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## The Dermestid Method of Cleaning Skeletons

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ABSTRACT: The dermestid beetle method of cleaning skeletons and skulls has been used in the University of Kansas Museum of Birds and Mammals for a number of years. Discussions of the procedure, the requisites of a bug room, the advantages of the method, and suggestions as to the successful utilization of the beetles are given.

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FOR a number of years the University of Kansas Museum of Birds and Mammals has been using dermestid beetles very successfully in cleaning skeletons. The use of these beetles for this purpose was begun in this institution over twenty years ago. At that time the black carpet beetle *Attagenus piceus*, a dermestid, was such a museum pest that a student, Dix Teachenor, working on small bird skulls, attempted to protect his specimens by enclosing them in tin cans. Later Mr. C. D. Bunker, in charge of the University of Kansas Museum of Birds and Mammals, upon opening the beetle-proof containers, found these delicate skulls cleaned and completely intact, and the compartment quite active with dermestids. The skulls which had been so painstakingly enclosed had, unknown to Mr. Teachenor, already been infested with dermestid eggs.

For some time these small dermestids were used by Mr. Bunker for skeleton cleaning, which was done in a specially constructed bug room.

The custom of hanging carcasses out to dry led to the use of the larger dermestid *Dermestes vulpinus*, herein referred to as "bugs," which, enclosed in similar containers, did the work much more quickly.

The University of Kansas Museum is, however, still using the small black carpet beetle for skeletal cleaning which the larger



beetles refuse or fail to accomplish, for although they are much slower, they will eventually clean nearly any specimen

The University of Kansas Museum has had numerous requests for colonies of the larger beetles and for information as to how they should be used. Hall and Russell (1933) have described the technique used at the Museum of Vertebrate Zoölogy, University of California. The methods have been improved and greatly simplified since that time.

It is a very simple matter to acquire a colony of dermestids. Anyone who has ever disturbed an animal carcass has seen these brownish-grey beetles with their floury abdomens and the prickly brown larvae scurrying out of the light. They can be found in large numbers under any old carcass that may be seen out in the open, or from a carcass that has been hung out to dry for several days.

The room in which these bugs are housed need not be very elaborate, but there are a number of requisites to be kept in mind when it is built. The beetles will migrate during the spring months and the collections of skins of the museum should be in a separate building. The size depends upon the number of specimens that it is intended to hold. At the University of Kansas Museum we have a room about fifteen by thirty feet. The room should be insect proof as nearly as possible. The walls, floor, and ceiling should be plastered smoothly so that spiders and cockroaches can be kept at a minimum.

In our bug room the windows are small and screened with fine copper mesh. They are tightly sealed during the winter, but may be opened in the summer to regulate the temperature when the preparator is working in the room.

Shelving can be of anything, but preferably of soft pine or steel. If constructed of soft pine, it will have to be replaced every five or six years because the larvae will bore their way into the wood to pupate and weaken the structure. The room should be absolutely dark at all times, as the beetles will not do their best in the light. The temperature need not be kept absolutely constant. In the winter, we have several steam pipes that furnish the heat. All that is necessary is to keep the room warm.

We have found that a hail-screen cage on a steel-top table is a very useful receptacle for specimens when they are first brought in from the drying line. The purpose of the hail-screen cage is to keep out cockroaches and animals such as mice which sometimes get into the bug room in spite of all precautions.



The animals that are to be cleaned should be drawn and all the feathers, hair, and skin removed. It is a good practice to remove the tough calluses from the feet in the larger birds because the bugs will seldom be able to clean them up after the cartilage and skin has hardened. Special care should be taken to remove the primaries and other feathers from the tips of the wings.

Material which is left uncleaned by the bugs will have to be subjected to a tedious process of boiling and scraping, which in the case of small specimens is almost certain to destroy delicate structures.

In warm weather it is necessary to do some defleshing. Large specimens should have most of the muscular and fatty tissue removed from the fleshy parts of the body.

It is well to disarticulate large specimens before they are hung up to dry so that they will not be bulky and hard to handle. The tongue and hyoid apparatus of large mammals should be removed and the hyoid apparatus dried separately. All skeletal material should be prepared so that air can circulate freely about it. Slits should be made between the ribs of large animals. Flies deposit eggs in small pockets that are not exposed to the air and specimens that have been infested with maggots are not cleaned up so well by the bugs.

After the animals have been drawn and prepared for skeletonization they should be hung up some place in the open where they can dry rather rapidly. In the case of the larger birds, it is advisable to tie the wings against the body and then with a half hitch of the same cord around the neck hang the carcass out to dry.

When the carcasses are dried so that a hard coat is formed over the flesh, they are brought into the bug room and placed inside the cage on the steel table.

