BLAST FREEZING THE BERKELEY LAW LIBRARY INFESTATION

Gillian C. Boal

The Law Library of the University of California, Berkeley, has one of the largest collections of legal material in the country, housing over half a million volumes. Within the library is the renowned Robbins collection which contains the Rare Book Library.

In November 1989, a cataloguer discovered an infestation while he was attempting to deal with a backlog of rare materials which had been shelved in Manville. Manville is a self-contained purpose-built storage unit, separate from the Rare Book Library, and built in 1980 for the storage of out of date journals, duplicates and the like. It houses 84 ranges with approximately 4000 shelves, having a potential for about 62,000 books.

Fig.1 - Manville

Ranges #56 and #57 housed approximately 1300 books. Lynn Jones, the assistant head of the Conservation Department, and I, were called to the Cataloguing Department in the Law Library to inspect this possible infestation.

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We went armed with polyethylene bags to isolate the infested books. We found that the infestation was active and we asked the cataloguer to collect all the books he had removed from Manville and return them there. This amounted to one library truck-load of approximately 50 books.

Fig.2 - Truck of Infested Books

The cataloguer informed us that two volumes from the backlog had been catalogued two years earlier. Presumably there had been no visible sign of infestation then, as they were subsequently shelved in the Rare Book Library. Consequently Lynn Jones and I visited the Rare Book Library. Even though the Library has monitored climate control, these two books were obviously now infested. There were also dead beetles around the base of the ranges, but we inspected the surrounding books and could see no further signs of activity. We had these two volumes returned to Manville. We also discovered an "odd beetle" which the entomologist said was a protein-eater and would probably be feeding off the dead carcasses of the other beetles.

Establishing the Extent of the Infestation

Lynn Jones and I then visited Manville, which is made up of compact shelving. This shelving was installed badly and the shelves are difficult to open when the electronics fail. There is no climate control.

The cataloguing backlog of rare books was located between the two ranges, #56 and #57. There were also other non-rare volumes and pamphlets in these two ranges. Most of the rest of the material was stack overflow published in the nineteenth and twentieth centuries e.g. out of date State Codes.

The telltale signs of an active infestation are dead beetles and frass (the debris from the larvae) on the shelves. There was plenty of evidence on these shelves.(The dead adult beetles were about 1/8" in length). We also found some dead beetles on the shelves of a few ranges on either side. We inspected the individual books in those ranges as well, but could see no signs of activity. The beetles seemed to have preferred the vellum and leather materials.

Fig. 3 - Dead Adult Beetle

We opened the books to investigate the damage, which was very extensive. According to the purchase slips, this backlog of books was bought mainly from a dealer in Italy in 1976. The two volumes that had been catalogued and placed in the Rare Book Library came from the same shipment. Many had been rebacked and rebound. Some were signed and dated by their binder "1976". Some texts showed previous evidence of an infestation and it is probable that they were infested when they arrived, since they now have exit holes in the new endpapers and vellum coverings.

By inspection we established that the active infestation was in only approximately one hundred books and mainly confined to these two ranges. We decided to treat all of the books in these two ranges.

Fig. 4 - Damaged Pages with Larvae and Frass

Identifying the beetle

Having established the probable extent of the infestation we now had to identify the beetle to discover its life cycle and understand what we had to do to eliminate it. This wasn't as easy as it might seem - about one fifth of all living species are beetles. We contacted the Entomology Department and the Pest Control Department on campus. We had removed two of the worst infested volumes, sealed them in bags and brought them to the Conservation Laboratory. They were there for two weeks.

This proved to be a mistake. Placing an actively infested book in a polyethylene bag will not necessarily contain the beetle. If the beetle is in its emergence phase - that is to say, the phase when the adult beetle emerges from its habitat to mate and/or disperse - it may eat through polyethylene. There is a species in California known as the "lead cable borer" because it will eat through lead.

One can be sure with an infestation this extensive that the beetles will be at all stages of their life cycle. There was only one exit hole and one dead beetle, so the odds are against us having infected the laboratory, but we have set up traps and are monitoring them. So far we have not seen any further activity.

John Doyen, a coleopterist, identified the beetle as Gastrallus Pubens Fairmaire, a member of the anobiid family and a species of the genus Gastrallus. It is similar to a species from Southern Europe, which is consistent with the speculation that the books from the Italian dealer were the cause of the infestation. In 1975 Yale University discovered and subsequently treated a similar infestation. Although Yale's beetle was a species of Gastrallus, it apparently still remains undescribed, so we cannot be sure it is identical to the Gastrallus Pubens Fairmaire.

