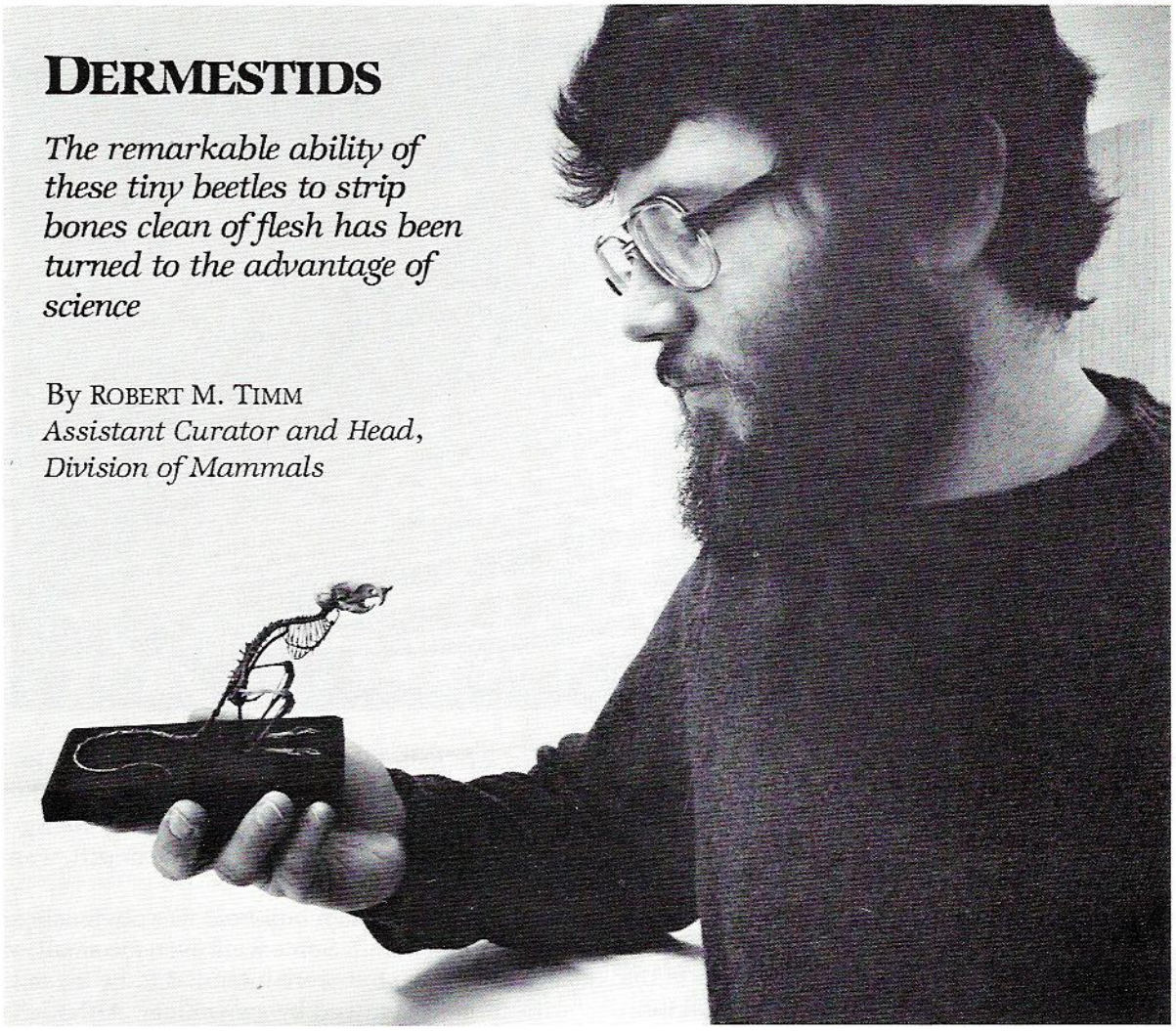
DERMESTIDS

The remarkable ability of these tiny beetles to strip bones clean of flesh has been turned to the advantage of science

