

Fear No Weevil

by Douglas L. Smith

Millikan, Hale, and Noyes kept Caltech small deliberately, in order to promote intellectual cross-pollination between disciplines, but even they probably didn't expect a hybridization of physics and library science. Yet that's what happened in the drive to eradicate bookworms from Caltech's Rare Book Collection. The collection—some 1,200 books—is, in the words of Institute Archivist Judith Goodstein, “one of Caltech's crown jewels. It has the books written by the people who made the first scientific revolution, starting with Copernicus, going through Kepler and Galileo, and ending with Newton. All original editions. The collection also includes all of their important contemporaries, Descartes and others, who wrote pro-Copernicus or anti-Copernicus; pro-Galileo or anti-Galileo; pro-Newton or anti-Newton. It's a rich cultural history of science. Remember that Newton said, 'If I have seen farther... it is by standing upon the shoulders of giants.' Here are the giants' shoulders—the literary shoulders.” The collection's heart is some 200 books bought in 1955 from Count Giampaolo Rocco of Bologna, Italy, an avid collector of early astronomical works. The purchase was arranged by then-dean Earnest C. Watson, of Watson Lecture Series fame, using money provided by Caltech Trustee Harry Bauer. To this were added hundreds of books from Watson's own collection, and others that the library already owned.

Believe it or not, until recently the latter had been sitting out on the open shelves, with call numbers tattooed on their spines, just like ordinary library books. Such rarities as the *Arithmeti-*

corum of Diophantus of Alexandria, printed in 1621 in Greek with a Latin translation in parallel columns, were available for any undergraduate so inclined to check out. (A cursory glance at the blank “Date Due” slip glued inside the front cover showed that none had.) “Millikan bought that one in the twenties, when Throop became Caltech,” Goodstein explains. “They had to build up a library, and it says something about the people that they bought deeply. They didn't just buy the standard texts; they obviously felt it was important to buy this too.” *Arithmeticonum* is the work from which Kepler learned the theory of conic sections that enabled him to deduce the true orbits of the planets—and his three laws of planetary motion—from the observations of Tycho Brahe. And although no earnest Darb ever took advantage of the opportunity to read Diophantus in the original Greek, or even the Latin translation, the point is that one could have. (The late Nobel laureate Max Delbrück *did* check it out twice, after it was moved to the Rare Books Collection.)

But if no Scurve or Lloydie ever had a taste for Diophantus, something else did. Bookworms had burrowed through its spine, a fact discovered last May when the collection was finally put in call-number order in the Archives' new home in the subbasement of the Beckman Institute. Since every volume was being picked up and handled individually anyway, it was an ideal time to take stock of the stock, as it were, and see which books needed pages repaired, or spines rebound, or other attention. One of the things that turned out to need attention was insect damage.

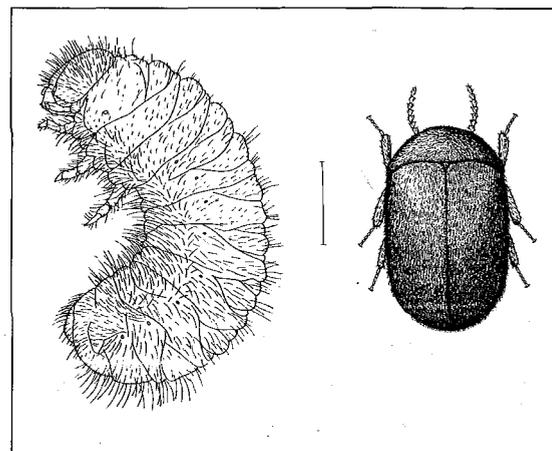
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Like any good university, these hallowed hardbacks provide room and board, as well as a sheltered environment in which the larvae may develop their full potential. The ancient glue, a collagenous distillate of horses' hides, pig snouts, and other dainties, is their staple diet, while the rice paper used to repair torn pages makes a tempting dessert.