Within a few days after the carcasses have been placed in the bug room they are ready to be put away in boxes. The eggs that have been laid on the carcass after it was placed in the bug room and those that had been laid on it while drying will have been hatched and the resulting larvae will begin to eat the flesh. Whenever the small particles of bug droppings appear on the carcass it is ready to be put into boxes.

These are double boxes made of corrugated straw board just large enough to contain the carcass. There are several advantages of the corrugated boxes over steel or wooden boxes. The small corrugations serve as places for the larvae to pupate so that the entire life history of the beetle take place within the same container



The boxes are cheap and can be replaced every few years. They are tight-fitting and thus help to control spiders, and they are substantial enough to be stacked.

If the skeletons are small ones they need not remain in boxes very long. A mouse or small bird will be cleaned in one or two days. Large skeletons will require a corresponding length of time. Unless we are in immediate need of the skeletons we leave them all until fall.

In the late fall the final cleaning begins. By that time the weather is cool enough so that the preparator is not annoyed by "bug dust," which is composed of the spiny larval bristles. The combination of minute spines and the preparator's perspiration produces very unpleasant effects.

The contents of each box are emptied upon a large square of black paper. With a pair of forceps, when necessary, the worker sorts over the material, picking out the bones which are then dusted and placed in specimen boxes.

The presence of fat often creates a definite problem. Long bones may contain considerable fat. If much of it is present in any place it will be spread over the entire skeleton by the bugs. Such skeletons as those of hawks and ducks will often come out covered with grease. It is a good procedure to remove as much fat as possible from the carcass to prevent its occurrence on the bones.

A twenty-eight percent solution of ammonia water serves as an adequate and efficient method of degreasing the skeletons. Immerse the bones and leave them for twenty-four hours. Remove the bones and place them in water for another day and then place them in the sun until they are thoroughly dry. The sun will bleach the bones slightly during the drying.

If skeletons of large mammals are desired for mounting purposes it is suggested that small holes be bored in each end of the long bones and the fatty contents be forced out with the aid of steam and air pressure.

Skull cleaning is a problem in itself. Mr. A. E. Borell (1938) suggests the use of small metal containers into which the skull is placed with a number of larvae. It is during the larval stage that the bugs do their most rapid and effective work. However, if there is no immediate need for the skull it may be left on the skeleton and will in time be cleaned up by the bugs. For best results the skulls should be put in the bug room as soon as they are obtained except that the larger ones will have to be dried enough so that they will not become covered with mildew.



The dermestid method has many advantages over the maceration method or boiling. The ease with which cleaning is accomplished is a great advantage. The only limit to the number that can be cleaned is the number that can be obtained. One preparator doing part-time work can clean thousands of skeletons in one year's time.

But even more important for research is the fact that the skeletons come out intact with sutures in place and soft bones undissolved. No ligaments are weakened to the extent of losing minute bones. Hyoid apparatus, zygomatics, lacrymals, auditory bullae, phalanges, and other elements are certain to be retained.

A striking example of the efficiency of the dermestid method is presented by a small ring-neck snake. It would be nearly impossible to clean such a specimen with its scores of tiny curved ribs and its minute vertebrae. But a few hours in the bug room will provide a perfect skeleton, clean and white as a pearl, with every tiny rib firmly in its own place.

While a few preparators have stated that they attributed the loss of certain small bones to the workings of the bugs, we have never found it to be true in this museum. It was only by dermestid method that I was able to discover the wide prevalence of the os opticus of the bird's eye.

In other methods of preparing skeletons large animals present great difficulty in the cleaning problem, but in the dermestid method size is no handicap. It is just as easy to clean a moose as it is to clean a mouse.

If the bug room contains large and active colonies of dermestids, skeletons such as those of small birds, bats, and mice need not be hung out to dry before being put in the bug room. Forty-eight hours after they have been placed in the hail-screen cage they will be stripped clean.

There are probably a number of reasons why the dermestid method has been so successful in the University of Kansas Museum. The prime requisite for the dermestid method is, of course, a large supply of bugs. And to have a large and constant supply of bugs there must be an adequate food supply. If necessary, carcasses of common animals must be put in the bug room to feed the beetles. At the present time the bug room in the University of Kansas Museum is literally alive with bugs, and the peculiar noise of their activity is never hushed.

Flesh should not be removed from small skeletons and skulls, as there must be sufficient food material for the bugs to become established.



We have found that papier-maché bricks are the most successful provision for pupation of bugs not in individual boxes. These bricks may be placed around about the room, on the floor, in the cages, or on the shelving.