By ROBERT M. TIMM
Assistant Curator and Head, Division of Mammals



D. Walsten

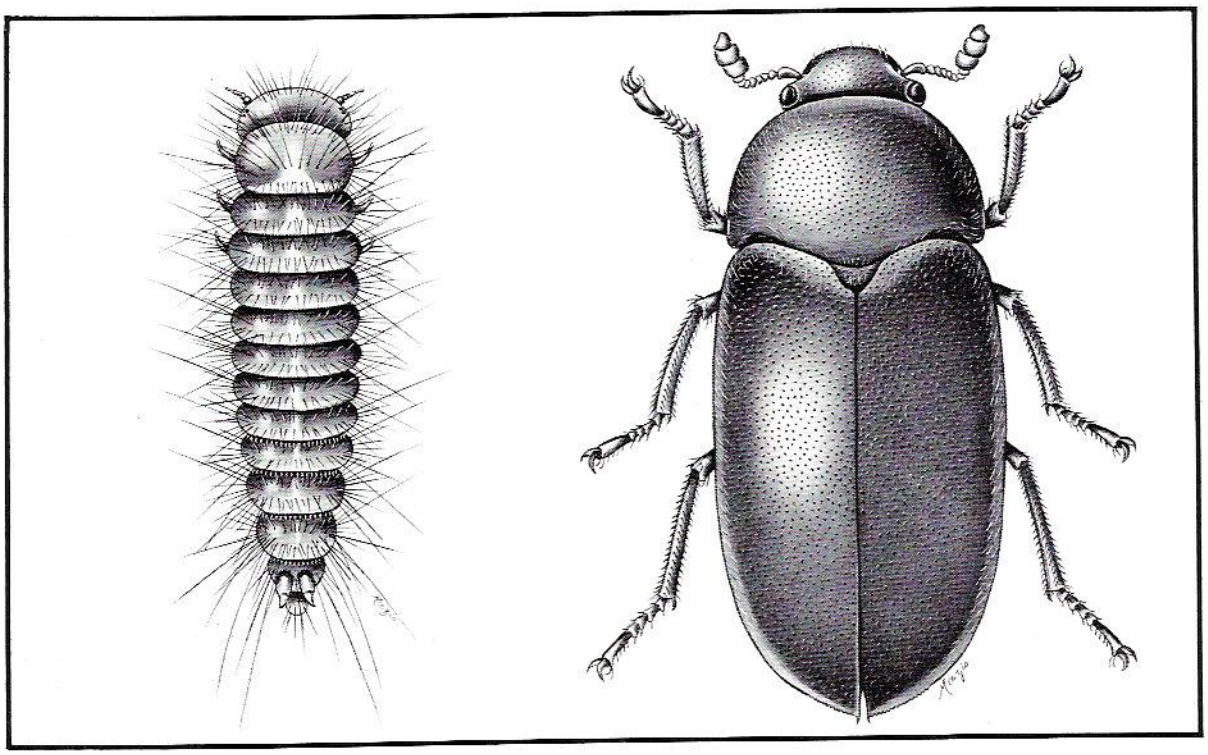
Author Robert Timm with mounted skeleton of kangaroo rat that had been cleaned by feeding dermestid beetles.

Curiously, the busiest room at Field Museum is one of the least known. It houses thousands of workers who go uncomplainingly about their task 24 hours a day, seven days a week, 52 weeks out of the year. The name of this room, tucked away on the third floor, is "the Bug Room"—a matter of irony, since it's located in the Division of Mammals, not in Insects.

The solution to this seeming conundrum is simplicity itself: In the Bug Room are cages of various sizes, each containing hundreds or thousands of matchhead-size beetles of the species *Dermestes maculatus,* all gnawing happily away at the carcasses of dead animals. In return for the free meal, these carrion eaters are performing an invaluable service to the Museum and to science: they are able to clean an animal skeleton of its flesh more efficiently than any other way—chemical or biological—known to science. Given the time and the right conditions, such as humidity and temperature, an army of dermestids can reduce the body of a shrew, a dog, or a horse (even, theoretically, a whale!) to a gleaming skeleton, still articulated (*i.e.,* with its bones still properly interconnected). Muscles and fat are all grist for the dermestids' gastronomic mill—leaving the bone, eschewed as it were, rather than chewed.