There is some information on Gastrallus but it concerns their natural habitat or examples of indoor infestations of wood. The beetles naturally occur in dry, dead wood. Apart from the Yale case, not many examples of infestations in books in US libraries have been documented, as the beetle is very rare here. However, as at Yale, the beetles do seem to have favored vellum books. The spines, the corners and the turn-ins were the most affected, probably indicating the places where the most, and the most accessible, food could be found. The heart of the infestation at Yale was also among a backlog of uncatalogued books.

The Beetle's Life Cycle

There are 4 stages in the life cycle common to the anobiid family. They are the egg, larva, pupa and adult stage - in that order. The eggs cannot be detected by the naked eye. The egg stage lasts 1-2 weeks, and the female lays many eggs. The larval stage lasts from a few weeks to several years, depending on the conditions, viz. the availability of food, the humidity and the temperature. Essentially all the damage is done at this larval stage. Early on, however, the larvae, too, are undetectable.

When disturbed, the visible larvae rear up at you from the open pages. The pupal stage lasts 2 - 3 weeks. The larva tunnels to just below the surface and then pupates into the adult beetle. The adult beetle lives a few weeks. They emerge from so-called "exit holes" to mate and disperse. They can return to the same book via these exit holes. They can also mate inside the book.

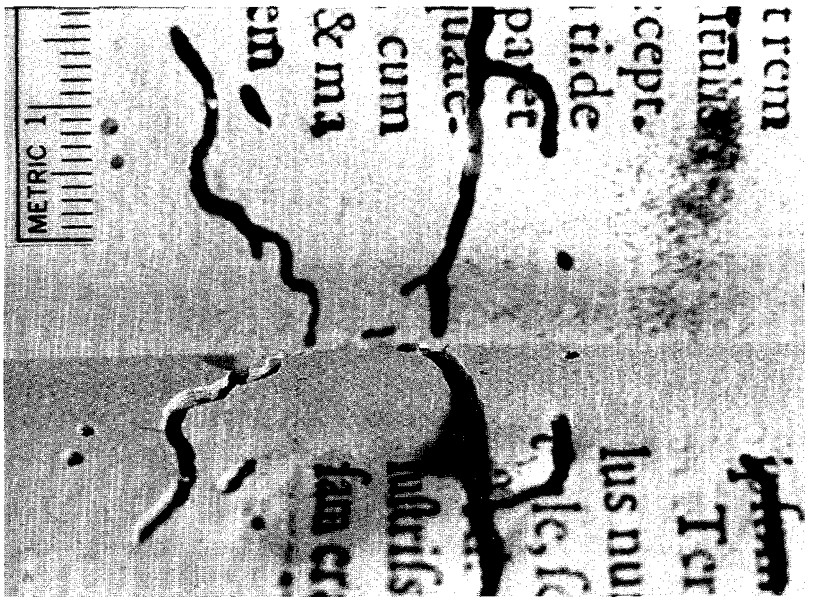

Fig 5. Rearing Larva

Deciding to Blast-Freeze

We were concerned that the method chosen to eradicate the beetles should do no harm to the materials or to the humans, and should be economically feasible. The blast-freezing treatment undertaken by Yale had been non-damaging, non-toxic and, most important, successful in eradicating the beetle.

To emulate Yale seemed the obvious course as the circumstances of the infestations were so similar:

(1) We had a beetle from the same genus
(2) Vellum books were the most affected
(3) It was a cataloguing backlog that had allowed the infestation to gain a hold.

Blast-freezing proved to be economically feasible, indeed, very inexpensive. It was $3.00 per hundredweight, with a minimum charge of $50.00. We had to organize two batches and they worked out at $50.00 for each freeze. The first batch was 65 boxes of 1300 books and the second batch was 18 boxes of 360 books.
There are other systems to consider, based on oxygen deprivation using nitrogen and carbon dioxide, but as far as I know they are not available commercially. In particular, one system using argon was devised by the Chemistry Department at the University of California, Davis, in response to a request from their Conservation Department to fumigate a single volume. This was performed in their own Conservation Laboratory.

If the Rare Book Library should need treatment, in the future, I would like to explore these other systems as I am attracted to the opportunity they offer to treat in situ and on a small scale.

Preparing for Treatment

We decided to concentrate our efforts on the heart of the infestation in Manville and freeze selectively only those two ranges that contained the rare books and the library book truck. Among these books there were no illustrated vellum manuscripts or wooden board bindings, which could be adversely affected by freezing. We inspected the rest of the building as thoroughly as possible, since the length of the building was well within the range of the flight of the beetles. We found no further signs of active infestation; however, we had to omit some of the electric compact shelves which would not open. It must be remembered, however,. that the eggs and the early stages of the growth of the larvae are not visible to the naked eye, so the infestation at this stage would not have been evident.

