The Principles of Pest Control in Museums

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Introduction

The general principles that apply to preservation of museum specimens in storage are those which apply through stored-product pest control generally. These principles call for a detailed reappraisal of the approach to curation of museum material in favour of the ordered management and integration of environmental and design considerations which have of necessity been introduced generally into stored product protection to maintain the high standards of preservation which are required today. Most attention has been given to the pest problem but nevertheless similar principles and procedures apply also to fungus problems.

Present Technical Services on Pest Control Available to Museums

There is no organisation with a responsibility for providing a technical service to museums on problems relating to deterioration of museum specimens from attack by pests and fungi. Currently limited investigations and a limited consultancy service are provided by individuals with a chance interest in the subject both within and outside museum staffs but this is usually within narrow limits of expertise. With increasing specialisation it is unlikely that any outside organisation could or would provide an adequate technical and advisory service and it is incumbent on museums to make their own provision for such services. In view of the significance and value of the material in the care of museums such provision would be prudent and timely.

Environmental Conditions

Environmental conditions are of primary importance in the preservation of museum material. The major factors concerned are temperature, relative humidity, light and composition of the atmosphere. These factors influence the storage life of preserved material in many ways other than in pest abundance, and alteration of these factors to reduce pest activity will usually create more favourable storage conditions. However it is necessary to realise that with the possible exception of light, alterations sufficient to reduce pest activity will also "reduce" the activity of human beings. Nevertheless it should be long term policy to plan for integration of desirable combinations of environmental conditions associated where practicable with physical exclusion of pests, for permanent solution of the problem.

Design Considerations in Display and Storage

To implement changes in environmental conditions attention must be given to the design of proper display containers, storage facilities and the housing structure itself to allow the change in ambient conditions required. Design features requiring consideration include:

1. Ability to regulate temperature and relative humidity at economic cost levels, including use of deep freeze techniques for disinfestation particularly of new material received for preservation;
2. gastightness or ability to achieve gastightness in display or storage containers to utilise controlled atmosphere techniques or to achieve satisfactory fumigation if required;
3. a fumigation capability within the building itself both in terms of ability to render the building gastight, to distribute the fumigant satisfactorily during fumigation, and to achieve adequate exhaust of the fumigant when the operation is complete;
4. provision for complete exclusion of pests, i.e. insect-proof containers;
5. construction methods which do not result in inaccessible and hidden harborages for pests

enabling them to escape detection during inspections.

Inspection, Recording and Reporting Procedures

Regular and frequent inspection of all structures, containers and specimens is essential if a satisfactory level of preservation is to be maintained. This must be carried out as a specific exercise within written guidelines established for the particular facility. The procedures followed must include a written record of the inspection (preferably on a simple form) and clear instructions as to who should be notified in the event of any pest occurrence being detected and what remedial action should be taken, and where responsibility lies to ensure effective compliance with the instructions. The records must be retained and readily accessible for future reference. More often than not the odd insect detected by chance is an indication of a well established population in some less used part of the building.

The Major Pest Species Involved

The major pest species belong to the following groups:

Dermestidae (museum, carpet and hide beetles) — pests of materials of animal origin including woollen fabrics, hair, hides and dried carcasses of other animals.

Anobiidae (furniture beetles) — pests of timber and most materials of plant origin.

Lyctidae and other wood boring Coleoptera — pests of wooden materials.

Psocoptera (book lice) — pests of animal and vegetable matter generally where mould is present.

Thysanura (silverfish) — nocturnal scavengers which are destructive to paper and most materials containing starches.

Blattodea (cockroaches) — nocturnal omnivorous scavengers.

Tineidae (clothes, house and grain moths) — pests of materials of animal and plant origin and general detritus feeders.

Acarina (mites) — mites proliferate only at high relative humidities which are otherwise detrimental to safe storage of commodities.

In addition to these there are the termites and the normal range of stored product pests where the specimens involved are foodstuffs, for example, Coleoptera: Bruchidae, Curculionidae, Ptinidae; Lepidoptera: Phycitidae.

General Considerations of the Control Methods Available

A basic principle in control of pests in museums is that it should involve minimal use of chemicals. They are palliatives and usually cannot be guaranteed to give the long term protection desired. They may induce undesirable changes in the material being preserved, most represent a considerable toxicity hazard to human beings either latent or acute, and the inherent capacity of pests to develop tolerance to most such materials, prejudices their continued usefulness and may allow damage before the infestation is detected.

The problems in preservation of museum specimens are complex because of the wide range of materials involved. Each case must be considered separately and where previous experience with particular materials is not available to give an unrestricted clearance for use, then investigations must be made on similar but expendable material. The choice of treatment will depend on individual circumstances and will be influenced by the facilities available and the type of application being considered whether for material being received in the museum, material on display or material held in storage.

Principal Types of Pesticide Available

Contact Pesticides. These usually are acutely toxic to pests from contact with treated surfaces. Some have a long residual life such as DDT, lindane, fenitrothion, iodofenphos and pyrethroids whilst others such as dichlorvos have a high vapour pressure and a comparatively short residual life. In museum buildings these materials are generally restricted to spot treatments and as such they do not achieve the level of control that is desirable.

Other Materials With a High Vapour Pressure. Materials which function partially as fumigants such as naphthalene, paradichlorbenzene and thymol, have been used but there is an increasing appreciation of dangers to staff from excessive exposure to these materials and their usage is declining.

Other Materials. Chemicals which contain intrinsically toxic elements such as arsenic and fluorine or toxic groups such as phosphides, or compounds which prevent feeding in other ways, may be impregnated into materials being preserved or sometimes used in baiting programmes. Some contact pesticides and fumigants are repellant to pests and a number of chemicals have been developed specifically for such use.

Fumigants. Formulations of gaseous materials such as methyl bromide, phosphine, hydrogen cyanide and ethylene oxide are used for disinfestation of materials, their containers and occasionally for the building as a whole. Fumigants should only be applied by trained personnel. Further, careful consideration should be given to the possibility of the fumigant reacting with, and damaging the materials being treated. For this reason alone specialist advice should be sought before fumigants are used.

Non-chemical Methods of Control

Hygiene. A high standard of hygiene is essential in museum premises to reduce extraneous sources of infestable material that can allow pest infestations to become established in the general environment.

Temperature Regulation. Heat disinfestation of commodities has very limited application as it may induce undesirable changes in many materials. Use of sub-zero temperatures however, offers considerable promise as a small scale disinfestation treatment. Low temperature storage is also highly desirable for many materials where appropriate.

Humidity Control. Adequate regulation of relative humidity levels is essential in museums. Whereas direct effects of humidity on preserved material must be of prime importance, it must also be recognised that lower relative humidities retard or prevent proliferation of many insects and suppress mould growth.

Controlled Atmospheres. The display or storage of materials in atmospheres deficient in oxygen offers considerable scope for future development. Such methods have the advantage that they are effective at normal temperatures and air pressures. Changes in atmospheric composition sufficient to inhibit insect reproduction would satisfy most museum situations.

Pest-proof Enclosures. Irrespective of other considerations, all containers, as outlined previously, should preclude entry of pests.

Conclusion

It cannot be stressed too strongly that chemicals provide a short term solution only and that those responsible for preservation of museum material should be looking for facilities that provide for effective and feasible implementation of long-term methods based on exclusion of pests and creating environmental conditions unfavourable for their development. The design of museum buildings and the facilities therein holds the key to this philosophy.