Since science first recognized the animal skeleton as something to be preserved and studied in a systematic fashion, scientists have looked for ways of cleaning from the bones the extraneous tissues that surround them in life. In former times, the carcass was simply soaked in water until the bacterial action broke down the soft tissues; then began the tedious manual process of picking and scraping off the remaining bits of tissue. Not only was this tiring and time-consuming, the results were never satisfactory. If the bacterial decomposition went on too long, the bones became disarticulated and teeth fell out. Too little soaking meant that extra time was needed for the hand-cleaning stage, and tendons and ligaments usually required more attention. The end result was poorly cleaned, piecemeal material.

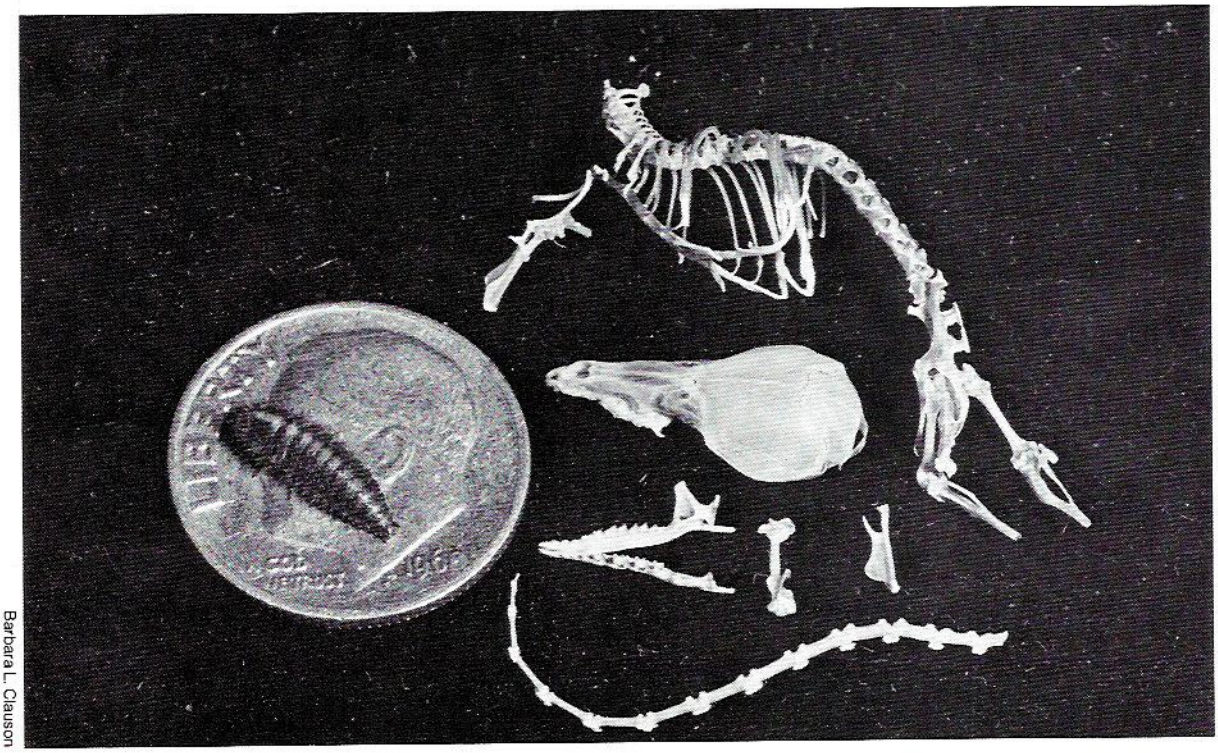
So zoologists were constantly on the lookout for a better method, and they experimented with ants, clothes moth larvae, mealworms,



Dermestes maculatus *(larva left, adult right), sometimes called the leather beetle, is the dermestid species used for cleaning skeletons at Field Museum. Larvae grow to slightly more than ½ inch long, adults are somewhat smaller. Drawings by Rosanne Miezio.*