For the first batch it took six hours for a crew of five to pack the books. We used the Hollinger record storage boxes from our disaster supplies. We hoped they would be recyclable, but due to the decision to store the books in the boxes until we were sure that Manville was clean and the freezing successful, we were forced to replace them.

Because of the compact shelving, the conditions were very cramped. Everyone worked hard, and we rotated the jobs. Unlike Yale we did not bag each book. We cut bubble wrap for laying in the bottom of the acid free boxes.

Fig.6
The polyethylene bags were placed inside the box on top of the bubble wrap.

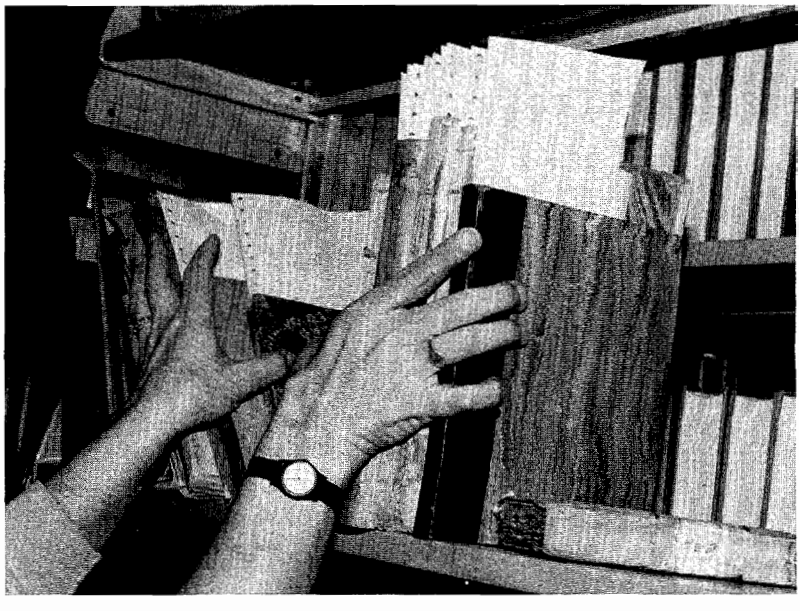

Fig.7
The books were roughly sorted and boxed according to size.

Fig. 8
They were packed into the open bag spine down.

We were lucky that, being uncatalogued, their order was not important. When it was filled the excess air was removed, and the bag closed and tied with a plastic tie. The tops, and when necessary the sides, were filled with bubble wrap to contain the books (as their sizes varied) in order to minimize movement during transit. We wrote the number of items on the outside of the box. They were then placed on a pallet and shrink wrapped. Some of the practical concerns were the security and protection of the books from physical damage in a commercial world where frozen turkey legs are the norm.

Blast Freezing

The freezing action lethal to the beetles is time/temperature dependent, so enough time at the lowest temperature of the freezing procedure is critical. We followed Yale's example of 72 hours at minus 20 degrees Fahrenheit to ensure this. However, contrary to what is generally recommended, we did not use thermo-couples but relied on the commercial freezing company's assurance that their facilities could fulfil these requirements. Blast freezing occurs in large chambers at freezer facilities where powerful fans increase the rate of circulation of cold air to bring down the temperature uniformly and rapidly. The freezing was done over a weekend at the US Cold Storage in Oakland, California.

*Three of the variables to consider when freezing rare books are:

(1) the moisture content - dry books and paper have between 6-10% equilibrium moisture content.
(2) the condensation of water vapor in the air of the bag.
(3) the moisture relationships between the air in the bag and the regain ability of the material.

Even though Manville has no climate control, the Berkeley climate is relatively dry and our books were not wet. Vapor does not freeze at the temperature used to eradicate insects, so the likelihood of condensation inside the bag is negligible. However, a way to minimize the risk is by thawing the frozen materials in the same environment in which they were packed. Some condensation did occur on the outside of the box and the bag served as protection. It was also used to protect from further contamination - not, as you will remember, to contain the infestation - but to prevent it from re-entry, as the boxes were returned to Manville to thaw, where, because of the decision to freeze selectively, there still remained a risk of reinfestation.

