking the most commonly used definition of sustainability, that of the Brundtland Report of 1987, which defines sustainable development as:

> 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987: 8)

Although sustainability has a huge literature of its own, there are a number of common principles that can be extracted. The most important of these, and one which was brought out in the Brundtland report, is that sustainability is at root about equity, both between generations and within generations. This principle sees humans as holding the natural environment and cultural heritage of the globe in common with all other humans, past, present and future. The present generation holds these resources in trust for past and future generations, and at the same time is entitled to use and benefit from them.

Museums whose collections continue to grow whilst their existing collections lack effective management are unsustainable by this definition. They seem not to be meeting the needs of the present in full because they are not able to realise the potential of the collections they hold (indeed often do not fully know what they hold), and they are compromising the ability of future generations to meet their needs by passing on these collections for them to look after, having added even more material to them. A simplistic cure for this condition would therefore be to say that the only way for museums to become sustainable would be to cease to increase their collections, or to dispose of as much material as they collect. However, this approach would fail to grasp the subtleties of thinking about sustainability. Sustainability does not mean an absence of growth, but rather is an attempt to manage growth in a way which does not damage resources and people in a significant way both now and in the long term. As such, sustainability is not a 'goal' to be pursued in a linear way, such that it will be 'achieved' after a certain amount of time, but rather it is a path, a new approach and a set of values that have to be constantly reinforced.

This way of thinking allows us not to be so pessimistic about collections growth in the future. The path towards sustainability has to begin with a fully strategic approach to collections management, which includes programmes of community engagement, documentation, storage improvement, acquisition, and disposal. Once this is embraced, then a sustainable approach to collections management will allow some continued growth of collections.

In order to do this, disposal does have to begin to play a significant role in collections management, but is still currently rarely used. This is because a professional reticence over the issue has developed, both through decades of training which has instilled a 'presumption against disposal' into museum staff, and because all disposals -- apart from restitutions to communities of origin – have been done on pragmatic grounds of saving costs or space, with no coherent intellectual framework within which to justify them. Making disposals on grounds of costs or space is dangerous in that it lays museums open to the charge of being driven by expediency rather than principle. Why not focus efforts on raising the appropriate resources rather then divesting themselves of collections? The charge can be made that what instead is needed is a review of the philosophy underpinning museum collecting and an examination of whether it still serves us well.

Towards an intellectual framework for sustainable museum collecting

The long-held 'presumption against disposal', which persists in the current Code of Ethics for Museums, has developed through a combination of factors, which stretch back to the original idea that museums hold material forms of collective memories which provide an objective record in which are located the identities of particular communities. In this section I want to look at the history of these ideas of objectivity and collective memory, and begin to challenge their utility as a set of ideas with which to structure the contemporary museum.

Museum Collections: Objectivity and Permanence

First, I want to examine how the notion has arisen that museum collections should generally be retained in their entirety for posterity, and how post-modern thought has begun to challenge this.

Several writers, most especially Susan Pearce (1995), have shown how the emphasis shifted in the 17th century – or Early Modern Period – from cabinets of curiosities which were essentially concerned with the rare and the curious, to the assembly of the normal and the regular. Eilean Hooper-Greenhill's work Museums and the Shaping of Knowledge (1992) draws on the work of Michel Foucault in describing this period as one of a transition from the Renaissance episteme to the classical one, in which knowledge is derived from classification through observation and measurement.

A number of scholars have shown that, in their public form in the 18th and 19th centuries, museums are almost archetypal modernist institutions. Benedict Anderson, in Imagined Communities (1983), wrote that modern states use three technologies of power to control their subjects: the census, the map and the museum. Just as maps laid claim to tracts of foreign land (and clarified ownership of land at home) and naturalised the colonial project, so too museums legitimised colonisation, and placed the boundaries of 19th century nation states in the mists of the past. Museums were the storehouses of the very material which justified the possession of territory by a particular nation, and justified the exploitation of others through the explicit and implicit narratives of their collections and their displays.

Susan Pearce in her book On Collecting (1995) takes this further by arguing that in the heyday of museum collecting, which she places from 1850-1950, systems of classification based on evolutionary principles developed in natural history, became applied to all aspects of human history and human relationships. Evolution could be transferred to society, and archaeology and the discovery of stratigraphy, added a time dimension to it. In this period, she argues:

> 'The big collections…demonstrate the central fact that organised material is knowledge, and knowledge is organised material. The belief that material display creates both knowledge and proper social relationships is a fundamental aspect of the European mentality' (Pearce 1995: 139)

In other words, the museum is fundamental to modernism because modernism's notion of knowledge is based on material evidence, organised systematically to legitimate the social system which gave rise to it. The encyclopaedic nature of collecting (with the aim of completeness, and the rhetoric of 'gap-filling') were fundamental because the total collection was a vital element of the grand narrative explaining European supremacy.

Pearce has also noted (1992: 33-5; 1995: 389) that it is no coincidence that state museums and their collections emerge at the same time as mature capitalism. One of the important functions of museums in capitalism, she argues, is the role they play as a kind of sacred set-aside for objects which would otherwise be market commodities.

It is this notion of set-aside, coupled with notions of objectivity, classificatory completeness, encyclopaedic holdings and the notion of retaining collections in trust for posterity, which have led to such anxieties about disposal from museum collections.

Another suspected cause of the persistence of a strongly held 'presumption against disposal' resides in an

inherited, collective vigilance in a profession understandably sensitised to past decisions by governing bodies to 'sell off the family silver' for reasons which have been seen to undermine public trust in the museum and marginalise a profession, which is by its very nature, conservative. Such deeply ingrained attitudes are only partially rational, and are perhaps hindering professional debate on this issue.

The changing museum paradigm

There is now a strong feeling that, in reaction to the modernist associations of the museum, we are already moving into a new kind of museum paradigm, in which, to quote Eilean Hooper-Greenhill:

> 'The great collecting phase of museums is over. The post-museum will hold and care for objects, but will concentrate more on their use rather than on further accumulation….Knowledge is no longer unified and monolithic; it becomes fragmented and multi-vocal. There is no necessary unified perspective – rather a cacophony of voices may be heard that present a range of views, experiences and values…'

The idea of a single universal truth expressed in museum collections and interpretations is replaced by an acceptance that knowledge is contingent upon historical and political circumstances, class, gender, ethnicity, and a host of other factors, and that there are therefore multiple perspectives on the 'meaning' of particular objects or of particular displays.

The question then arises as to whether, in the light of this changed conception of the museum and its role, the notions of permanence, posterity, set-aside and presumption against disposal of the modernist museum, still pertain?

Posterity, memory and heritage

Examination of some of the literature in the wider field of cultural heritage and the anthropology of memory can provide some assistance. The starting point for this must be the growing interest in memory and forgetting, summarised in Forty and Küchler's book The Art of Forgetting. In this, Forty clearly sets out how, following the Aristotelian model, the Western approach to memory since the Renaissance:

> '…has been founded upon an assumption that material objects, whether natural or artificial, can act as analogues of human memory. It has generally been taken for granted that memories, formed in the mind, can be transferred to solid material objects, which can come to stand for memories and, by virtue of their durability, either prolong or preserve them indefinitely beyond their purely mental existence' (ibid: 2).