Caltech has its share of bipedal bookworms, to be sure, but the ones that haunt the Rare Book Room are even more secretive than the most reclusive Mole. "You won't see bugs running around on the shelves," says Associate Archivist Shelley Erwin. "They're way too clever for that." The bookworms, which are actually the larvae of any number of species of beetles and moths, live unseen in the binding. Like any good university, these hallowed hardbacks provide room and board, as well as a sheltered environment in which the larvae may develop their full potential. The ancient glue, a collagenous distillate of horses' hides, pig snouts, and other dainties, is their staple diet, while the rice paper used to repair torn pages makes a tempting dessert. And in the fullness of time—a month or two—they pupate. The adults, an inerudite lot, have no interest in books and fly off to parts unknown, returning only to lay their eggs. But like bored students carving their initials in the desks of lecture halls, these boring bugs leave their own signature. An exit hole in the binding marks where a graduating beetle forsook academia for the Real World. Often the only sign of their passage is a pinch of cinnamon-hued dust that trickles out of the binding the first time the book is opened. And occasionally one finds their homework assignments on interior pages: some species are dilettantes, randomly chewing crescent moons the size of rice grains, while others are serious scholars, leaving tunnels that may penetrate the volume from flyleaf to appendix.

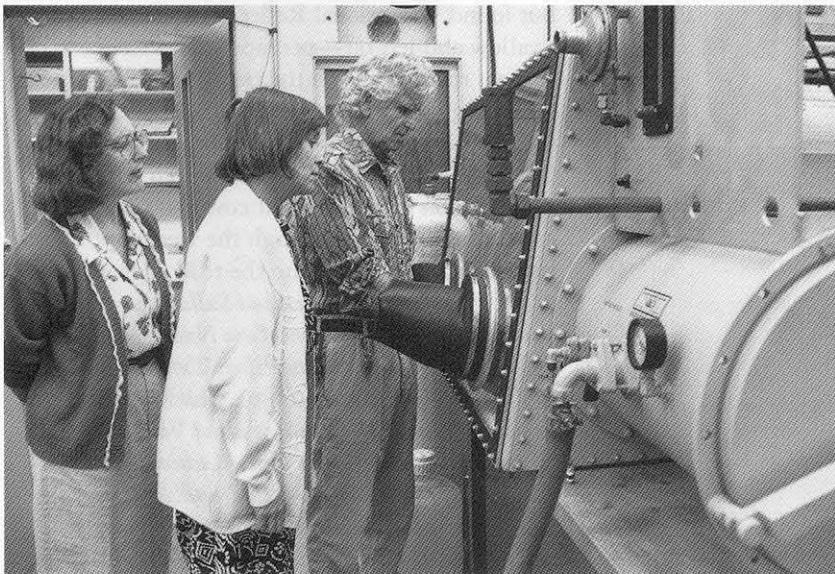
"We saw evidence of these two kinds of eating in a number of books," Erwin recalls. "Enough

The perp: *Lasioderma serricorne*, a.k.a. the cigarette beetle. The larva is on the left side; the adult is on the right. The bar between them is one millimeter long. The larvae are white; the adults, reddish brown. Both are covered with fine hairs.



that we decided to call in an expert." James Harmon, R.P.E. (Registered Professional Entomologist), came highly recommended by the rare-book people at UCLA. "He looked at the books that we thought had bugs in them, and got very excited and oohed and ahed over these wonderful carcasses that he was able to find. He didn't find anything alive." What Harmon found were tawny, slightly fuzzy husks, about an eighth of an inch long—the mortal remains of both larval and adult cigarette beetles, *Lasioderma serricorne*. Says Harmon, "These guys are a very common household pest, first identified in cigarettes and loose tobacco. They're kissing cousins to the carpet beetle. I looked at about 20 books, all of which had some type of damage, but only a couple of them had any signs of recent infestation." All the recent damage was attributable to cigarette-beetle larvae, based on the nature of the damage as well as the corpses of the perpetrators. (The damage to all the other books Harmon inspected was older, accumulated under previous owners.)

What to do? A few years ago, the li'l vandals would have been dispatched with methyl bromide, a fumigant. But that's expensive nowadays, and only one company in southern California still has a fumigation chamber. Alternatively, says Harmon, "You could leave the books in a house that's to be tented for termites and kill two bugs with one stone, but I wouldn't recommend it, and archivists tend to be reluctant to do this." And in any case, methyl bromide damages leather and rubber. Deep freezing, often done with newer, less valuable books, was out, too. "It's quite



Another book checks in to the roach motel. Asplund (right) makes the guest comfy inside the glove box as Goodstein (center) and Erwin (left) look on with proprietary interest.

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tricky. Unless you’re an expert, it’s very easy to damage the books.” Any moisture in the book becomes ice crystals that can ruin the binding. Clearly, a kinder, gentler killing method was needed. Harmon recommended asphyxiation, specifically via liquid nitrogen, which would instantly evaporate and eventually suffocate the bugs.

