PCT
PEST CONTROL TECHNOLOGY

BED BUG SUPPLEMENT:
Lessons From the Past

The HISTORY of Bed Bug Management

BY MICHAEL F. POTTER

"A Strenuous Struggle, a vigorous campaign, is before any housewife who is called upon to dispute the occupancy of her home with that persistent pest unfavorably known as the bedbug, who, gorged with the blood of his victim, lieth up in his lair from daylight to candlelight, only to swoop down upon his helpless sleeping prey during the midnight watches."

— C. L. Marlatt, *The Bedbug*, 1916.

For centuries the common bed bug, *Cimex lectularius* L., was the most hated of household pests. Infestations were rampant, extermination was difficult, and treatments were sometimes as risky to people as to pests. In battling today's global resurgence of bed bugs, much can be learned from the past. If history repeats itself, the bed bug could again become the stuff of nightmares.

ANCIENT ORIGINS. Bed bugs have been biting people since the beginning of recorded time. Studies suggest the bugs first parasitized bats and then humans inhabiting the same caves in the Mediterranean region where civilization began. Most likely, relations between bugs and people were intermittent back then since hunters and herdsmen moved around a lot, making it harder for bed bugs to become established. Life became easier for the bed dwellers with the formation of villages and cities. Fossilized bed bugs have been unearthed from archeological sites dating back more than 3,500 years — a time when they were considered both pest and potion. The Egyptians, for example, drank a

Fumigating with hydrogen cyanide. The operator is opening a can of Zyklon discoids, a popular bed bug fumigant in the 1930s and '40s. (Photo courtesy of E.J. Gerberg)

[1]In print we typically see bed bug spelled with either two words or one word (bedbug). The modern scientific designation is two words although older writings often used one word. The entomological rule of thumb in the common naming of insects is to use two words if the insect truly resides within that hierarchal order of classification, and one word if it does not (e.g. bed bugs and stink bugs are considered true bugs in the order Hemiptera, whereas neither a butterfly or dragonfly are true flies in the order Diptera).

bed bug cocktail as a cure for snakebite (asps). The Greeks and Romans burned them to make leeches loosen their hold. The ancients also believed that bed bugs cured many diseases when ingested with wine, beans or an egg.

To deter bed bugs, early Greek philosophers (400 B.C.) advised hanging the feet of a hare or stag at the foot of the bed. Others suggested hanging a bear skin or setting a vessel of cold water under one's bed while traveling.

DISTRIBUTION & SPREAD. As civilization expanded, bed bugs spread throughout Europe and Asia, reaching Italy by 100 A.D., China by 600 A.D., and Germany and France in the 1200s and 1400s. Heat generated from sleeping and cooking fires allowed the bugs to live comfortably both in castles of the wealthy and huts of the working class. The poor, however, suffered the most; an observation made in the 15th century and attributed to a lack of vigilant cleaning: "For they do not breed in beds of which the linen and straw is frequently changed, as in the houses of the rich" (De Animalibus Insectes, 1603). Bed bugs were first reported in England in 1583, but were probably there earlier. Soon after, they hitchhiked their way to the Americas with European explorers and settlers. Aided by commerce, infestations initially arose in bustling seaport towns, appearing farther inland later on.

The bed bug resurgence in recent years followed a similar pattern, with infestations in the late 1990s first appearing in such "gateway" cities as New York, Los Angeles, San Francisco and Miami.

The global lineage of bed bugs can also be traced to their naming. In ancient Rome, bed bugs were called Cimex (meaning "bug"), while the species designation lectularius referred to a bed or couch. The early Greek term for bed bug was Coris, meaning "to bite," from which the word coriander comes. Coriander (cilantro) is one of the world's oldest spices. They probably named it so because when the leaves were crushed the pungent smell resembled that of bed bugs. In England, bed bugs were simply referred to as "Bugs[1]." *(See footnote on page 1.)* The early Spanish word for bed bug — "chinche" is especially relevant today since Spanish-speaking customers often refer to bed bugs as chinches or chinche de cama — bug of the bed. Other names once used for bed bugs include wall louse, bed louse, wallpaper flounder, night riders, red coats and crimson ramblers. Bed bugs did not occur in North America before the arrival of European settlers, thus there is no word for them in the language of Native Americans.