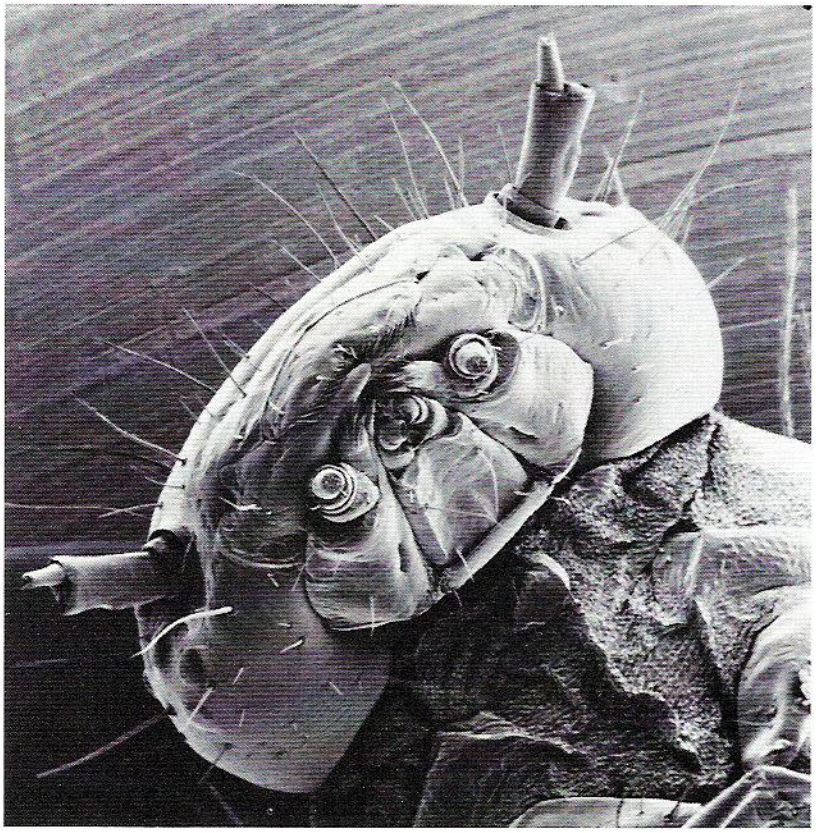
crawfish, marine isopods and other biological methods—to say nothing of corrosive chemicals. All had serious drawbacks. Then, in the 1870s, in France, dermestid beetles were tried, and they came through with winning colors. About sixty years ago dermestids came into use in American museums, and today colonies of these beetles are standard equipment wherever larger collections of vertebrate skeletons are maintained.

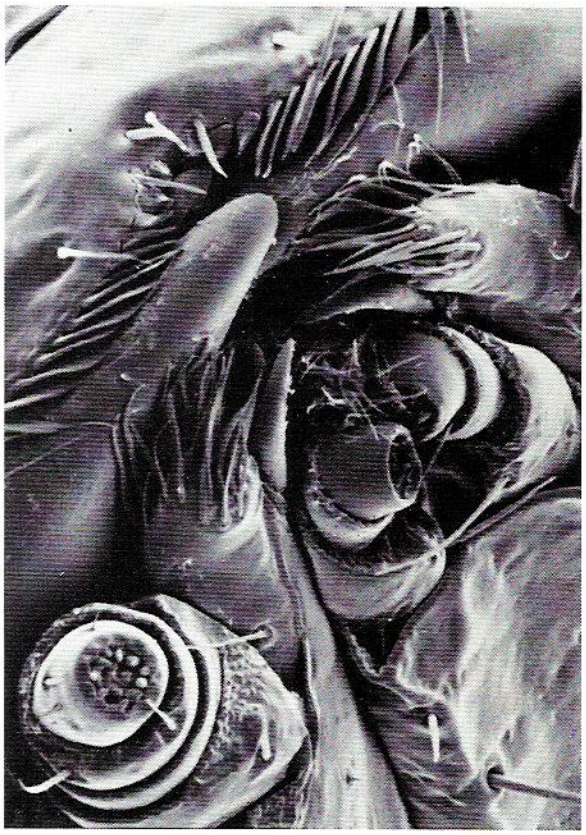
Dermestid beetles, which constitute the family Dermestidae, are worldwide in distribution, with about 700 known species—125 in the United States and 25 in Illinois. About 50 have reputations as pests of stored animal and plant products, consuming everything from Jello to rugs to wool sweaters to butterfly collections. Of these dermestids, a few have proven useful to scientists as bone cleaners; some don't adapt well to colonization, however (whole skeletons are cleaned efficiently only with self-perpetuating "colonies" of hundreds or thousands of in-



Barbara L. Clauson

U.S. dime shows relative size of beetle grub and tiny, partially disarticulated shrew skeleton, cleaned by the beetles.