The philosopher John Locke wrote about the human memory being a storehouse of ideas, and the museologist Susan Crane draws on this analogy in her analysis of museums:

> 'The externalizing of the memory function in museums literalizes Locke's metaphor: the museum stores memories' (Crane 2000: 3).

Given these ideas, it is hardly surprising that maintaining the integrity of museum collections has been so closely defended. Museum collections, under this way of thinking, were literally physical embodiments of the collective memory of the nation (or region, or locality), and were also objective records through their tangibility and through the all-encompassing classificatory schemes which provided the collecting impulse.

However, increasing numbers of scholars – such as Paul Connerton, David Gross, and John Urry, have begun seriously to question this framework as a basis for understanding how memory and material culture can best be understood. They argue that, for example, advances in neurobiology have overthrown the idea that memories are in any way accurate or true, and have demonstrated that collective memories (for example of nation, class or religion) have been shown to be partial and manipulated for particular purposes.

From this latter insight has developed an interest in forgetting, as a corollary to the scholarly interest in social memory. It is pointed out that in order for individuals to function, they have to forget the vast majority

of things that they encounter, and that societies also have to forget much of their history in order to heal wounds, or simply because of the mass of potential memories available.

Others go so far as to challenge the notion that the past is a non-renewable resource. According to Cornelius Holtorf, this is misleading because 'the heritage' is created again and again from the available materials, and if some are destroyed then the values with which they were imbued become transferred to other materials. Whilst this may seem an extreme argument, there is surely some truth in the notion that heritage does not exist 'out there' to be saved, but is rather created through the actions of heritage professionals.

David Lowenthal, in an important article in 2000, summarises the implications of this:

'Time-honoured goals of eternity, stability, and permanence are nowadays increasingly discarded as unreachable. Cultural guardians who once hoped to husband heritage for all time, like ecologists who envisaged a timeless, changeless nature, are learning to accept that things are in perpetual flux'

And, a further quotation from him runs thus:

> 'In shedding claims to omniscience and omnipotence, in admitting that their stewardship can only be partial and temporary, heritage managers gain both self-confidence and public credence. It is not a sign of despair but a mark of maturity to realise that we hand down not some eternal stock of artefacts and sites but, rather, an ever-changing array of evanescent relics' (Lowenthal 2000: 20).

The need to ascribe value

If we begin seriously to challenge the notions of objectivity, permanence and collective memory in museums, then where does that leave us? Does it now mean that museum collections become subject to the whims and interests of individual curators? Does it mean that we can simply get rid of anything we like? It is certainly not the case that the only alternative is a descent into extreme relativism. What it does mean, however, is that the museums profession has to give far greater attention to the purpose of holding collections in museums than it has before, rather than hiding behind notions of objectivity and permanence as a means of avoiding tackling pressing issues of collections management.

The opportunity afforded by the challenge to traditional museum values outlined above is to free up museum workers to see museum collections not as inalienable assemblages passed on from their predecessors, but as dynamic resources, which can be re-worked to suit contemporary and future needs, and to be able to pass on a sustainable legacy to the future.

This in turn means that we will have to assess collections much more in terms of their value and significance for present and future, rather than treating all material as if it were of equal merit. Heritage professionals are used to ascribing values to the historic environment in order to make choices about what to preserve and what to allow to be destroyed, yet we tend to resist such categorisations of museum material. However, we have had Designation of whole collections; and there are now some good examples of museums beginning to grade their collections in terms of importance so that they can make decisions about their future management, including disposal. We also need to recognise that there are many different ways of assessing value – for example research, enjoyment, educational, symbolic, monetary -- and we need to develop mechanisms for assessing these for museum collections, drawing on the wide experience of other areas of environmental resource management, including archaeology and conservation.

We can never know what future generations' needs will be so we have to be clear that we are making value judgements based on today. We must also be clear that heritage is not actually contained within the objects and records that are preserved. Rather, heritage is comprised in cultural values, which society constructs and imposes on objects and the way in which we see them. Such values are inherently evanescent, a fact that we would do well to remember when considering the status of objects and the way we develop a sustainable paradigm for collections management.

Existing schemes to ascribe value to museum collections

In the UK, a few museums have embarked on large-scale 'rationalisation' programmes in which collections are graded in terms of their significance. A number of schemes have used different forms of grading, which are summarised in the slide.

From these, we can see that there will always be a central 'core' of collections which are likely to be retained for as long as possible. These, it is important to note, would include well-documented research collections, such as the voucher specimens essential to scientific research or the well-contested archaeological archives fundamental to the construction of the early past. Level of use should thus not normally be the main axis on which value is measured.

To take two examples, the National Maritime Museum (NMM) has been undertaking a Collections Reform Programme which has used curatorial expertise to grade collections from A to E, and then carried out a preservation assessment of those in grades C and D. For those in grade E, collections reviews were carried out in order to prepare for their disposal. Reviews have so far been carried out on the props in the Queen's House, the ordnance, furniture and ships' models.

Glasgow Museums Service is just embarking on a review of all of its collections. It has developed a scheme for assessing their significance by grading them on a scale from international importance to no importance. Assessment will be undertaken by specialist curators, who have to justify their choices by reference to a series of questions which examine its representativeness, potential for research, learning, creativity and display or for informing better management of the resource. Its provenance, state of documentation and preservation are also taken into account in coming to a recommendation for future use.

Conclusions and Prospects

So, what are the prospects for the future? I think what all this means is that we should free ourselves up to take our own responsibility for active stewardship of collections rather than feeling under the burden of slavish acceptance of our predecessors' decisions which have to be preserved intact for an indefinable posterity. This, emphatically, does not mean that we can get rid of anything we like. Rather, it means that curators and managers will have to develop the confidence to ascribe value and significance to collections, in order to allow their sustainable development. One of the implications of this is that expertise becomes absolutely fundamental to the process. So, one of the key issues about sustainability is how we invest in the museums workforce to allow this to happen.

I think we should recognize that not all museum collections should be accorded the same treatment and valuation. It may be the case, for example, that different kinds of museums – and different kinds of collections – might have different life-cycles and trajectories. The great national museums come closest to the notion of permanence and preservation for the indefinite future, while some community museums – for example mining museums founded as an act of collective community grieving for the passing of an industry and a way of life – might have a shorter lifecycle once grieving is over and recovery is underway.

