Fumigants & Pheromones

Digital Newsletter Delivered by Insects Limited, Inc. *Issue 160*

Museum Monitoring Guidelines

Pat Kelley BCE
President of Insects Limited

Trap Placement: When implementing an IPM program within a museum, library or historic house, one should begin by placing blunder traps un-baited flat, sticky glue traps) snug against the wall on either side of all doorways, in corners and every 50 feet (15 meters) in areas where susceptible materials are being stored or exhibited.

Susceptible materials can include any and all animal fibers including hair, fur, feathers, hide, animal protein, wood and other plant-based materials. An example of a recommended and effective blunder trap is the Insects Limited Museum Monitors (IL-1600).

A Museum monitor blunder"trap placed correctly against a wall in a historic house.

Museum Monitor traps incorporate a very tacky glue that is excellent at grabbing and holding onto crawling insects that are passing through an area. It is essential to place the traps snug up against the walls. Insects tend to follow lines as they try to conceal themselves. The junction line where the floor meets the wall is where the largest traffic flow of insects exists. *Note: Blunder traps placed randomly in the center of a room rarely capture insects even in rooms containing large insect populations.* Insects Limited's Museum Monitors can also be divided into thirds for monitoring small spaces or discrete public exhibits. After placing traps around the doors and in corners, traps should be concentrated in areas that contain any of the susceptible materials listed above. The more traps that are placed out, the better the information that one will have to make well-informed pest management decisions. In high-risk areas or in areas containing materials with extremely high value, traps can be more densely placed every 5 -10 feet (1-3 meters) along the sections of the wall.

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Frequency of Trap Checks: Blunder traps and pheromone traps can be checked as often as staff allowances and budgets allow. If one is actively seeking information from a specific area, traps can be checked multiple times each day or even hourly. It is recommended to check traps at least weekly or monthly for early detection of pest issues. Some museums or historic houses are only able to check traps on a quarterly, bi-annual or annual basis due to staff availability or other hurdles. Any information that the traps can give to an IPM manager is better than no information at all. The longer that the traps go unchecked though, the better chance is that they become full of insects. It must be noted that once a trap becomes more than 50% full of insects or debris, it becomes much less effective at capturing insects. Also, insects left in a sticky trap for long periods can become food for carpet beetles and dermestid beetles which are themselves considered to be museum pests. In this respect, the full traps would become a breeding ground for the damaging pest species. For this reason, we recommend checking traps and replacing full traps on at least on a quarterly basis if not more frequently.

Varied carpet beetle larvae feeding on a cricket captured in a blunder trap

When checking the traps, a person trained in pest identification should become involved to identify what is being captured. A record of the species being captured should be noted along with the quantity of that insect present in each trap. Insects Limited can assist with insect pest identification. There are software programs that are designed to keep track of museum pest populations in monitors. One recommended software package for this purpose is Zpest Tracker:zpesttracker.com. Software programs like this can assist with record keeping and pest history that can assist in making Integrated Pest Management (IPM) decisions.

Pheromone Use: After the insect species have been identified in the blunder traps, and if they are a museum pest, the general area around the trap with the pests should be visually inspected to identify why the pests are there and where they are coming from. If the identified pest has a commercially available pheromone, monitoring lures can be used to effectively pinpoint the exact source of the infestation. The goals of most pheromone monitoring programs are to:

1. Indicate the presence or absence of the pest.
2. Locate the source of the pest if they are present.

Knowing the presence and location of pest insects in a large storage room or exhibit space allows the program administrator to treat or remove the infested material and achieve a pest-free facility. In order to achieve this, a focused visual inspection around the areas where trap captures are highest is needed.

A Clothes Moth Bullet lure placed into a sticky trap will let you know when a moth population is close by

The process to pinpoint the source is as such: Place the traps containing pheromone lures out in a grid pattern throughout the area, placing more traps around potential problem areas. Since pheromone traps attract the target insects to them, they can be hung or placed in all areas within a room and do not necessarily have to be placed up against a wall like the blunder traps. Allow the traps to collect data over a set time and check the number of insects in each trap. Focus your attention on the areas around the traps with the highest activity and perform a visual inspection for signs of infestation in those areas. If no visual signs are found, move new pheromone traps into a tighter grid pattern into the area around the trap or traps that are experiencing the highest activity. If a trap in this tighter grid is now capturing the most insects after several weeks, perform a detailed visual inspection around that trap to look for the source. Continue this process of tightening the grid of pheromone monitors until the area is considered manageable for detailed visual inspections. This may include physically opening storage boxes, drawers, and cartons to look for signs of pest activity.

Once a source of the infestation is found, the object or objects should be treated on-site or covered and removed to prevent the further spread of this pest. Consult with Insects Limited for safe and effective pest treatments for museum objects.