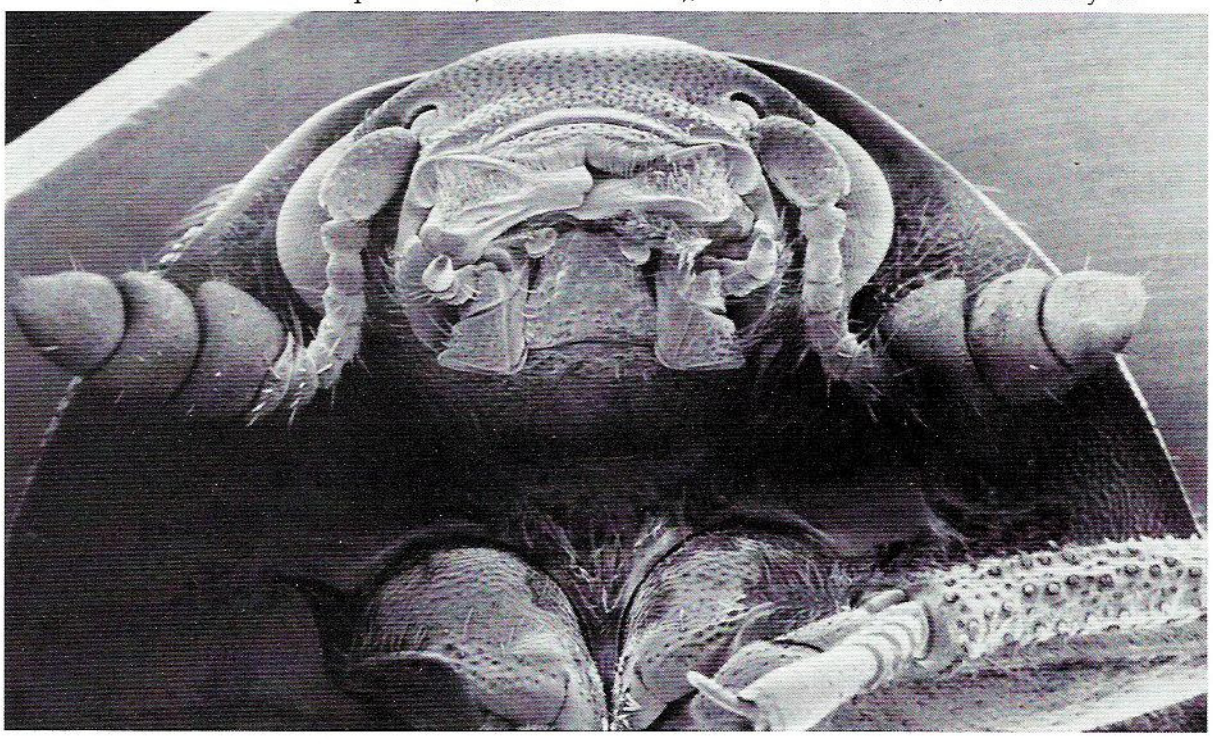


Scanning electron microscope photos of D. maculatus: *(above, left) head of first instar, or growth phase, of larva magnified 125 times; (above, right) head of first larval instar X520; (opposite page, top left) urticating, or irritant, hairs that cover the grub's body X690; (this page, below) head of adult X33. Photos by Robert Timm.*

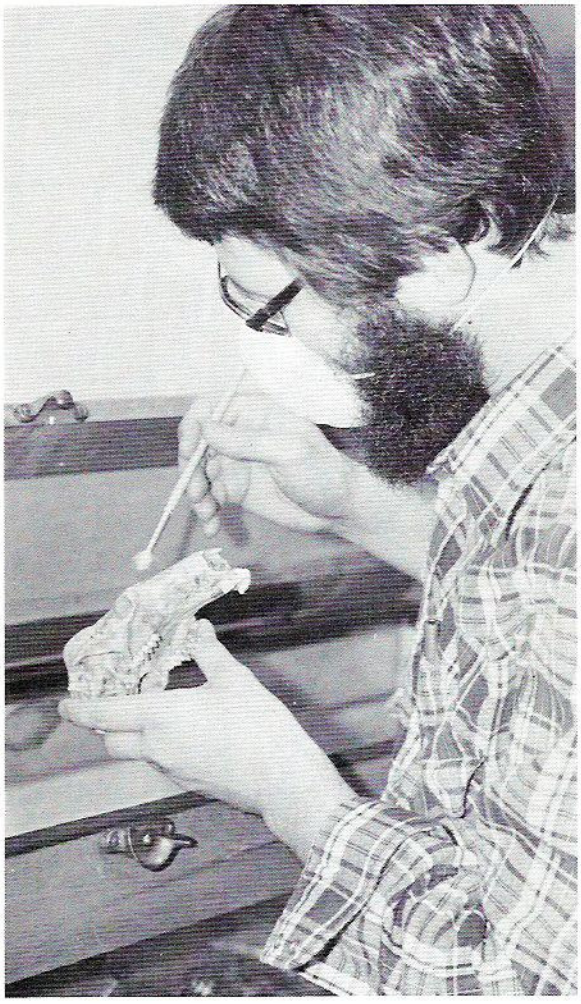
dividuals); others are not efficient enough in cleaning up soft tissues or are too rough with the bony parts.