Title pages from Southall's 1730 treatise on the bed bug. The book sold for one shilling while a bottle of his "Nonpareil Liquor" bed bug killer cost two.

EARLY DESTROYERS. Methods of managing bed bugs today can be traced to the first European exterminators. Among the most famous were Tiffin and Son of London, who formed a business back in 1690 to exterminate bed bugs for the wealthy. The gas-lit sign over their shop read:

"May The Destroyers Of Peace Be
Destroyed By Us.
Bug-Destroyers To Her Majesty."

Recognizing the constant threat of infestation, Tiffin noted: "We do the work by contract, examining the house every year. It's a precaution to keep the place comfortable as servants are apt to bring bugs in their boxes and clothes." Tiffin reported finding the most bugs in beds, but cautioned "if left alone they get numerous, climb about the corners of the ceiling, and colonize anywhere they can." Centuries later the pest management industry is again advocating routine preventive bed bug inspections. Catching infestations early reduces spread into other areas and can lessen liability for some clients. Considering the limitations of current insecticides, pre-emptive inspections of bed bug-prone accounts seems a prudent strategy.

Another of England's earliest bed bug destroyers was John Southall, who published a 44-page treatise on bed bugs in 1730. The manual contained information on bed bug habits, prevention and control based on his experiences. Southall cautioned against bringing in infested furnishings and also recommended that belongings of servants be inspected as well. To limit harborage and simplify treatment, he also suggested that beds be "plain and as free from woodwork as possible" — a far cry from many beds in use today.

Southall also gained notoriety for his "Nonpareil Liquor," a supposedly terrific bed bug killer which he obtained from a native while traveling in Jamaica. The formula for the liquid has been lost, but may have been derived from quassia wood, a tropical tree with insecticidal properties (Busvine 1976). Many other "secret" bed bug formulas have been marketed over the millennia, a trend continuing to this day. Mr. Tiffin had a pragmatic view of such remedies, noting "secret bug poisons ain't worth much, for all depends upon the application of them." Some of the worst advice for killing bed bugs was published in The Compleat Vermin-Killer (1777), instructing readers to fill the cracks of the bed with gunpowder and light it on fire.

THE 1800s. As noted earlier, bed bugs became plentiful in North America with the coming of European settlers. As a deterrent, beds were often made from sassafras wood and the crevices doused with boiling water, arsenic and sulfur. This provided only temporary relief. As villages became cities, life became crowded with people and bed bugs from around the globe. Ships and railroads afforded ideal accommodation for the bugs, and rapid transit to where they had not been before. Hotels and boarding houses were especially buggy, and smitten travelers unwittingly carried them from place to place in their trunks and satchels. Vigilant travelers learned to pull beds away from walls and immerse the legs in pans of oil. Others relied on pyrethrum powder: "Dusted between the sheets of a bed, it will protect the sleeper from the most voracious hotel bug." (USDA Division of Entomology Bulletin, 1896).

Many "secret formulas" over the years claimed to control bed bugs. These advertisements were from the early 1900s.

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Frequent, careful examination of beds was encouraged to find the first bed bug. A feather was sometimes used to apply kerosene and other liquids to cracks and crevices. (Photo credit: Clemson Agric. College Bull. 101, 1941)

Although such methods may have helped, they could result in incarceration today.