The worst pests of the bug room are the spiders and cockroaches. We take as many precautions as possible to prevent these pests from getting into the bug room. In spite of all our efforts, however, they do manage to get in. Because of this we have found it expedient to clean the bug room every few years, destroying all old boxes and fumigating thoroughly with sulfur. In a few months, as I have already suggested, we will again have a large working colony.

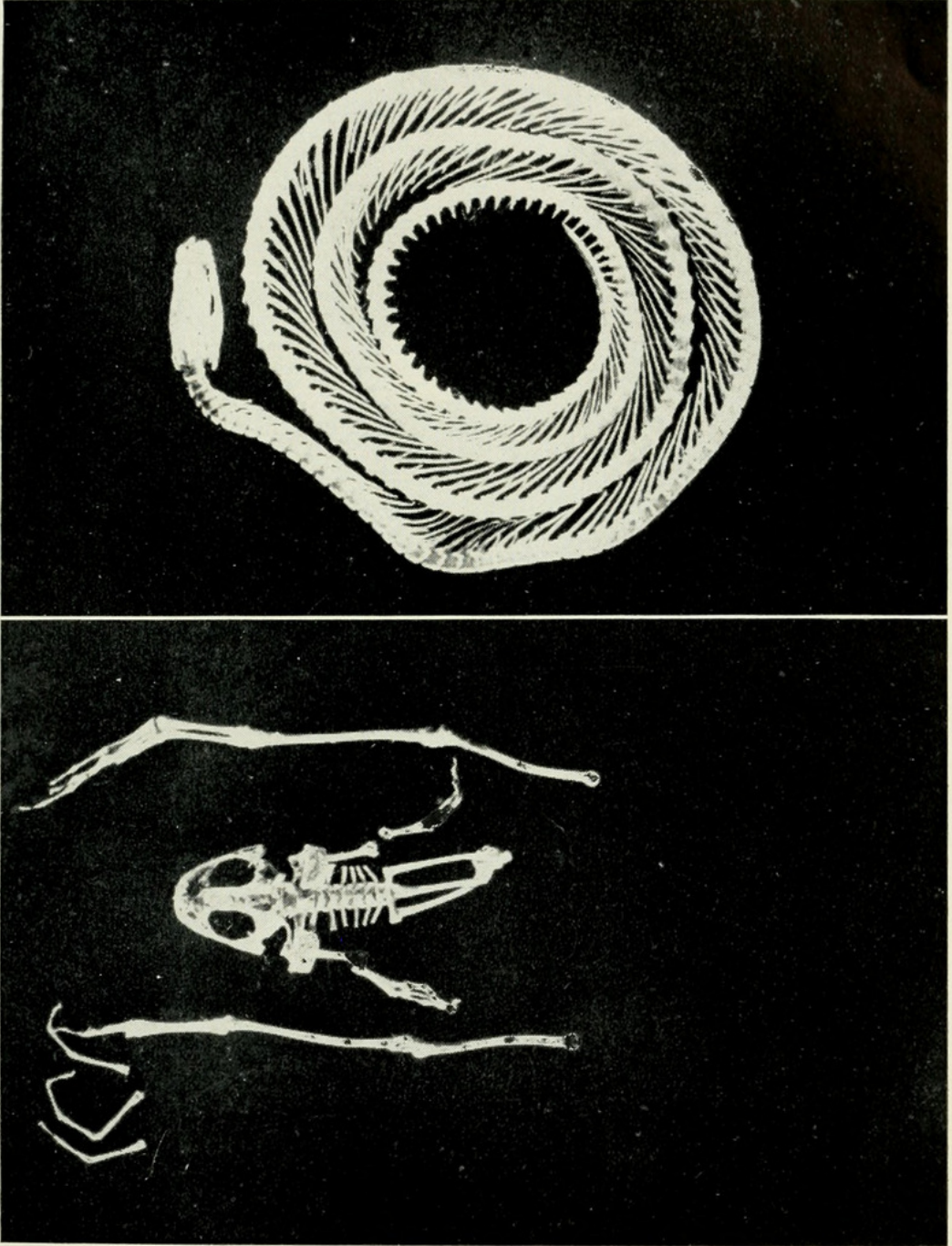
The final requisite for good bug work is absolute darkness. They are naturally found either under a carcass or excavating beneath the dried surface. This should be kept in mind in order to obtain clean skeletons.

I wish to acknowledge my indebtedness to Mr. C. D. Bunker, of the University of Kansas Museum of Birds and Mammals, under whose direction and supervision this method of cleaning skeletons has been developed.

#### REFERENCES

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PLATE XLII



Upper. *Diadophis punctatus arnyi*. K. U. 21232.

Lower. *Acris gryllus*. K. U. 21238.





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