“He told us to seal the books in a plastic bag with masking tape, and then fill it with liquid nitrogen through a straw. This is not trivial for twelve hundred books,” says Goodstein. Fortunately, when the idea of freezing books came up, she had immediately thought to enlist the aid of her husband, David, professor of physics and applied physics, on the grounds that his academic specialty—a field formerly known as low-temperature physics—amply qualified him to freeze books. “I said to David, ‘Could we do this in our own freezer at home?’ and he just looked at me.” But he knew who to turn to: Nils Asplund, research engineer for condensed-matter physics—the expert on vacuum systems who builds experimental apparatus for Goodstein’s, Assistant Professor of Physics Nai-Chang Yeh’s, and Associate Professor of Physics Michael Roukes’s research groups. Although Goodstein didn’t know it, Asplund is rather an amateur entomologist himself, a hobby he picked up through fishing, by tying flies.

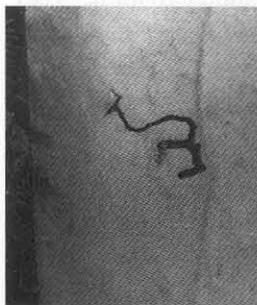
“David called me into his office and said, ‘Boy, have I got a job for you,’” Asplund remembers. “‘Kill bugs.’ And I said, ‘Yeah, I can do that, probably, without destroying the book, I hope.’ Not being a chemist, I would have just used a

hammer on them, but this wouldn’t have been good for the book. You can beat hell out of the book and never dislodge the bugs. I once killed a bunch of bugs in feathers by putting them in a Ziploc bag with some crushed mothballs. I could have done that here, but it would have stunk up the library. They didn’t go for it. They suggested liquid nitrogen, but I was afraid it would break down the paper fibers.” As it happened, Asplund had a spare glove box—an airtight chamber in which oxygen-sensitive chemicals are handled—sitting around in his workshop off the loading dock behind Sloan Laboratory. The box, which he purged with nitrogen for half a day before getting started, was big enough to accommodate one folio-sized book or two quartos. He built a stand of heavy-duty plastic on which the books could be propped open, placed the books in the box, and pumped it down to a 25-micron vacuum before refilling the box with the nitrogen that came conveniently to hand out of the pressure-relief vent line from the LN₂ tank next to the dock. However, nitrogen straight from the tank contains traces of water vapor.

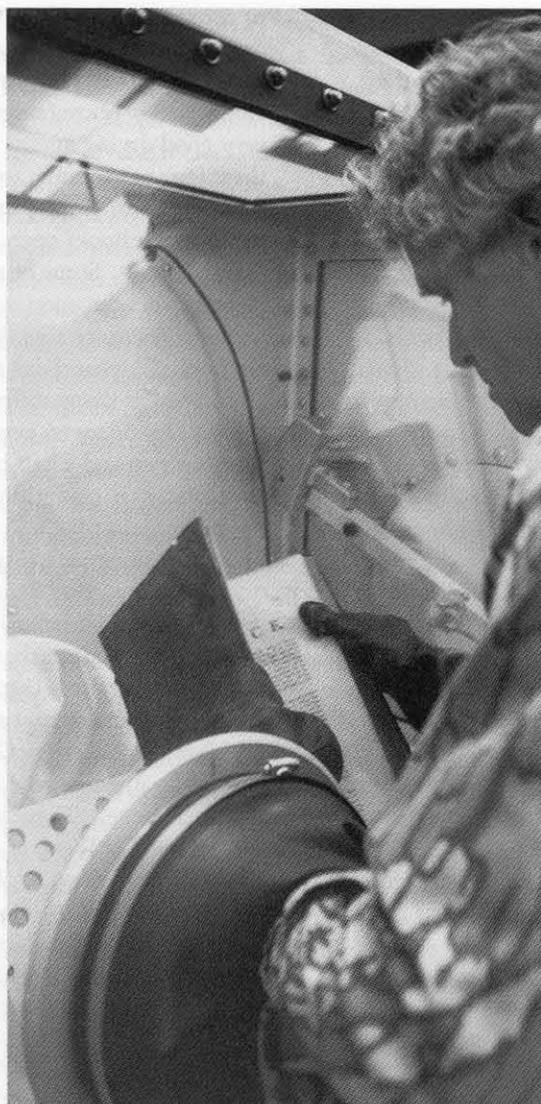
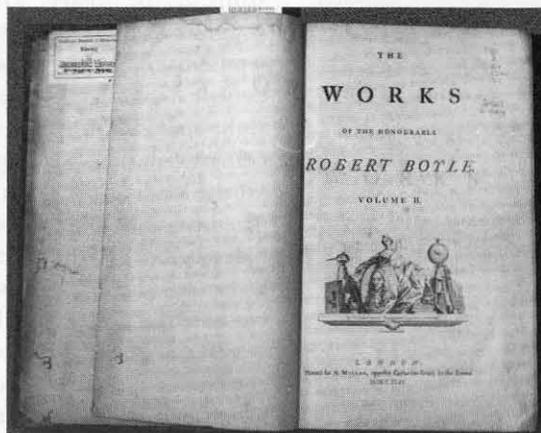
“I wanted to dry the nitrogen, so I ran it through a desiccant—phosphorus pentoxide, which is a very good drying agent. I’d leave the books in there four to six hours to make sure, and every so often, I’d turn the pages. I was thinking about hanging the books open, but I was afraid of ripping the glue. Some of them are quite fragile.” Some insects can survive in an oxygen-free environment for quite a while, so before starting on the books, Asplund did some endurance tests. “I grabbed as many different sample bugs as I could. Dry nitrogen generally killed everything in about two and a half hours. Actually, a roach lasts longer than anything, but they don’t attack books.”