Dermestes maculatus, the dermestid species we use at Field Museum, is commonly known as the leather beetle, because of its special fondness for leather and fur. (Before effective insecticides were developed it was a serious pest in industries that dealt in these products.) When properly cared for, *D. maculatus* is highly prolific; a female may lay 500 or more eggs; these eggs hatch two to ten days later into grubs, which grow to adulthood in six to nine weeks. The larval period may be protracted for years if the temperature and humidity are not optimal and food is scant.

The newly hatched larvae, 1mm long (1/25 inch), are voracious eaters, and an army of

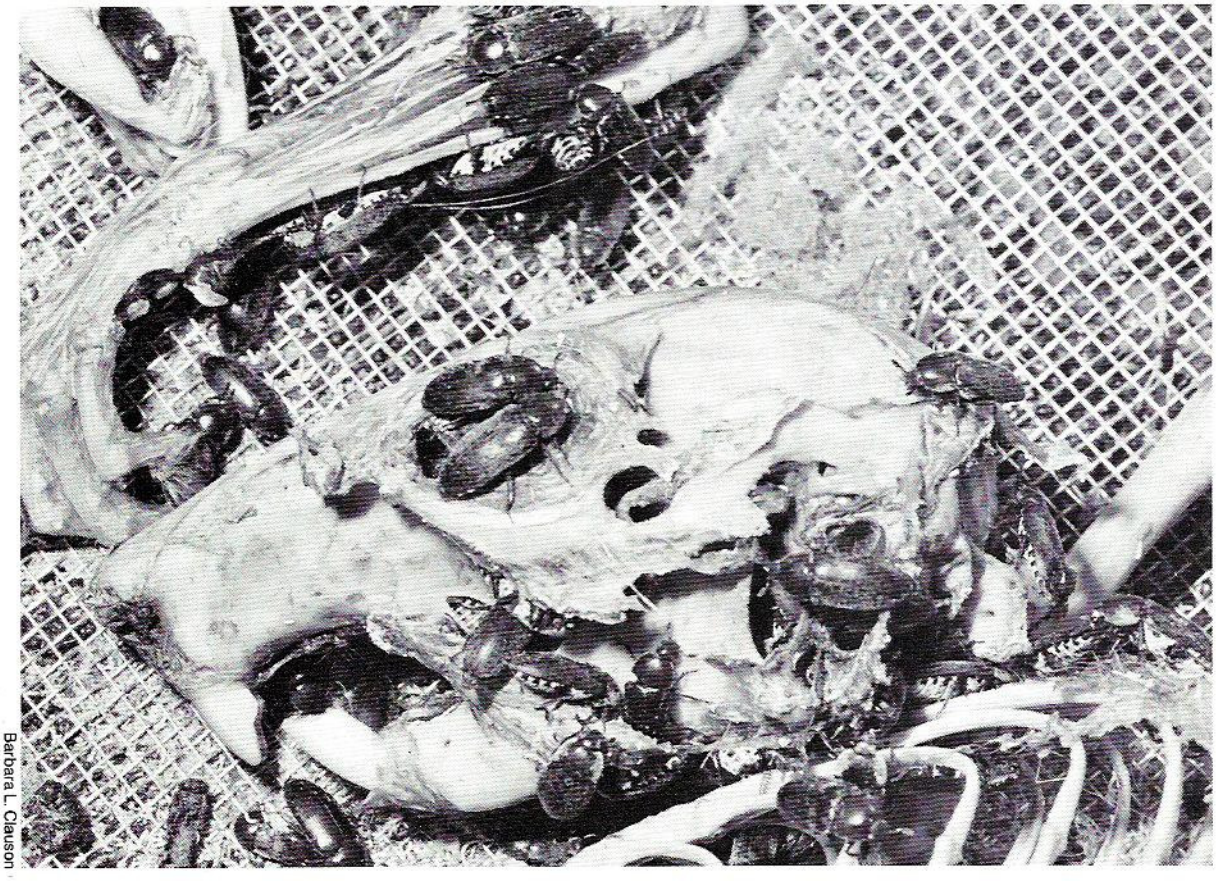


grubs can reduce a shrew, or mole, or bat to a skeleton overnight; a horse may take a few weeks. The larvae molt six or seven times, and when fully grown at 15mm are ready to pupate. When this time comes, they bore into whatever



Barbara L. Clauson

Timm brushes beetles from cleaned kangaroo head. Surgical mask prevents inhalation of dust-size particles of dried beetle exoskeleton, larva setae (hairs), and excreta that pervade air of Bug Room. Prolonged exposure may result in allergic reaction.



Barbara L. Clauson

Dermestid adults and larvae at work on squirrel head.

D. Walsten

Timm in Bug Room with largest of several dermestid colony cages. The cage lids as well as the double doors to the Bug Room are precision sealed.

material is at hand, finding a snug, isolated spot to lie dormant for 7 to 14 days. One of the extraordinary facts about the dermestid is the ability of this pupating grub to bore through the hardest material—even through the mortar and stonework of walls; lead pipes, cables, and electrical fuses have proven notably vulnerable to them. Hakluyt's *Travels* records that in 1593 a ship carrying a cargo of dead penguins was made unseaworthy by the hundreds of thousands of tunnels bored into the wooden hull by pupating dermestid larvae (after feeding on the penguins).

Cleaning the bones with dermestids is both good husbandry and an art; it is not simply a matter of throwing the bones to the bugs. Before being placed in a beetle colony, the animal's body is skinned, eviscerated, and the larger muscle masses removed. The beetles prefer to feed on tissue that is well dried—but not too dry. Temperature and humidity control are also critical, and the beetles are extremely sensitive to mold and mites; either can wipe out a colony overnight. At the Field Museum we use dermestids not only for cleaning the skeletons of mammals, but also those of birds, reptiles, amphibians, and fish—dried fish seems to be their favorite.