Diagram showing NoSurvivor® Pheromone Traps placed out in a grid pattern within a storage area

Tips & Tricks

1. Place blunder traps (non-baited sticky traps) against the wall on either side of every door, in corners and every 50 ft (15 meters) in areas where there is a potential food source for the pest insects.

2. More traps can be placed against the wall in areas where highly susceptible materials are stored or exhibited or in areas that contain highly valuable materials.

3. Identify the insects within the trap to check general environmental trends and for specific museum

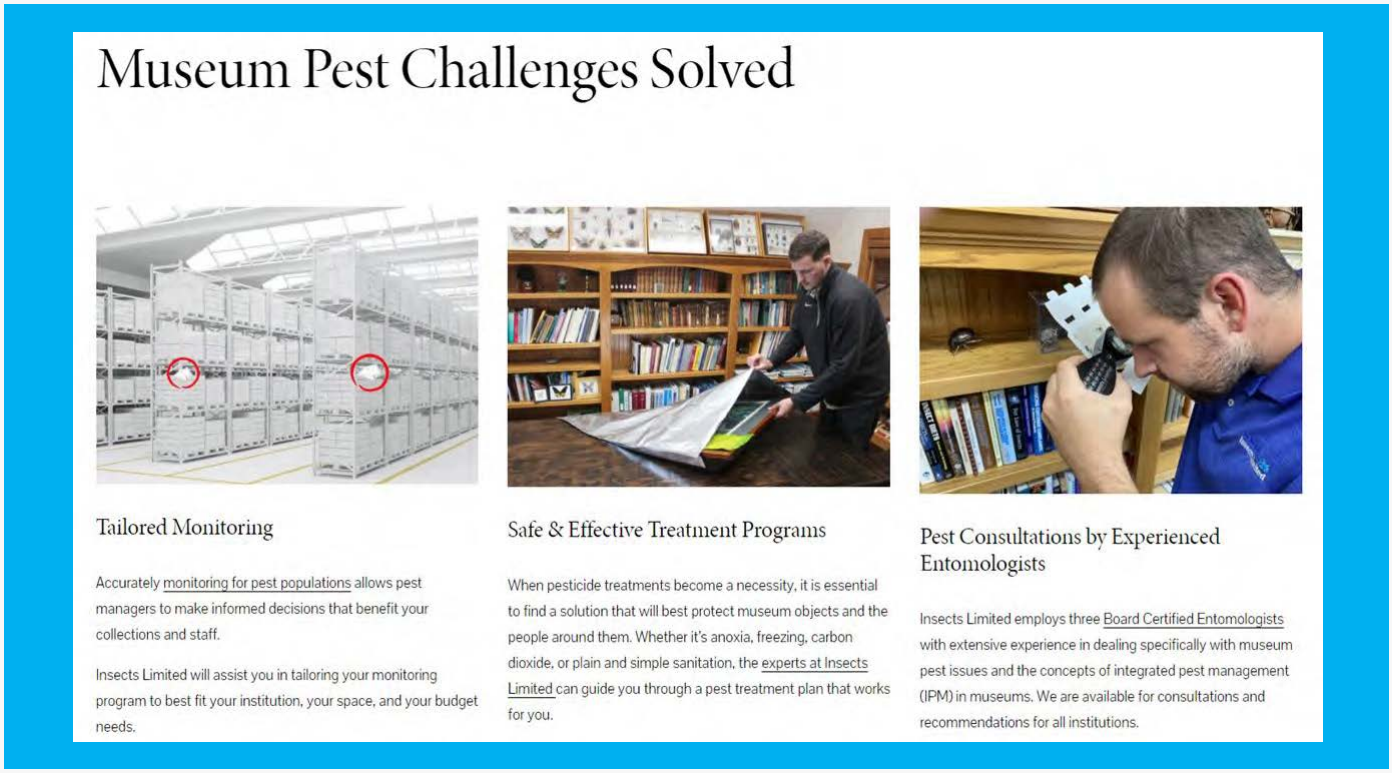
pest insects. If a large number of temporary invader insects/arthropods (E.g. millipedes, crickets, ants, spiders, ground beetles, etc.) are present, examine the seals around doors and windows or other physical openings into the structure that may allow pest entry. Keep in mind that insects can sometimes enter through gaps that are only 1 mm wide. Door sweep installations, foundation repairs, filling gaps with caulk or other pest-proof barriers can eliminate these temporary invaders.

4. If the identified species are specific museum pest insects (E.g. clothes moths, carpet beetles, cigarette beetles, drugstore beetles, etc.) an immediate inspection of the surrounding areas should be performed to see if a source can be found and treated or removed. If no source is found, check to see if a commercially available pheromone exists for that insect.