Overall, my message is that, however much we may improve standards, we continue to operate unsustainably in relation to museum collections, and that this is no longer justifiable on intellectual grounds, on resource grounds, and on moral grounds in terms of intergenerational equity, so we must begin to be more courageous about our responsibilities to the future by getting to grips with the problem today. I would like to see a loosening up of the whole process of collecting, disposal and collections management. We could think of museum collections as ecosystems or habitats, which need managing, developing, sometimes growing, sometimes cutting back to prevent choking. The challenge for museum professionals, then, is to think through what balanced museum ecology would look like. To tackle the collections management problems in museums, and to continue to collect sustainably, will require therefore an ethical effort at collective altruism. This is something museums have never really been inclined to do, obsessed as they have been by the notion of collecting as an end in itself.

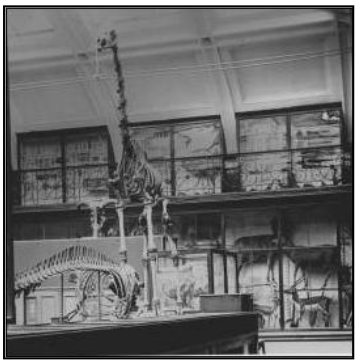
Finally, to return to the piece of paper you wrote on at the beginning. I thought we could burn them all in a bonfire outside as a ritual act of disposal, but this would be contrary to my ecological principles. So, what I suggest is that you exchange your paper with the person next to you, and as you make your way out now, begin a conversation with them about the collective altruism of disposal.

Leeds Collections on Display

Jen Kaines, Registrar, Museums and Galleries, Leeds City Council

Natural History Collections on display have a long history in Leeds. The origins of the City Museum can be traced back into the 1770s, but the first purpose built Museum was opened in this fabulous building in 1821 on Park Row by the Leeds Philosophical and Literary Society.

City Museum on Park Row



Park Row Displays

The Collections were in main natural history, with some archaeology and a very little anthropology. Many of the specimens from that Museum are still on display today. This was very much the age of the keen gentleman naturalist, although the first professional curator was appointed to the Museum in 1825. There were strong links with the other major institution of the time in Leeds, the hospital. One of the surgeons in fact carried out at examination on the newly acquired Egyptian mummy in 1828.

The displays were traditional type, very specimen rich and a mixture of skeletal, mounted and preserved specimens. The Museum was extended in the 1860s and the quality and quantity of the collections expanded to form the basis of the Designated Natural History collections Leeds Museums and Galleries holds today. The Museum continued until 1941 when it was badly bombed, and many valuable specimens were completely destroyed, according to eyewitnesses mummy remains were blown onto the street by the force of the bomb. Part of the original building was demolished and the rest was heavily shored up with a cement-rendered wall. Even so it enjoyed a huge post war renaissance, with such successful activities as a Saturday children's club.

1941 Bomb damage to City Museum on Park Row

1966 Collections move

The Museum 'made-do' with its building into the 1966 when it was closed for Health and Safety reasons, (a theme that reoccurs later in the history of Leeds City Museum), and after lengthy negotiations the Museum occupied the first floor of the library, now in the municipal buildings from 1969. As the building space available was quite small temporary exhibitions were often held in other buildings in central Leeds such as the former Midland Bank. This was far from ideal and planning for a new Museum was never off the agenda, but really kicked off in earnest in 1999 following the enforced closure of the museum in the library by the Fire Officer, due to fire risk. The collections were then moved to our site at Yeadon and the concept of accessible storage was tried for the first time in Leeds.

A site for the new Museum was identified in the Mechanics Institute on Millennium Square, with the theatre moving out to a purpose built venue. This is right in the centre of Leeds, a fabulous location for a Museum, but not practicable for a storage facility given space constraints of the historic building and the value of that land. So plans for a separate storage facility entered the equation at that point. The bid for a Museum conversion and a purpose built store was successful. Heritage Lottery being the major funder for this project, with other funds coming from the City Council and a variety of other funding bodies.

The new Museum then, will be primarily display space only, there are only a very few back of house areas, and no collections storage on site at all/ The plan for the galleries is to draw on the fantastic collections held by Leeds Museums and Galleries, which we have not had the opportunity in recent years to display to their full potential. The curators have chosen themes around the collections using our existing collections, we have not collected specifically for these displays, but see it as an opportunity to showcase some of our collections. The new Museum is due to open late summer 2008, and we all look forward to seeing the new displays in all their glory.

Obviously storage of the collections not to be displayed in the new Museum was a major consideration, in fact the second part of this City Museum Project. The site at Yeadon had been successfully operating as an 'open store' facility and it seemed ideal to expand this concept to include our other remote store, which Leeds had been 'temporarily' occupying for about 20 years in the city centre, our store at Sovereign Street. Sovereign Street Stores was a five floor old leather warehouse with a lift dating back to the 1930s, no access that did not involve steps and a fire limit of 20 people, which meant we were never going to be able to open it to the public. Plans therefore for this new facility would need to take the millions of specimens, including anthropology, archaeology, arms and armour, botany, conchology, entomology, zoology, geology, numismatics, social history, costume and textile collections. A site was identified in an area of Leeds near Royal Armouries and building work commenced in 2004.

The plan was for collections, to be fully accessible, although on racks and perhaps traditionally thought of as in storage being much more on open display in a less conventional manner than in a museum environment. When I arrived in post in Leeds at the end of April 2005 the task of packing the collections and creating a basic inventory from summer 2005, but with work taking priority for the Service from January 2006. Leeds Museums Discovery Centre, as we are calling this new facility was handed over to us in October 2006 and we commenced the move of collections from our Sovereign Street Stores in November, completing this phase at the end of March 2007.

The collections were moved by specialist professional contractors, overseen by Registrar team. During the pack and move we have started to rationalise the collections, working on the larger items initially before moving them so maximising resources. The rationalisation considers a number of factors: condition, provenance, duplication, potential use and display. We are carefully considering each item and working through due process. This rationalisation is continuing across the collections. The aim of this new facility is to provide access to the collections and the best storage conditions for them. The building is basically divided into two main sections in its design, the ancillary block consisting of visitor and staff facilities and the storage block.

The ancillary block has two floors, the first for visitors and second for staff. Upstairs there is a large open plan office for curatorial, registrar, education and admin staff, a staff room, and a meeting room. On the first floor there is a large reception area, commercial store and office for the whole Service, a large education space that can be used as one room or two, and a small research room and curatorial library, with the other usual facilities such as toilets, baby change, first aid room, etc.

Leeds Museums Discovery Centre

The storage block is extremely functional, basically a large extremely secure concrete box, with full environment control set for objects, not necessarily for the comfort of staff and visitors. The store was designed to provide maximum visual impact and accessibility in one space, and for us to be able to easily get objects out for researchers, school groups, community groups, in fact any potential user.

Access is controlled through security fob for both entrance and exit, and no member of the public will be allowed unaccompanied in the storage block. The majority of the collections are stored in this large Store 1 at 16°C and 50% RH, light being controlled by movement sensors. There are a small number of collections not included in this main block, the decision to remove these to discreet areas was only undertaken after detailed risk analysis. We have a separate store for Spirit Collections, comprising of vented cabinets with plasticized shelves, another highly secure restricted access store for our fire arms and numismatics, and a photographic store. These smaller stores are held at more appropriate temperature and relative humidity for these collections, and will be restricted access to members of the public. We have a Conservation Studio and quarantine room, with a freezer large enough to take the Yak.