By the mid-1800s, bed bugs had become a particular problem in poor, overcrowded areas with low standards of cleanliness. Wealthy households with an abundance of domestic help discovered that bed bugs could be kept in check with vigorous housecleaning, especially with respect to beds. Washing bedding, breaking down beds, and dousing the slats, springs and crevices with boiling water or grease from salt pork or bacon proved helpful — but the bigger benefit from such efforts was early detection of infestations in their more vulnerable initial stages: "The greatest remedy is cleanliness, and a constant care and vigilance every few days to examine all the crevices and joints, to make sure that none of the pests are hidden away" (USDA Report of the Commissioner of Agriculture, 1875). As bed bugs again become plentiful, it will be interesting to see if hotels, apartments, and other stakeholders commit the resources required for such preventative measures.

THE 1900s. Bed bugs received a big reproductive boost in the early 1900s, when central heating of buildings became common. By the turn of the century, cast iron radiators were delivering warm air to every room in the house, a process made even easier in the 1930s by electricity, fans and forced air heating. This enabled the bugs to thrive year-round, whereas before that, populations followed a more seasonal trend, increasing as the weather warmed.

During the 1930s and '40s, bed bugs became a community-wide problem like rats and mosquitoes. Infestation was worse in poorer, overcrowded neighborhoods, although wealthy households had problems as well. Besides being introduced on infested items, the bugs sometimes moved from house to house, escaping through exterior windows and doors and traveling along walls, pipes and gutters. A similar observation of bed bugs traveling outdoors between infested adjacent buildings was recently made by a pest control firm (Permakil) in Cincinnati.

In Europe, an estimated one-third of dwellings in major cities had bed bugs and similar ratios were reported in this country. Prior to move-in, mandatory fumigation of tenant furniture was proposed. Some Swedish cities even provided sleeping tents for citizens while their premises and belongings were being fumigated and they also contemplated building hotels for this same purpose. In Germany some landlords required a "clearance letter" of sorts from an exterminator, stating that the apartment being vacated showed no signs of infestation. Today in similar fashion, some property managers have begun asking about bed bugs during pre-screening of prospective renters.

During the war years, bed bugs were transported on bedding into many public air-raid shelters. They also feasted on sleeping soldiers in barracks and battlefront trenches, and were spread on belts, backpacks, canteens and helmets. One interesting account from World War I states, "In the East African campaign the bugs invaded the cork lining of the sun helmets of the soldiers. As the helmets were piled together at night, all soon became infested and the soldiers complained of bugs attacking their heads." (Medical Entomology, 1932). Bed bugs also occupied warships and the nooks and crannies of submarines. Besides the usual places, bed bugs were common years ago in laundries, dressing rooms, factories and furniture upholstery shops. Theaters had big problems and sometimes had to tear out entire rows of seats and install new ones. Coat rooms and lockers in schools were commonly infested, as is happening again today. All modes of transport including trains, buses, taxicabs and airplanes were spreaders of bed bugs. A 1930s survey of 3,000 moving vans in Sweden found bed bugs on 47 percent, foretelling big concerns for moving and storage companies today. Perhaps most unnerving was that bed

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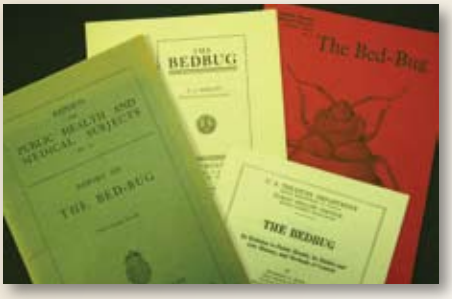
bugs used to be common in hospitals — another pattern from the past which has resurfaced in recent years (see "The Business of Bed Bugs," Pest Management Professional, 2008). Heavy infestations of bed bugs likewise once occurred in poultry houses and were spread via the crates in which birds were shipped or held at market. A similar pattern in poultry production is reappearing today.



Much of what is known about bed bugs today was published before 1950.

