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Title: The pest problem within the dry Arachnida and Myriapoda collection

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modified precisely by computer. In both the warming-up and cooling-down phases of the treatment the relative humidity is controlled in such a way as to ensure that the humidity balance is maintained. As a result, no dehydration can occur.

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The Use of a 'Dynamic' System for Fumigating Museum Objects

The fumigation of pest-infested objects has been carried out at the Science Museum for a number of years. In April 1997 a pest strategy was written to support the Museum's Collections Management Policy Statement. The Conservation Section, in conjunction with setting up an Integrated Pest Management programme (IPM), had begun to investigate methods of fumigation which presented a non-harmful treatment for the objects but did not create a health and safety hazard to its staff.

The most common insect pests identified as harmful to the Museum's collections are *Attagenus smirnovi, Anthrenus sarnicus, Stegobium paniceum* and *Anobium punctatum*. In the past, methyl bromide had been used to fumigate infested objects coming into the store. This is still an acceptable treatment for many wooden items although it is not appropriate for most composite objects as methyl bromide will react with sulphur-containing materials and also attacks metal surfaces. Methyl bromide is known to deplete the ozone layer and can create a health hazard to those exposed (methyl bromide is specified as a Part 1 poison, Poisons Act 1972). Therefore an alternative treatment was explored.

Initially, the use of high levels of carbon dioxide was investigated. When exposed to high levels of carbon dioxide, insects open their spiracles allowing body moisture to escape, so causing them to die from dehydration. Two fumigations were carried out with good results. Although treatment using carbon dioxide appeared successful, there were a number of reasons why another method was explored, not least Health & Safety issues, availability and cost. Following a course on "Pest Management and Control For Museums", organised jointly by The Getty Conservation Institute and The Conservation Unit of the Museums & Galleries Commission, I was encouraged to investigate the use of a 'Dynamic' system using nitrogen. A 'Dynamic' system refers to a method of fumigation where an inert gas is used to flush out air from a bag/chamber until low levels of oxygen are attained. These levels are then maintained for a specified period of time.

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The Pest Problem Within The Dry Arachnida and Myriapoda Collection

Arachnid and Myriapod specimens are preferably stored in 80% methyl alcohol as this preserves soft-part anatomy, lost if specimens are dried. The Natural History Museum additionally has significant dry-pinned material dating back to the early 19th-century and housed in 208 entomological drawers (mostly Hill units). The dry collection is now not of great scientific importance as in recent years much of the type material has been restored in spirit; many specimens are just large and showy with little data. However, most of the dry specimens were donations and some have an important historical component, so the collection has been largely maintained in its original form. Unfortunately, in some parts of the collection, specimens are poorly preserved, especially tarantulas with soft abdomens, and brittle millipedes. Scorpions and centipedes with their flattened, highly keratinized bodies, appear to have fared much better. Parts of the dry collection have been subject to the ravages of the Guernsey carpet beetle - *Anthrenus sarnicus* - the larvae of which have reduced some spider specimens to a mere pile of legs and frass!

At first glance, it is not apparent how pests were able to gain access to the collection. The dry collection is separated into three discrete blocks to the rear of the store room away from the interior doors. There are no windows through which beetles can fly. However, there are several air ducts leading out of the storeroom to the roof, along with a ‘dumb waiter' lift shaft, which present ideal routes of entry, as well as dead areas in which detritus can accumulate and where pests can breed. Also, but less likely, specimens could have been infested when drawers were opened for study elsewhere. Other factors have also contributed to the pest infestation problem. Because the dry collection is not often used, infestations are likely to go unnoticed for long periods of time. A change in housekeeping policy meant that the storeroom was no longer cleaned. The effect of the preventative chemicals added to the collection in the past (probably BM mixture - a cocktail of saturated solution of naphthalene in benzene, often with a proportion of beechwood creosote and even phenol), has also worn off. This has all occurred against the background of reduced staffing levels.

But, with greater emphasis now placed on Collections Management within the BMNH, it was recognised that priority should be given to the problem. It has been tackled in various ways. Removal of extraneous items has provided a less cluttered environment. All collection drawers have been frozen and cleared of frass. Any remaining type specimens have been removed and placed into methyl alcohol. Cabinet interiors and bases have been treated with 'Constrain', a permethrin-based insecticide approved for museum use. The collection is also being monitored by sticky traps and three-monthly visual checks. Drione dessicant dust may be used in the future in dead spaces as an additional measure. Hopefully, such a strategy should spell the end of *A. sarnicus* in the dry Arachnida and Myriapoda collection.

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Control of *Stegobium paniceum* in the Economic Botany Collections at RBG Kew.

The Economic Botany Collections (EBC) at the Royal Botanic Gardens include more than 30,000 timber samples, and 44,000 specimens of economic plants, spanning the whole spectrum of uses, such as food, forage, fuel, fibres, medicines, poisons, dyes, gums and resins. Specimens range from dried plant parts - medicinal roots and herbs, to artefacts manufactured from plants. All specimens are now stored in taxonomic order, in an open shelf, wheel-to-compactor system, in an air conditioned and purpose built storage space in the Sir Joseph Banks Building at Kew. All items were repackaged in acid free boxes, plastic topped glass jars, or punctured plastic bags. The move of specimens to the store was completed in 1993.

The first *Stegobium paniceum* (Herbarium or drug store beetle) appeared in the store in August 1993, and collected by the windows, and the following July numbers reached epidemic proportions. Spot checks revealed some heavily infested families, with a poison and starch bias. Consultation suggested several methods of management of the problem within the store: regular cleaning, greater insulation of fire exit and connecting doors, placement of traps and regular monitoring. The main method was to be through temperature control, with the presumption that sustained low temperatures would prevent the *Stegobium* completing their life cycle. The air conditioning system was capable of lowering to 15°-16°C (with the RH around 60°C acceptable for organic collections). Traps were placed at intervals throughout the compactors - a mixture of pheromone lured and non-lured Fuji traps, and museum traps. Very severe infestations were found on the shelves containing certain families, genera and species - notably *Ricinus communis, Castanea sativa, Manihot esculenta, Papaver somniferum*, and *Myristica fragrans*. Major infestations were in concentrated areas around the main collections. All infected specimens were removed and frozen for a minimum of 3 days at -30°C.

With the lowering of the storeroom temperature, there was an immediate drop in *Stegobium* activity. Some trap catches were made, with higher numbers on the pheromone lured than non-lured traps, but this was not an accurate indication of activity. In most cases, insects preferred the specimens to lured traps placed among them - perhaps due to reduced attractiveness of the pheromone lure at lower temperatures.

In July 1995 activity was much reduced, but it was decided that a temperature below 13°C would be more effective in preventing the *Stegobium* completing their life-