To maximise space in the store the full height of 4metres is used wherever possible and roller racking is also used, for paintings, boxed items and adapted racking to accommodate our bespoke molluscs system. The central area and end bays are racked with static racking to showcase some of our items, which will be on rotation. Our costume collection is hung in static wardrobes along one wall. Currently this central area is very much work in progress, with the first theme of the displays yet to be finalised before the completion of the moves of natural history objects from our store at Yeadon.

Collections are therefore not stored as previously in separate discreet aras or rooms, but rather next to each other in racks, again to primarily maximise space but also to break down some of the traditional ideas about divisions of collections and collecting as separate areas. For example one of our first displays on the picture racking will be African spears, linking in with the 'Out of Africa' gallery at the new Museum, which will be on racks next to our social historical paintings; more practically geology is stored on the roller racking from ground to 2m and social history toys and games occupies 2 to 4m. Curators therefore will be working much more closely together, if only because there are only a limited number of aisle-ways that can be put in the roller racking at any one time, but on a more serious note we do have a number of projects that are cross curricula in the pipeline and are looking at interventions and installation type displays within the store.

Leeds Museums Discovery Centre is opening to the public this summer and groups are welcome to book the facility to have a general tour, access the collections, for education, activities, or simply use the conference and meeting facilities. Further details of the programme and activities will be launched in July at the opening. We are all very much looking forward to working and developing our ideas for the building and use of the collections at the Discovery Centre, and very much look forward to the opening of the new Museum next year. However we are not resting there and are looking to the future for more collections to be on display.

We are currently working on a plan and a bid for funding to build another Discovery Centre type building next to it as a mirror image, this time in partnership with the West Yorkshire Archive Service to open a joint facility for accessing archives, paper, print and photographic material, so watch this space.

If any one would like further information or to book a visit to the Leeds Museums Discovery Centre then please contact Jen Kaines (jen.kaines@leeds.gov.uk).

Making Collections Count: natural science collections and biodiversity conservation
- Trevor James, NBN Development Officer for National Societies and Recording Schemes

This paper is about how museum biological collections fit into the bigger picture of biodiversity. Hopefully, it will offer some useful thoughts about what museum biologists (and above all, museum policy makers) can do to enhance the profile of collections, which, all too often, have suffered from neglect, especially since the 1980s.

What is needed for UK BAP?
BAP, of course, is not the only use of wildlife data for conservation, let alone other uses, but it might serve as a starting point. Reference to this table in a recent UKBAP report serves as a useful touchstone for seeing where wildlife data fit in to the BAP process. Above all, it shows that: a) there are problems with BAP delivery for a range of reasons; b) the greatest deficit in support for species action plans in particular lies with inadequate research and survey information. The latter, in particular implies that species data, for one reason or another are either not being collected enough, or properly, or that the basis for understanding what those data actually mean is inadequate. Either way, data quality is an issue. As BAP has a high policy profile, not only in UK terms, but across Europe, this is important.

Lessons from the Past: the Pool Frog

Just one example may help to paint the picture. The Pool Frog has only relatively recently been thought of by most as a native British species. Read any older books on UK amphibians and it will scarcely get a mention. It was recently declared extinct in the wild in the UK, after only having been formally recognised as native for a short time. We seem to have seriously missed the conservation boat! Although steps are being taken to re-introduce it. So, what were the decisions about native status made on? These ultimately relied on DNA tests of a very few historic specimens in museums that seem to have gone unnoticed before. But what about the future of these specimens? How secure are they?

Lessons from the past (2): What is hit is history!
This deeply unfashionable sentiment has long been quoted by old-school naturalists! It underpinned Victorian collections. It also had a serious point, whether we or animal rights people out there like it or not! It may no longer be either necessary or desirable to shoot golden orioles or rock thrushes to prove they made it to Britain, but it is absolutely certain that in other cases, even for reasonable size species, such as these related longhorn beetles, that collection sometimes is both necessary and desirable to ensure: a) correct identification; b) monitoring of changes. In addition, the very existence of historic collections, of things like rock thrushes as well as beetles, means that we still do have a basis for making all sorts of studies with historic perspectives that otherwise would be impossible. So, maybe, the dictum still holds, fashionable or not!

Examples from the present: Countryside Survey
The ongoing Countryside Survey, carried out periodically by the Centre for Ecology & Hydrology, provides land-use policy makers, biodiversity organisations and others with a UK-wide resource to aid them in their work. It also generates a mass of data, including detailed data on species that occur in sampled habitats and 1km squares. At the moment, CEH have not shared much of this data with others, partly for resource reasons. However, the collection of these data also point up other problems, particularly over the potential long-term issue of data quality. If detailed species data from these surveys were to be available, how can users be assured that the data are ultimately reliable? Hopefully they are (and the surveyors are pretty good), but backup in terms of vouchers for records is minimal. CEH has no resources to devote to this, and does not, so far as I know, currently work with any outside organisation to undertake this activity.

Examples from the Present (2): the Harlequin Ladybird Project
Over the last two years, the Ladybird Recording Scheme has been rejuvenated by the advent of the Harlequin Ladybird *Harmonia axyridis*. We managed to get some money out of Government to support a project officer, and set up web recording. Part of the process has been to get specimens sent in to check, especially from beginners. This was very successful and ensured data accuracy. It also provided some live speci-

mens for research. But there has never been any facility for keeping any of these for future reference. This is just one example, potentially, of many throughout the recording schemes, even more so those not run from an institution. It is also something that gets forgotten when such a project is set up – what about the samples being collected? Who looks after them? This in turn can limit future opportunities, and the potential value of having done the initial research or survey.

National recording schemes and specimens

So, how many recording schemes are actually likely to need to collect vouchers to ensure data accuracy? I will give just one example, from one of my own areas of expertise: beetles. There are some 16 beetle recording schemes on the BRC list (of which one or two are currently rather moribund). Of the active ones, 13 are likely to need voucher specimens to be collected, named by specialists, and presumably permanently retained as vouchers. In other words, only the Ladybird Recording Scheme actually does not normally rely on specimens, and even that one needs some, especially for small, nondescript species! Every other scheme needs at least some records to be checked at some stage, especially from beginners.

National recording schemes (2)

But which of these schemes have got some sort of system in place to try and ensure that these vouchers are properly dealt with and housed? On my estimate, only 6 of these recording schemes actually have any central support from a museum for housing specimens, and even for some of these, it is not a core activity. For 4 of these schemes, also, the person running the scheme has either retired from the museum in question, or otherwise left, so that their link with the museum is as a volunteer. In one other case, the scheme organiser's paid work is not really related to the scheme, and the museum's role in relation to the scheme is therefore tenuous. So, only **one** beetle recording scheme actually gets real support from a museum in which the member of staff is housed, and even he does other taxonomic work outside the UK as another part of his responsibilities. As for specimens collected by third parties involved in recording for these schemes, there is no information about whether they maintain collections, or if they do, where these are destined to go. Very few museums are apparently actively soliciting their deposition.