Efforts were made back then to make habitations less favorable to bed bugs. Heavy, wooden bed frames laden with cracks and crevices were replaced with metal beds that were less preferred by the bugs and easier to inspect. Attention was also paid to bed bug-proof construction (see subsequent section on "Miscellaneous Methods"). Most importantly, homemakers took steps to prevent bed bugs from entering the home. This involved constant watchfulness and attention to clothes sent to the laundress, and to blankets brought home from summer camps, cottages and suitcases after traveling. Frequent and careful examination of beds was advised to aid in finding the first bed bug. Interestingly there was little mention of preparing for the exterminator — surprising considering how much emphasis is placed on client preparation today. Perhaps this was because most households back then had fewer furnishings, knickknacks, clothing, toys and clutter. Concern about spraying people's belongings with pesticides was also less of an issue.

The bed bug epidemic during the first half of the 20th century prompted a great deal of research by universities and government agencies. Studies were conducted on bed bug biology and habits, risk of disease transmission, and management. Much of what we know about bed bugs was discovered during this period (1900-1950). Notably, no simple solution was discovered other than "eternal vigilance" (C. L. Marlatt, USDA publication, 1916).

BED BUG INSECTICIDES. Insecticides used for bed bug control have a long and interesting history. All sorts of concoctions were employed, both liquid and gaseous, and some were as toxic to people as to pests.

Sprays. Typical bed bug remedies during the 1800s and early 1900s included arsenic and mercury compounds prepared by the druggist. The poisons were mixed with water, alcohol or spirits of turpentine and applied with a brush, feather, syringe, eyedropper or oil can wherever bed bugs were found. Mercury chloride, better known as corrosive sublimate or "Bed Bug Poison," was a common remedy used by both exterminators and householders. One way to apply it was with the whites of an egg, beaten together and laid with a feather (Good Housekeeping, 1888). Unfortunately, Bed Bug Poison also killed some people, accidentally or by intent.

A much safer material used since the mid-1800s was pyrethrum, prepared from dry Chrysanthemum flowers. The insecticidal effect was first discovered in Iran; an early brand was known as Persian Insect Powder. Pyrethrum was included in many early bed bug preparations formulated as sprays and powders. During wartime when quantities were in short supply due to military requirements, other compounds were used such as rotenone, phenol, cresol, naphthalene and Lethane 384, an organic thiocyanate which also had activity against bed bug eggs.

Turpentine, gasoline, kerosene, benzene and alcohol (an ingredient in Sterifab) were also widely used against bed bugs until the mid-1940s. Applied alone or with pyrethrum, the effects were short-lived, seldom lasting longer than a day. Because the sprays lacked residual action and toxicity to eggs, treatments had to be thorough and the wet deposit had to come in actual contact with the bugs to be effective. Consequently, the materials performed better when problems were discovered and treated early, before infestations had spread beyond beds to other areas of concealment.

Bed bug ads often were entertaining. The cartoonist for this 1928 Flit ad was Theodore Geisel, better known as Dr. Seuss.

Experts of the day cautioned against "putting too much reliance on the very numerous preparations on the market which claimed to get rid of bed bugs" — sage advice that is also applicable today. Follow-up spraying 10 days to two weeks later, regardless of whether bugs were seen or not, was recommended to kill emerging eggs and any adults or nymphs that were missed. Additional treatments were made thereafter until no more insects were found. Fogging of rooms as was sometimes done for fly control did little more than "activate" the bugs — another lesson to consider before revving up our fogging equipment versus bed bugs.

As can be imagined, many of these early bed bug preparations were smelly. Thus, "perfuming" the spray was recommended in such places as hotels, theaters, coaches and for "discriminating housewives," whereas ill-smelling preparations were suitable for use in "jails, cheap lodging houses and various other free, public institutions" (Bed Bugs And Their Practical Control, 1943). Since many of the petroleum-based products also were highly flammable, buildings sometimes caught on fire if a match was struck too soon after treatment. As noted previously, the above-mentioned sprays were most effective against light infestations discovered in the early stages. Spraying was more tedious and unreliable against heavy infestations that had dispersed beyond beds into other inaccessible areas. In these instances (and before DDT), fumigation was recommended.