But we must pay the price for this wonderful talent: since dermestids will nibble on just about anything that is dead (including Egyptian mummies), natural history museums must take special care that their dermestid guests are housed in carefully sealed quarters. The Bug Room has a double set of tightly fitting doors and each colony container (commonly a tropical fish aquarium a few cubic feet in volume) has a dermestid-proof lid.

The beetles also pose a unique health problem for technicians who must work with them. Persons exposed to the room's air over a period of time may develop a host of disagreeable symptoms that are an allergic reaction to substances in the beetle's system: itching of the skin, hives, irritation of the eyes and respiratory passages, cold sweat, weakness, fever, headache, and nausea are all part of the syndrome. An allergic person who is overexposed to the room's atmosphere may even go into serious anaphylactic shock of the sort that can befall a bee-sting victim.

The allergic reaction is the result of breathing microscopic particles of dead beetle exoskeletons, molted grub skins with their fuzz of irritant hairs, and excreta—all floating in the air as a fine, impalpable dust. The only protection against this insidious hazard is to wear a surgical mask.

What good are all these old bones? Does anyone ever look at them? The answer is a resounding YES. In the past year, the mammal collection received some 800 visitor-days of use by professionals (in addition to that by our own staff), and we sent out almost 100 loans of specimens to scientists at other institutions. The loan and visitor use of the Field Museum collection is one of the busiest such arrangements in the scientific world. During this 12-month period, scientists in 28 states and 11 foreign countries made use of it—including mammalogists, anatomists, archaeologists, paleontologists, anthropologists, and veterinarians. In recent years, an annual average of more than 40 published technical papers and scholarly books have involved research based on the study of our specimens—many of which had been beautifully "prepared" by the remarkable dermestids. Once looked upon as just a pest, *Dermestes maculatus* has risen to become a valued tool in the pursuit of scientific knowledge. □