NBN recommendations in support of data quality

The National Biodiversity Network Trust, among others, has been concerned about support for recording since its inception. We have recently issued guidance to those involved in recording and data management about things they could be doing to improve the reliability of wildlife data. These suggestions have included getting the recording schemes and societies involved to "up their act" in relation to the way they uphold data quality – identifying in particular for which species, if any, they would accept records from different people with different levels of experience, and whether a particular species record should be supported by vouchers. We have also suggested that these organisations **actively** look to set up agreements with institutions such as museums to receive and maintain collections.

NBN recommendations in support of data quality (2)

At the same time as focusing on the recording schemes and their volunteers, we have also addressed proposals to organisations that are responsible, one way or another, for financing and organising data. For example, over the last 20 years, local records centres have burgeoned (albeit in a piecemeal fashion, and with patchy financial backing). The result has often been that they have become divorced from the museum that at one time had the staff and money to support them. There is, therefore, a need for such bodies to reconsider what they do about making sure their data are reliable. In some cases, museums are still involved, but how much have their governing bodies considered the relationship between the data being collected and their museum collection policies?

Another group of organisations is potentially involved, though. Biodiversity is becoming a vital part of Government-funded activity, even though the Government sometimes appears to be reluctant to admit it. As a result, Government conservation agencies, research institutions etc., are all realising that the infrastructure supporting biodiversity data is shaky. Ironically, as a result, there may be opportunities here for collections managers to seize an opportunity for support, beyond the usual sources that museum people tend to think of.

So what are people doing about data quality?

Progress can be painfully slow about implementing guidance, but here is just one example, with which I am familiar. From the perspective of one scientific society, responsible for very important data, the BSBI has begun to think these things through and put in place some actions of its own to help. It is re-visiting the question of herbaria – those deeply unfashionable collections of dried plants that so many museums over the last 50 years have quietly "lost". In 1983, the Society published the second edition of its listing of UK herbaria (the original was issued in 1958). Every collection worth the name in some form of institution was indexed. It is now re-examining these, and the evidence so far is that a considerable proportion of even those that had survived, moribund, until 1983 have since vanished, or been subsumed elsewhere. As for **active** curation, that is another matter still. How many local museums have anyone even faintly knowledgeable about the plants in their care? However, the BSBI is going to promote those herbaria that are still active. It is also working to produce clear guidance for anyone doing recording which species need to be supported by specimens, and on how to go about ensuring their survival. The likelihood is, therefore, that regional museums will be approached by more people about housing important collections. The Society is also working with existing active curators to help them get their collections properly documented – through an on-line documentation project involving its own members. Ultimately, though, the success of all this depends on the museums recognising they have a vital role to play, and seeking ways to support it.

So what are people doing about data quality? (2)

A final example can come from the world of biological recording organisations at the local level. Hampshire has one of the best local records centre set-ups in the country. It is not only VERY active, it also has a high level of staffing, a wide programme of survey, voluntary sector engagement, and gives biodiversity data support to all the relevant authorities in its large, very biodiverse area. In order for this to work, it has entered on a big programme of development – both in terms of who it is serving, as well as sorting out the infrastructure to do the work. Part of this has been to put in place a very wide-ranging, active partnership, both of voluntary sector organisations and statutory bodies. Among these, note that the Hampshire Museums Service is one. It means that the Museums Service has a stand-alone high profile as a vital part in the business of collecting and ensuring the quality of biodiversity data in the County.

It is early days for this partnership, but the signs are good that, at last, people outside museums are beginning to realise that biological collections are absolutely vital for biodiversity data support.

What are the benefits?

The benefits for biodiversity data collection and ultimately conservation are that we are acting on sound information, properly backed up by facts. But what are the benefits for museums and their collections? I believe they are potentially many, and only partially tapped by a few museums: a broadened base for potential financial support; engagement with communities of people who do not normally consider working with museums; hence a higher public profile in ways that challenge the usual public view of museums; which can then engender political support because museum collections are seen to have broader public benefits – meeting needs identified elsewhere, such as broader community engagement and sustainability. Ultimately this can only benefit museums themselves, by helping to ensure their future as an integrated part of community endeavour. This way museums guard against the inevitable disasters that can befall them, and especially highly vulnerable and ultimately irreplaceable natural science collections.

The EYE Project: Environmental Recording in the Museum Context

Naomi Hewitt, EYE Project Co-ordinator, Tyne & Wear Museums

Exploring Your Environment, or the EYE Project, is a three year, joint partnership project between Newcastle University and Tyne and Wear Museums. It aims to encourage people to think differently about the environment they live in through active involvement with biological and geological recording. At the same time, it aims to develop a regional bank of information about the biodiversity and geodiversity of the North East of England, in order to inform the future planning of the region's natural environment. It is funded by the Heritage Lottery Fund, Northumbrian Water, Newcastle University, Tyne and Wear Museums and the North East Regional Museums Hub, Natural England, Northumberland Wildlife Trust and Tyne and Wear Museums Business Partners Fund.

The first aim of EYE is to increase public knowledge and understanding of biodiversity through environmental recording. As the project title suggests, EYE is about encouraging people to think about the environment around them by recording the animals and plants that they see, thus developing positive attitudes towards the natural world. The Project works closely with Newcastle University's Department of Civil Engi-

neering and Geosciences and Tyne and Wear Museum's ICT and Web Development team to develop a unique web site, which uses WikiTOID technology developed by the University. This will allow people over the whole region to record their sightings of species on a digital mapping system. Recording will be undertaken with reference to landscape features on a map rather than having to input detailed location descriptions or grid references. It will also be possible to search for species recorded over the entire region or indeed to a specified sub-regional or local level. At the same time, a mechanism to restrict access to detailed locality information for sensitive species has been incorporated. Central to the function of the website is the desire to foster an understanding of biodiversity and the changing nature of species and habitats, and the important role that recording plays in this.

The EYE Project extends throughout North East England, working with partners across the region from the Scottish border in the north to the southern boundary of the Tees Valley in the south. However, it is very firmly based within the Great North Museum, the working title of the current re-development of the Hancock Museum in Newcastle upon Tyne, led by Newcastle University. The museum is currently closed to the public for three years as it undergoes a £26 million transformation, made possible through a series of grants and funding from the Heritage Lottery Fund, Newcastle University, Newcastle City Council, ONE North East and the TyneWear Sub-Regional Partnership, the European Regional Development Fund, Northern Rock Foundation and numerous other trusts and foundations. This exciting new development will bring together three museums into one, combining the natural history collections of the Hancock Museum with Greek and Etruscan collections housed in the Shefton Museum, and the prehistoric, Roman and Anglo-Saxon collections of the Museum of Antiquities. A visit to the new museum will consist of an exploration of galleries with global significance, such as world biodiversity, geology and evolution, Ancient Egypt, Ancient Greece and world cultures, but will also contain displays with a regional focus, particularly a central gallery devoted to Hadrian's Wall and another to the natural history of Northumbria. The EYE website will take a central place in the new museum, and be a key feature of the Northumbrian Natural History gallery when the museum re-opens in 2009.