Fumigants. Early bed bug fumigation often involved burning sulfur, sometimes called

[2]The first insecticidal composition of DDT developed by J.R.Geigy, the Swiss parent company of modern-day Syngenta, carried the designation "Experiment No. G1750" later named "Gesarol" for the spraying of agricultural pests. "Neocid" was the early designation for DDT compositions used to control lice, bed bugs and other pests affecting man and animals. Much of the early testing was done by a team of 29 scientists working at the USDA Testing Station in Orlando, Fla.

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the "fire and brimstone" method (brimstone being the ancient word for sulfur). A dish of powdered sulfur was placed in the center of the room, surrounded by a larger pan to keep the molten mass from spattering and setting fire to the floor. Ready-made sulfur candles could also be used but were more expensive. Metal fixtures prone to tarnishing and corrosion were removed or coated with lard or Vaseline.® The sulfur fumes also bleached and damaged wallpaper and fabrics, especially in the presence of moisture. Nonetheless, the procedure was simple, affordable and relatively safe to humans, making it a viable control option for both householders and professionals. The sulfur fumes were lethal to all bed bug life stages including eggs, but had poorer penetration than some other gases and sometimes had to be repeated.

The gold standard for bed bug fumigation during the first half of the 20th century was hydrocyanic acid (cyanide) gas. Fumigating with cyanide was highly effective, but costlier and far more dangerous than previously mentioned methods. As with modern-day fumigations, the entire building had to be vacated, which was not always necessary when burning sulfur. Due to the danger, cyanide fumigations were best performed by professionals — but this was not always the case. In the 1930s and '40s, state agricultural experiment stations often provided instructions for using cyanide in their publications. Some went on to say that local druggists could supply materials and further advice — a risky business considering that breathing the gas caused unconsciousness within seconds and death within minutes. Many people without the proper training and safety equipment were killed or seriously injured, and even professionals had mishaps using this effective but lethal material.

Various commercial preparations of hydrogen cyanide were available, including Zyklon B pellets and powder used in the gas chambers during the Holocaust. The most popular and convenient formulation used by pest control firms were "discoids," consisting of fibrous absorbent discs saturated with liquid hydrocyanic acid. The discs were packed in gastight metal containers and opened with a special can opener. (Image 5, Cyanide Fumigation) When exposed to air, the liquid cyanide quickly volatilized into toxic gas, necessitating use of a gas mask. Applicators worked in teams with one person opening cans while the other scattered the discs onto layers of newspaper, cardboard or into dishpan-type wire containers.

Hydrocyanic acid gas could also be generated by sprinkling calcium cyanide dust onto strips of paper on the floor, or by placing water, sulfuric acid, and ounce-size sodium cyanide "eggs" into earthenware pots. These methods had their own inherent risks and were generally less convenient than using discoids.

Despite the drawbacks, fumigation was long considered the most effective and efficient means of eliminating serious bed bug infestations. Railroad cars and ships were also fumigated, and fumigation chambers and moving vans were widely used for debugging people's belongings. But all that changed after the start of World War II when a new and more potent chemical spray became available — DDT.

DDT. The discovery and development of DDT for battling bed bugs and other pests is legendary. Dichloro-diphenyl trichloroethane (DDT — *see footnote on page 5*)[2] was originally synthesized in 1874 by a young German chemistry student working on his thesis, but the compound stayed in obscurity until 1939 when Paul Müller, a Swiss scientist with the Geigy Company, discovered its remarkable insecticidal properties (Müller was awarded the Nobel Prize for the discovery in 1948). Initial quantities were allocated to protecting U.S. military forces from louse-borne typhus and disease-carrying flies and mosquitoes during World War II. Beginning in 1942, DDT was also evaluated against bed bugs in hopes of finding a more effective and economical method of control in military barracks. Preliminary results were deemed "phenomenal" and DDT soon became known as "the perfect answer to the bed bug problem" (USDA Bureau of Entomology, 1945). By late 1945, several suppliers were running ads in Pests and their Control (the precursor to Pest Control Magazine), announcing availability of DDT for civilian (non-military) uses.