Housekeeping and Monitoring

While the books were being frozen we vacuumed and cleaned Manville, the Cataloging Department and the Rare Book Library. We placed traps, supplied by the Pest Management Office, and baited with paste, to monitor for signs of further activity, and set up a system for monitoring by the Law Library staff. Then the books were returned to Manville for thawing. There was a period of three months when everything was put on hold while the decision was made as to how long the books would be best stored in their boxes after thawing, whether they could be stored and, if so, where.

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*(See Mary-Lou E. Florian's article on the freezing process.)

Freezing the Second Batch of Books

In March 1990 we double checked the shelves, including those which we had been unable to check before. We found that range #33 contained catalogued, duplicate volumes bound in vellum and leather. Although the books themselves had no signs of activity, and all the traps were clean, some dead beetles were found on these shelves and to be on the safe side it was decided to freeze this range as well. We followed the same procedure as before, the only difference being that, as the books were catalogued, we had to devise a marking system to enable us to keep them in order.

Cleaning out the books

In April, when both batches had thawed (with the second batch we waited a week), the debris was brushed out. On advice from Yale we waited a few days for the dead blackened larvae to dry out. We only brushed out those books that had signs of infestation, e.g. frass, exit holes and obvious tunnelling to the pages, to make sure the beetles were dead. The books were also inspected for any other damage - they appeared unharmed by the freezing. The bags were turned inside out and the books were repacked. They will be stored in the University's Northern Regional Library Facility until we are sure there is no more activity.

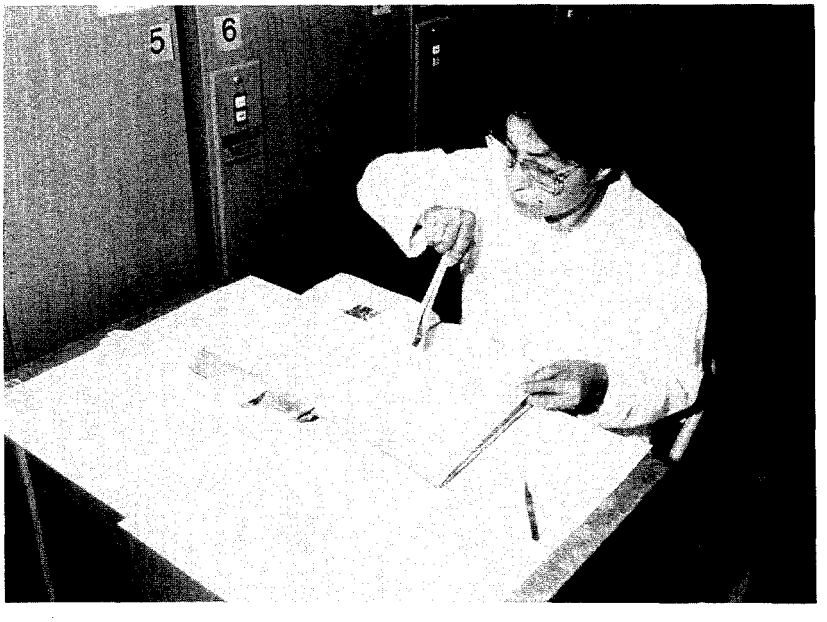

Fig 9 - Brushing out the books

Conclusion

Presuming that no adult beetles are found after a further two years we may be able to declare the operation a success. However, two years may not be long enough, as there is always the possibility that the freezing was not completely successful. Also, no one can advise on the exact length of time the larvae might survive - some species have been documented to live 11 years. If more beetles are found in Manville then the decision to selectively freeze will be repeated; a complete freezing might then become necessary. However, with strict regular monitoring and housekeeping once a month, we hope to be able to contain future infestations.

The moral of the tale is regular collection maintenance: moreover, the less time a cataloguing backlog is allowed to lie undisturbed the better.

Acknowledgements and a Bibliographic Note

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I would like to thank those of my colleagues in Conservation whose advice I sought. In particular, the conservators at Yale for their support and good example. I am also indebted to Mary-Lou E. Florian's article 'The Freezing Process - Effects on Insects and Artifact Materials' in the Leather Conservation News, Fall 1986. v.3, 1.

There is a wealth of literature now available since the Yale example, but in particular I would like to mention these recent publications:

A Guide to Museum Pest Control American Institute of Conservation and the Association of Systematics Collections, 1988.

deCesare, Kymron B.J. 'Safe Nontoxic Pest Control for Books' Abbey Newsletter, Feb. 1990, v.14, 1, p.16.

Valentin, Nieves and Frank Preusser 'Insect Control by Inert Gases in Museums, Archives and Libraries.' - Restaurator 1990, v.11, 1.