The EYE Project plays a key part in the evolving function and purpose of the Hancock Museum. It reflects a shift towards the role of the museum visitor as an active contributor to the knowledge base, as well as allowing this information to be shaped virtually from outside the boundaries of the museum. The Hancock collections contain many historic specimens, some dating from a time when natural history collecting meant hunting live specimens to be subsequently mounted and preserved in a static display. However, despite this apparent conflict, the museum has always played an important role in making its audiences aware of the importance and fragility of the natural world. This has become even more important in today's society where views of the natural world continue to change and are greatly influenced by the conservation movement. The increase in leisure time for many people and improvements in transport provision have contributed to greater public access to the countryside. At the same time, the popularity of television programmes such as the BBC's Springwatch, Autumnwatch and Planet Earth have raised awareness of the natural environment as a living, fluid ecosystem. These changes have implications for the role and purpose of a natural history museum, as growing emphasis is placed on collecting information about the natural world as well as specimens.

In addition to the website, a further objective of the programme is to provide opportunities for people to get involved in recording, data collection and to find out more about species, habitats and identification techniques. The Project runs a regular events programme with activities for both adults and children held in a variety of locations around the region, including museums, parks, and nature reserves. These have included a nest box day, animal tracks and signs investigation, wild flower trails, and amphibian and pond exploration workshops. Activities focusing on particularly high-profile species such as red kites, recently reintroduced to the North East, allow people to gain an in-depth understanding of the lifestyle and behaviour of one type of animal but also provide opportunities for learning about other species and how to record information about them. School workshops, an annual fair and an annual public survey, are further examples of different ways in which a varied events programme engages with the community, to increase knowledge of the natural world through recording. Spring 2007 saw the launch of the first EYE annual survey, the *Northumbrian Water Wild Flowers on your Doorstep Survey*, designed to encourage people to record twelve common wild flower species which are indicators of rich wild flower grassland.

The second aim of the EYE Project is to collate and manage biological and geological records from disparate datasets. Records in the region are held by a large number of organisations and individuals. These include the three regional wildlife trusts, Natural England and the Environment Agency, as well as a number

of specialist interest organisations such as the Natural History Society of Northumbria, who own the Hancock Museum and its collections. There are also extensive records generated through numerous regional and national recording projects. EYE is working to locate other, hidden sources, such as the vast array of historical information which is bound up with museum collections and archives. This information will be collected, managed, and fed into the database. The North East Regional Environmental Data Hub will provide an information resource which can be drawn on by a variety of organisations and individuals. These include professionals working in the field of biodiversity and conservation, planners and ecological consultancies, specialist groups and individuals as well as museum curatorial and learning staff. The latter will, in particular, be able to use this resource for the development of permanent and temporary exhibitions with a regional natural history focus. Appropriate records from the Data Hub will also be available on the EYE Project website.

The core of the Data Hub is a database that was built up from the 1970s to the late 1990s, originally accumulated as part of the North East Environmental Records Centre, housed within Sunderland Museum and latterly the Hancock Museum in Newcastle. This is a substantial database of about half a million records, but due to changing curatorial roles, very few records have been added to it over the past six years. This database is drawn on by conservationists and planners when responding to building developments, so it is essential that this is kept up to date to reflect the changing nature of species and habitats.

A volunteer programme commenced in January 2007, and through this the Project has recruited a task force of 36 volunteers who have undertaken a number of roles, including entering paper records into the Data Hub, archive research and gaining practical field recording skills. This has been another way of getting people involved both with the Project and the wider recording community, as well as creating an extensive bank of new records for the Data Hub.

The EYE Project is a new, exciting and challenging way to extend the role of the Hancock Museum and to enhance the strong links between the museum, the region and the wider environment. It demonstrates that museums are well placed not only to be institutions which hold information about the world, but that they can increasingly be vehicles for encouraging people to become more actively engaged with the environment around them and to contribute to this knowledge base themselves.

To find out more about the EYE Project, see the temporary website at www.eyeproject.org.uk or contact: Naomi Hewitt: EYE Project Co-ordinator, naomi.hewitt@ncl.ac.uk

INP Table Ronde, Grande Galerie d'evolution, Paris December 2006
- Simon Moore, Hampshire County Council Museums, Libraries and Archives Service

When first approached by the *Institut National pour la Patrimoine* to give a series of talks about conservation aspects relating to taxidermy specimens in museums and in French, it was a new type of challenge and the idea of a paid trip to Paris just outweighed any linguistic doubts. Following the other speakers' presentations (bar one) was quite difficult as we know how rapidly the French can speak and there were certainly a few who outran my translating think-rate and pen! The items below are as accurate as I could ascertain at the time. The event was organised by Amandine Pequignot of the Paris NHM and who came over to give presentations at both the SPNHC/NatSCA Conference in 2005 and to the more recent Biochemistry Seminar at Kew's Jodrell Laboratory in November 2006.

She opened the proceedings with a talk about historic taxidermy and the techniques used in past centuries including embalming. An article by Dufresne in 1803 is one of the first on the subject of taxidermy, which included the preservation of other lower animals – caterpillars and other invertebrates. The term *Naturalisation* was coined at the end of the 19th century to cover animals that were specifically more lifelike, as opposed to 'stuffed', which included tanning of the skin and were used in dioramas. She showed X-ray examples of earlier works which included the entire skeleton minus the rib cage and vertebral column and how this type of mount was used until the end of the 19th century when even less of the skeleton was used.

A range of period preservative agents included many botanically-based substances, resins, herbs, spices including the composite 'herb' *Artemisia absinthimium,* the basic ingredient of the Paris Bohemian's favourite tipple *Absinthe*. We then proceeded to the actual stuffing materials: *Zostera* (sea grass), mosses, tobacco, several sponge species, hair, cotton waste, paper, magazines, also plaster and clay. The bind-up as we call it, or *pelote,* was held together by binding it with an iron wire armature and which also passed through it to support the body in a lifelike pose. Some bird armatures were illustrated showing the triangular form, the 'hook-type' and a more rhomboidal form. Several historic specimens were mentioned including King Louis XV's quail and the Duc d'Orléans' giraffe. Specimens were often 'fixed' by pinning to hold tissues in place and then cooking (which stabilises protein) and included specimens from 1729 such as Buffon's monkey 'Jocko'. We were taken through the process of constructing a heavy wood and iron armature for taxidermist Jules Terrier's buffalo and which is still displayed and looking good after over 100 years.