What made DDT special was its long-lasting effectiveness as a dry deposit. No longer did sprays have to contact the bugs directly as was required with other materials. For the first time, bed bugs residing in hidden locations and nymphs hatching from eggs succumbed, by simply resting or crawling on previously treated surfaces. While some studies reported a residual effect lasting at least six months, Arnold Mallis in the second edition of his Handbook of Pest Control (1954) indicated that samples of wallpaper which he sprayed with DDT continued killing bed bugs three years later! Experiments further showed that DDT had no repellency and did not disperse bed bugs throughout a room or building like pyrethrum and some other materials. (Recent studies by University of Kentucky researchers confirm that some pyrethroids also can produce irritancy or repellency in bed bugs (Romero et al. 2008).

In 1945, suppliers began advertising the availability of DDT for civilian use, including bed bugs.

DDT applied as a 5-percent oil-based spray or 10-percent powder was so effective that all the bed bugs in a room could eventually be eliminated by thoroughly treating the bed and nowhere else, since the bugs eventually had to crawl onto the bed to feed. In practical use, other locations in the room were also thoroughly treated to hasten eradication. One application normally did the job — in contrast to the multiple treatments required previously — and what we are experiencing again today.

Another aspect that helped hasten the bed bug's demise was that DDT was relatively inexpensive and could be bought and applied by anyone. Unlike fumigation, the material could be applied by householders and professionals alike. A few ounces of spray or an ounce of the powder was enough to treat a full size bed and prevent re-infestation for at least a year. For added convenience total-release DDT "bombs" were sold, the same ones used in wartime by the military.

According to Dr. John Osmun, professor emeritus at Purdue University and one of the

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first to evaluate DDT against bed bugs — after three to five years of civilian usage it became hard to find populations of bed bugs on which to do further testing — another testament to the knockout punch of the material.

ENTER RESISTANCE. As bed bugs were disappearing, reports began surfacing that some populations had become DDT-resistant. Failures were first noted in barracks of the Naval Receiving Station at Pearl Harbor in 1947 — only a few years after the product was introduced. During the next 10 years, other cases of DDT resistance were confirmed, and by 1956, the National Pest Control Association was recommending malathion as an alternative. Malathion as a 1-percent spray proved effective when applied thoroughly to the mattress, frame, baseboards, cracks and other hiding places. To reduce odor, ventilation and masking agents were employed. Other products used during the 1950s to 1970s to control occasional infestations of bed bugs included diazinon (when the bugs became resistant to malathion), lindane, chlordane and dichlorvos (DDVP). Mattresses were sprayed and aired as part of the overall treatment. As with DDT, a single application often did the job, provided spraying was thorough. Sporadic recurrences of bed bugs during the 1980s were eliminated with organophosphate or carbamate insecticides, none of which are available today.

History has shown that bed bugs can develop immunity to insecticides at a rapid rate. High levels of resistance to our most potent pyrethroids was confirmed recently in field populations from around the United States (see "Insecticide-Resistant Bed Bugs: Implications for the Industry," PCT, July 2007). What is more worrisome today is that we have few alternatives, underscoring what can happen when pests resurface after entire classes of insecticide are removed from the market.

MISCELLANEOUS METHODS. Insecticides have long been the principal means of controlling bed bug infestations. Other methods have been employed, however, and some of the same are being tried again today.