For the most part, Asplund was hunting an unseen enemy. But *Arithmeticonum* (the oldest book treated) yielded up a live one. “I did see a weevil come out of the binding. And no, he wasn’t clutching his throat and gasping.”

Rather than attempting to treat the entire 1,200-book collection, Goodstein and Erwin decided to just treat the 15 or so books with visible damage. These included volumes two and four of *The Works of the Honourable Robert Boyle in Five Volumes, to Which is Prefixed the Life of the Author* (1744)—Boyle being a countryman and contemporary of Newton and the father of modern chemistry. Volume four had only suffered a spinal injury, but volume two had been devoured from the front endpaper and flyleaf straight on through the “Experimental History of Colours,” and “Some Considerations Touching



Upper right: Boyle's Works, Volume II. Note the call number penciled on the title page, and the Engineering Library sticker on the inside front cover, mementos of life on the open shelves. The filigree on the lower left corner of the cover, the endpaper and, less visibly, on the lower right corner of the title page, is the worm's work. Above: A closer look at the damage. Right: Looks like this one's a real page-turner! The swiss-cheesy item in the lower left-hand corner is the book stand Asplund made.



the Style of the Holy Scriptures"; the worm then ruminated on "Occasional Meditations" but found "Occasional Reflections" too much to swallow and left off—perhaps with a foretaste of its own mortality—on the essay entitled, "Upon the Being in Danger of Death." Other courses included *Histoire Naturelle du Senegal* (1757, by Claude-Jean-Baptiste Bauche), which had been munched on its inside front cover and ornately marbled endpaper, although the worm apparently lost interest after perusing the title page; and *Saggio di Naturali Osservazioni Sulla Elettricità Voltiana, Colla Descrizione d'une Nuova Macchina a Corona di Persone e di un Piliero Tutto Vegetabile* (1806, by Giuseppe Baronio), which translates as *Essay on Natural Observations about Voltaic Electricity, with a Description of a New Machine with a Crown of People and of an All-Vegetable Battery*. The "new machine with a crown of people" recalls that at that time, electricity's primary use was as a parlor trick wherein a ring of partygoers would hold hands with a static-electricity generator and watch one another's hair stand on end, while the "all-vegetable battery" is just what it says—a recipe for a voltaic pile made entirely of veggies. Besides being the ideal crudités to serve at a static-electricity party, this recipe must have whetted the worm's appetite—the inside cover, spine, front flyleaf, and endpapers had all been savored. A dozen less-thoroughly digested volumes were treated as well.

For the short term, at least, the problem appears to have been solved. But preservation is a constant struggle. Who knows what lurks in the books that haven't yet betrayed obvious signs of life? And even in the treated ones, whether the eggs have been killed is anybody's guess. Goodstein and Erwin will now inspect each book annually, and Asplund stands ready with his glove box any time more chewed classics are found. "It really doesn't take any of my time," he says. "I just put the book in the box." Says Goodstein, "We couldn't have asked for a better synergism between our needs, his expertise, and his own interests. We did it without any bureaucracy. The absence of paperwork was impressive. We offered to reimburse him, but he said no. If he'd done the entire collection, that would have been different. But the goodwill, the genuine interest, and the crossing of disciplinary lines really happens a lot at Caltech. People say it a lot, but it's really true. And we have a wonderful staff whose members are as creative as the professors." □

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