Throughout this and many of the subsequent talks there was much 'overlapping definition' for the work done: *conservation* strictly means curation, *restauration* means conservation, *reconstitution* means restoration. I have also found the term *restaurateur* more applicable to a restaurant owner than a conservator! Many use the mouthful *conservateur-restaurateur* to define a conservator but then one person could define this terminology one way and then another would turn this around in their own presentation. The word *curateur* defines a legal curator or administrator! Confused?

Following on from this introduction, Frédérique Juchauld of the *Centre technique de Bussy St Georges* talked about the breakdown of collagen fibres in skins, including leather. Inducing artificial ageing with heat and contaminants which cause the molecular triple helix to break down, particularly when accelerated above 68°C. This was monitored using a head stage with an Scanning Electron Microscope.
She then gave results from analysing toxic biocides in specimens. These included salts of Arsenic, Lead, and Mercury as arsenical soap [Na3AsO3], lead acetate [Pb(COOCH3)2], lead arsenate [Pb3(AsO4)2], arsenious oxide [As2O3], mercuric chloride [HgCl2] and sodium tetra-borate [Na2B4O7]. She also compared the use of Doctor Weber spot testing, which is non-destructive, versus X-ray fluorescence spectrometry using a 'point & shoot gun' which has a parameter of 0.01% for lead and 0.05% for arsenic, whereas gas chromatography can detect up to 0.01ppm.

After a short break Jacques Cuisin (Paris NHM), explained about the many problems that can occur when looking after large collections of mammal and other animal skins. These included water contamination removing tan salts and their preservative effects *(mégissage),* leading to cracking when they subsequently dry out, the problems of fungal infestation and ensuing tissue breakdown; also the 'hyper de-greasing' of fish skins leading to embrittlement. Some of these he illustrated using the 7 plagues of Egypt as an analogy,

especially the infestation aspect!
He showed the Museum's problems: unsuitability of wrapping materials to prevent infestation and cramped storage to the extent of finding mounted specimens between compactor units! He concluded rather sourly that there are many problems and not-so-many solutions with the irony of finding more perfect taxidermy specimens in a school than in a museum!

Julie Nives-Nivou added to this a list of further deteriorations that occur but at a more molecular level. The complex chemistry found in a single taxidermy mount measured against how much should one intervene – the ethics *(déontologie)* and metaphysical aspect of inervention. As an example she showed a fish mount that had been stabilised and part-restored but showing clearly, the delineation between original and new materials.

Michel van Praët, the director of the museum talked about the all-too-familiar problems facing a museum. Ownership and legislation, how to maintain an old building to modern museum standards, how to keep visitors comfortable without compromising the stability of displayed skins; trying to find the ideal solution to the dilemma where a rare specimen must be displayed to please the public but might deteriorate due to being displayed over a long period. His talk mainly focussed on the aspect of trying to achieve a correct equilibrium and led to a lively discussion of the present situation in France. How little expertise there is available to help sort out some of these problems at ground level, let alone trying to get government officials to understand.

All of this left me feeling rather depressed as I took the stand for the first time and explained about the dilemma of keeping the public happy by letting them touch exhibits on open display as well as providing a banquet for insect and other pests. Despite my apparent cynicism, there is a lot of good that can come of open displaying, even if we have to pander to modern taste in order to survive and the public **is** beginning to expect to touch. At least none of the specimens nvolved was rare or of scientific importance and even if the rabbits and pigeons had their heads wrenched off or plucked, they were (sometimes) conservable and easily replaceable.

Christophe Gottini, a taxidermist at the Paris NHM for 30 years, said that the lack of conservation know-how is a definite issue in France. At first, less than 10 specimens were conserved and only with consultancy from Germany and from Switzerland. He talked of tears to specimens and resin gapfills that would not take painting, the problem of nails in heavy mannequins and underlying layers of rust that corroded the skin or leather, particularly when conserving the Duc d'Orléans' giraffe. He talked of mannequin weight reduction and substituting resins, dry-cleaning specimens with solvents and restoring faded colours using waxes - techniques which are becoming rather outmoded these days.

Jacques Cuisin came back again to talk about the problems with reserve collections. He used the example of a lioness perched on an entomology cabinet to illustrate the problem of overcrowding, yet the importance of their scientific value was stressed. He mentioned how some of the enormous and scientifically-important collection of mammals was spread over 3 sites and yet if there was no current (public) interest in any of these groups then new funding was unavailable. He finished the rather pessimistic but objective view with the question of what to do with all the oddments!

I then followed this, showing how the Hampshire Museums Service adapted farm buildings – a few still have animal feeding facilities built into them, to become areas to store sensitive biological specimens and other objects. Over the years these have been improved and expanded so that there is just enough space (but only just) and that the all-important atmospherics are controlled/regulated by a Norwegian humidification-dehumidification system. I also showed the multiplicity of collections ranging from freeze-dried fungi (highly humidity-sensitive) and stored in a 'dry room' along with the conchology collection and where the RH is not allowed to rise above 50%, moving onto the fluid-preserved material, entomology cabinets, a herbarium and large taxidermy collection. This was also illustrated with some of the problems encountered over the years together with conservation remedies.

Christophe Gottini continued Jacques Cuisin's list of problems - having to transport specimens across busy Parisian streets and the problems of dust and vibrations of frequently-passing lorries. He showed how a thylacine and a Panda had been wrapped for transportation and then outlined the problem of preparing a displaying peacock!

The next day of talks centred around ownership, legislation and ethics. Dominique Wahiche works for the Paris NHM's directorate and handles legal affairs. He spoke of the gradual legislation of natural objects, especially taxidermy (in 1986), leading to the protection of nature in 1995, similar to our Countryside Act. Transgressors of 'taxidermic' laws are summoned before a tribunal hearing, who since 1996 can mete out a suitable punishment. Keeping a frozen corpse of a protected species post-1995 is punishable but a clause additionaly states that a pre-1995 protected specimen cannot be prepared if it is for financial gain. Provided that some proof of natural death of a specimen is available, then there are no legislative problems.
Article 13 mentions about qualifications of those who conserve/restore such specimens, since in France, taxidermy items are considered as works of art.

Gilles Pacaud opened his talk with the amazing fact that only 3% of the collections actually belong to the museum, the rest is for research.
These days, he added, the specimens are much better kept on display than being in store, especially when the stores are situated near the central heating boilers!

After a short break I spoke about the ethics involved in taxidermy conservation. This is a subject dear to my heart as, in certain cases, some slight restoration is often required to bring a display specimen up to scratch. I illustrated this with some slides showing mounted birds against a faded background and how lacklustre they looked compared to when a little colouring was added to the case back-drop. The main question was where to draw the line between conservation and restoration. For some this is still a grey area but the general definition centres around adding something new to the specimens or display, including colouring. The other area concerned repairs to areas either ravaged by pests or severely broken. Just how far could one conserve in the purest sense – to prevent further deterioration, but having to put it back in the collection looking terrible, if stable? For display specimens, these have to be restored as well otherwise the public will find them unacceptable. Scientific specimens often require further stabilising via restoration but provided that this treatment is logged then that is OK.