Bed bug-proof construction. Efforts were made in the past to make buildings less favorable to bed bugs. Wooden bed frames laden with cracks and crevices were replaced with metal frames which were less favored by bed bugs and easier to take apart and inspect. Another advantage of metal over wood was that "alcohol or kerosene could be poured over the joints and set fire with a lighted match" (American Journal of Nursing, 1922). Mattresses were also redesigned with fewer buttons, folds and creases. Eliminating hiding places in elements of construction was also recommended. Cracks and crevices were to be filled with soap or other sealants. In the 1930s and '40s, hospitals and hotels in Europe were being constructed with metal windows and doors and little or no woodwork. Floors were of cement or other tight composition, often having no baseboards. Walls were smoothly painted in lieu of peeling-prone wallpaper — sage advice in modern-day hotel rooms where wallpaper borders are often installed at the ceiling-wall juncture. Such bed bug-proofing

CHASING BED BUGS IN MARCH

Years ago people battled bed bugs as part of spring cleaning. An advantage of such timing was that in unheated homes, populations tended to be lower at the end of winter due to the effects of cold temperatures. The excerpt below is one family's account of battling bed bugs in rural Arkansas in the early 1900s.

"To slow the bed bugs down and thin them out we took down and outside the beds and all the bedding, emptied the old straw ticks and burned the straw. We washed and boiled anything that was washable and scalded the bed slats and springs and poured boiling water in all the cracks and crevasses that the water would not ruin. We cleaned all other furniture and used a coal oil-soaked rag to get at places we could not pour water. We cleaned the walls as best we could, sometimes throwing boiling water on them then re-papering… We set the bedposts in cans of coal oil and kept beds and furniture away from the walls about two inches. We then could sleep in peace for a few weeks until another batch hatched out then we had the whole bit to do over. All this seems like such a lot of hard work (and it was) but having bed bugs was somewhat akin to having the itch or plague — embarrassing to have but impossible not to have, especially for people who moved a lot from house to house."
— Adele Meacham Wood's Little Red River Journal

ONE TOUGH BUG

An oft-mentioned statistic about bed bugs is their ability to survive long periods without feeding. Longevity studies conducted in the early 1900s showed they can indeed survive more than a year without feeding. One investigator (Bacot 1914) starved bed bugs in an outhouse for 18 months and found that several survived to feed another day. It should be noted however that bed bug longevity is variable.

Their ability to survive long periods without a blood meal is influenced by such factors as temperature, humidity and life stage. Cooler temperature and higher humidity tend to prolong survival — at a constant temperature of 45° F and 90-percent relative humidity, starved adult bed bugs in one 1940s experiment survived a maximum of 550 days — but only 181 days at 73° F. Lacking a warm-blooded host, young nymphs die sooner than older nymphs and adults, often succumbing within a few months.

Studies have shown that the reason bed bugs can persist so long without feeding is their remarkable ability to retain water, comparable to arthropods adapted to dwelling in deserts. They retain moisture by having a water-impermeable cuticle (outer shell), and the capacity to become quiescent while living in moisture-conserving aggregations (Benoit et al. 2007). Desiccant dusts have been used against bed bugs and other pests for centuries. Targeting their ability to conserve moisture makes sense considering they possess little vulnerability.

1926

"Sometimes it is possible to destroy a light infestation localized in one room by thorough soaking of the bed and other places with high-test gasoline."

— Pennsylvania Dept. of Agriculture Bulletin on Household Pest Control, 1926

efforts have long been abandoned in favor of comfort. The coziness of the modern sleeping room is testament to how long it's been since bed bugs were a state of mind.

Lethal temperatures. If bed bugs have one vulnerability — it's elevated temperature. Heat has been used as a control tool for centuries. Boiling water was used to scald bugs residing in bedding, bed slats, springs and other locations. Candles and plumbers' torches also were employed in the manner that some residents today are attempting to roast the bugs with cigarette lighters. In the 1920s and '30s, a larger version of today's portable steamer was used, as were heat-generating lamps plugged into electric outlets.

A more efficient way of using heat was adapted from methods developed in the early 1900s to de-infest granaries and flour mills. In a 1916 article titled "Eradication of the Bedbug by Superheating," investigators showed it was possible to de-infest a two-story house in Canada by stoking up the furnace and other stoves during summer to a temperature of 160°F. Similar success was reported in another study where steam was used to heat a 350-room dormitory on a college campus in Mississippi (Harned and Allen, 1925). In this case, maximum temperatures in bed bug-infested rooms ranged from about 110°F to 125°F, over a heating period lasting a few days. The authors concluded that very high mortality can be achieved at temperatures as low as 110°F when maintained for two days, and from a few hours exposure to 120°F. In the first (1945) edition of The Handbook of Pest Control, Arnold Mallis also mentioned successfully using superheating to de-bug an animal rearing laboratory. He reported that after eight hours of heating, "the mortality was so terrific, that a carpet of bedbugs covered the floor, and a slight draft through the room piled up windrows of the bugs against several objects on the floor."

Interest in using heat to control bed bugs all but vanished after the discovery of DDT. Today's interest in the approach reflects the lack of effective management options and greater concerns over pesticides.

LITIGATION. Litigating over bed bugs is mainly a modern-day phenomenon — but not entirely. Bed bug bites have in fact triggered lawsuits for more than a century. In 1895, for example, a Chicago jury ruled that "no man shall be required to pay rent for a house infested with bedbugs." Editorializing on the verdict, the news media noted that if the ruling held, "the great majority of Chicagoans would be relieved of their rent bills." In another early case involving a hotel, the court ruled that the presence of bed bugs did not furnish grounds for the recovery of damages because the plaintiff must have known that the hotel was previously "buggy" (Bly vs. Sears, Daily Iowa State Press, 1902). Railroads were also defendants in bed bug litigation. In 1913, a Milwaukee man sued the St. Paul Railroad for $10,000 (a lot of money back then), claiming bed bug bites made him so ill that it interfered with his business trip. When the man returned home he stepped off the train carrying one arm in a sling.

THE FUTURE. History has shown what to expect from bed bugs in the future — and the forecast is concerning. All of society will be affected as infestations appear in the same places they had before. Besides homes and hotels, watch for them in such places as schools, theaters, and especially health care facilities. Small cities and towns will be spared for awhile but not for long. There will be new challenges this time around including an unprecedented mix and movement of people from across town and across the globe; more bug-friendly belongings and clutter in which to hide; fewer options and more restrictions in respect to fumigation; societal apprehensions about pesticides; and a pervasive feeling today that when someone is harmed they should sue.

Bed bug management will be handicapped until the chemical industry invents a safe, residually potent product with a permissive label. This will not be easy given the priorities and challenges facing our industry partners. In the meantime, we must utilize the tools available. The essence of bed bug management remains hard work and constant vigilance to prevent or detect infestations in the early stages. This cannot be achieved by the pest management industry without informed and cooperative customers. Thankfully, though, we've come a long way from hanging rabbits' feet at the end of the bed. ■

Special thanks to all our senior industry leaders who taught us the ways of bed bugs — Arnold Mallis, Harry Katz, John Osmun, Val Smitter, Vern Walter and many others.

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THOROUGHNESS IS KEY

A common mantra of bed bug management today is that treatments must be thorough. The following excerpts show this same advice was given years ago…

"Thoroughness is the key word and only experience will teach a man how to best find every possible place bed bugs may be harbored. Most operators take the beds completely apart and remove the casters from the bed legs. Dresser drawers are removed, rugs rolled back and pictures taken from the walls. Floor lamps are upturned, moldings pried loose in some cases and books and papers carefully examined…"

— Bed bug Spraying, Pests and Their Control, 1940

"It should be remembered that amateur efforts usually produce amateur results."

— "Bed Bugs and Other Bugs," Mallis Handbook of Pest Control, First Edition, 1945

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