Christophe Gottini continued the topic illustrating the dilemma of very fragile specimens but which needed stabilising. He mentioned the use of chemicals and their effects: how formaldehyde (used as a bactericide and tissue 'stabiliser') rendered many tissues "Hard as a pebble". The problem of cotton wadding stained with oxidised lipid leading to skin embrittlement and deterioration and how after 4 to 6 treatment hours to stabilise each specimen, this can prolong its life up to a further 30 years. He gave an interesting aside example of Louis XV's rhino had been given a horn of resin to prevent theft of the real horn, especially since the original had already been broken. He added that in France, specimens preserved in IMS or formalin are now forbidden from display unless the preservative is an impractically-low concentration. He then talked about historic bases for taxidermy specimens and how, if damaged, these are often disposed rather than being conserved as well. How specimens and bases often become separated and subsequently muddled. He concluded by mentioning the dangers of loans and how, particularly the problems of mildew and other deteriorative fungi, can arise during a loan period.

I then concluded the day's talks a little hastily as time was running out about interventive treatments that were acceptable for deteriorated taxidermy specimens. These included the use of Japanese Tissues for stronger and more discreet repairs, document cleaning powder for removing dust and dust stain from white plumage. No matter what, some specimens, especially those stripped by clothes moth larvae, were beyond conservation.

The final day was devoted to conservation-related organisations and qualifications that look to the future. Gilles Pacaud started by talking about the museology and (slightly) conservation-related group OCIM: The *Office de Coopération et Informations Muséographiques* (not an anagram of ICOM!), a part of the University of Burgundy in Dijon. Outside of France who knows or cares about OCIM he asked? A questionnaire was circulated to French museums a while ago and only 27 replied, of these 51% were carrying out research into conservation – mainly concerning taxidermic mounts and skeletons. Nathalie le Dantec representing her director, Astrid Brandt-Grau, talked about the INP which is similar to our ICON (Institute of Conservation) with a similar composition and mission. She mentioned ethics and outlined their database relating to conservation reportage.

Next was Jane Richter, head of the Danish School of Conservation. She spoke methodically (and in English) about the functions of the School's role in Natural History Conservation. She covered a wide range of topics: taxidermy is not taught apart from the methodology, their use of original museum objects and that

there are no PhD students yet. There is a series of 5 x 8 week obligatory courses for a BSc including a 2 term general course. She then switched to technology and talked about their technqiues for degreasing whalebones using enzymes, how a sea-snake holotype specimen (in IMS) had become gradually decalcified (detected by x-ray) and that there were traces of zinc chloride and zinc phosphates which had contributed to this deteriorative process. She spoke about analysing jar sealants as part of a Masters course and that students can get short-term contracts in museums but more permanent positions in Norway.

Julie Nives-Nivou spoke about the Sorbonne University's conservation diploma, broken down into short courses, it includes all relevant branches of chemistry including analyses, biology practical sessions and how this can lead onto a Masters. Jacques Cuisin then continued about preventive conservation, broken down into 5 units that cover all the aspects of field and preventive conservation, including collections movement, buildings and other logistical problems. 117 students have been awarded certificates since 1994 (to 2005).

Amandine Pequignot talked of the diversity of natural science specimens and how ethnogaphy and organics exist as grey area disciplines and molecular biology where DNA is termed AND in French (RNA is similarly ARN). The problems that can arise from these disciplines, for example how the morphometry of a badly-glued skull can be affected. The then spoke about staff structuring and some of the confusing terms relating to conservators and how these, as staff inter-act. She also compared staff structuring in the USA and Europe: at the Natural History Museum (London), Field Museum (Chicago), the Smithsonian Conservation Institute and the Canadian Conservation Institute. How some of these museums have no permanent conservation staff and often sub-contract to the private sector or to other Institutes. She mentioned NatSCA and its conservation force, especially those who covered all of the Natural Sciences, the Regional Alliance for Preservation in the USA and the previously-mentioned Royal Danish Academy of Fine Arts School of Conservation, of the RCA and V&A conservation courses in London and in France, the Syndicat des Naturalistes de France which no longer exists and the CAP de Taxidermie, which I suspect is similar to our own Guild of Taxidermy.

With Jacques Maigret, Amandine finally wound up the talks with the problem of having to care for millions of specimens, coupled with the cost of conservation or restoration, maintaining such objects in a stable environment and replacing display specimens with something fresh every now and again.

Overall, it was really good, the sun shone and Paris looked as lovely as ever. Still, at the end of it all, many problems to be addressed but **what** is the french for conservator……. *Restaurateur, conservateur-restaurateur……quoi alors?!!*

NEWS

Notices, Adverts & Meetings

NatSCA Seminar on Anoxia

Venue tbc
Late 2007

For further information and details:
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GCG Study visit
4-6 October 2007

Dorset Museums, Attractions and the Jurassic Coast
(Dorset and East Devon World Heritage Site)

The study visit will be over three days from Thursday 4th Saturday 6th October 2007. So far we have plans to visit Charmouth Heritage Coast Centre, Lyme Regis Museum and Dorset County Museum, as well as visits with local fossil collectors and fossil shops.

There will also be the opportunity to attend a short session/debate on fossil acquisition and the management of palaeontology sites led by Richard Edmonds, Jurassic Coast Project Officer. Saturday will be spent on the field examining some of the spectacular geology and palaeontology of the World Heritage Site.

Identification, care and conservation of sub-fossil bone
7 November 2007

Natural History Museum, London

Sub-fossil bones are usually found in mixed geology collections and can be some of the most difficult objects to care for. If you have a geology collection in your care, chances are there are some sub-fossil teeth, bones, tusks or antlers in your collections, and some will probably be incorrectly identified. So, take the chance to find out about them from one of the UK's leading experts on sub fossil bones, Dr Andy Currant of the NHM, and find out how to ensure that they will last in your collections for generations to come with staff from the NHM conservation labs.

34th AGM & Local Heroes conference
GCG Seminar and AGM: **3-4 December 2007**
Natural History Museum, Dublin, Ireland

To commemorate the 200th anniversary of the Geological Society of London, the 150th anniversary of the Natural History Museum in Dublin and as a front-runner event for the International Year of Planet Earth in 2008, the seminar will adopt the theme of Local
Heroes which the Geological Society is promoting throughout 2007. We invite members to offer presentations, both oral and posters, on their own geological heroes. Whilst the
organisers will address some Irish geological heroes, we encourage offers of contributions on any geological collectors and curators who have made a significant impact on our science. We would anticipate that the focus of any contributions will relate to collections or museums, in keeping with GCG's purpose. It is planned to include a celebratory field visit to Mount Jerome Cemetery, where many important Irish geologists were buried.