5. If the specific museum pest insect has a commercially available pheromone, place the traps containing that pheromone lure out on a grid pattern (Check manufacturer's recommendations for spacing) throughout the area. Place a majority of the traps available in areas near insect food sources. Allow the traps to collect data over a set time and check the number of insects in each trap. Focus your attention on the areas around the traps with the highest activity and perform a visual inspection for signs of infestation in those areas. If no visual signs are found, move new pheromone traps into a tighter grid pattern in the area around the trap that is experiencing the highest activity. If a trap or traps in this tighter grid is now capturing the most insects, perform a detailed visual inspection around those traps to look for the source. This may include physically opening boxes, drawers, and cartons to look for signs of insect activity.

6. Once a source of the infestation is found, it should be treated on-site or covered and removed to prevent the further spread of this pest.

For more information on how Insects Limited provides solutions for cultural heritage institutions to preserve their valued collections from pest damage, visit insectslimited.com/museums



Fumigants & Pheromones

Digital Newsletter Delivered by Insects Limited, Inc. *Issue 166*

Glue science: How we get insects to “stick” around in traps

James Feston, BCE

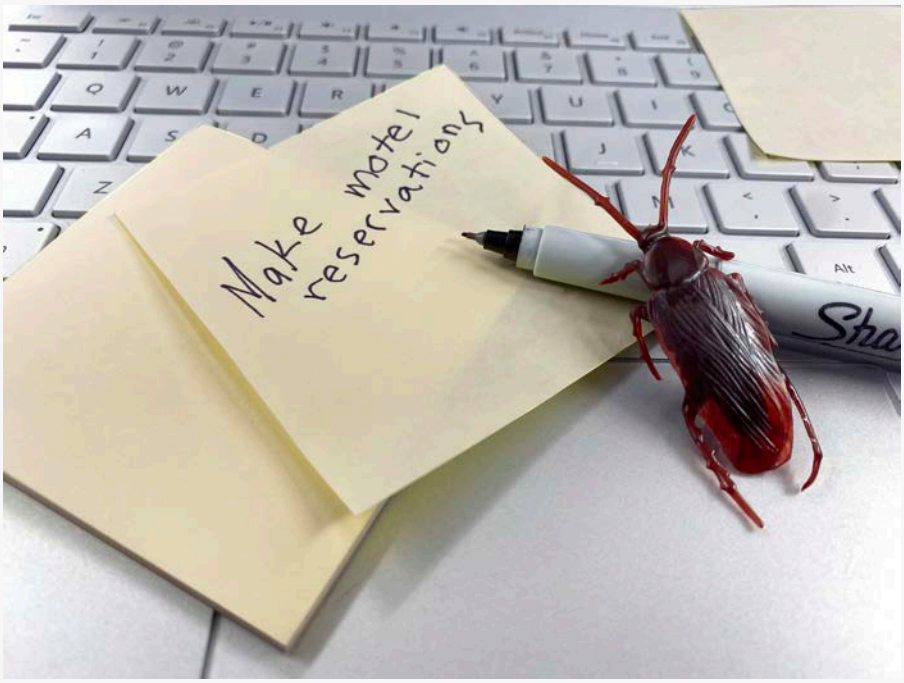
Director of Product Research, Insects Limited

One of the biggest issues, when monitoring for insects, is that the insects don’t really want to be caught. Go figure.

Regardless of the trap style, whether it be a pitfall trap or a sticky blunder trap, the insects that approach them tend to, by and large, avoid hurtling headlong towards death.

We do our best to design traps to outwit these crafty bugs and if you spend some time watching a trap, you’ll see what I mean.

Take a pitfall trap for example, you’ll probably see a number of insects walking around the trap and leaving.



Sticky note adhesive is designed to exacting specifications. The glue on the back of each note has the ideal balance of tackifier and elastomer to make peeling easy, not leave behind any residue, and have high enough shear resistance to hold the note on a vertical surface without sagging or sliding.

You might also see insects walking up the ramp and changing their mind as they reach the edge and begin to lose footing. Sticky blunder traps have the same issue. Observation of a glue board will reveal that a decent number of potential visitors might get right up to the glue line, test a toe in the water, then pull themselves free and head the other direction. This tendency towards self-preservation keeps us always working towards the perfect trap. In the meantime, we do catch a percentage of them. This is why so many insect traps are used primarily as monitors instead of eradication methods.

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It is All about the Glue:

In the pursuit of a better insect trap, manufacturers put a lot of effort into developing glues that balance all the important qualities required to catch the best percentage of unlucky insects. We probably don't give glue that much thought on the average day, but they really are all around us and come in a variety of forms and chemistries.

Take white school glue for example. It falls under the category of a "structural" adhesive. Structural adhesives are those that cure or harden based on one or more factors. Our white glue starts as a liquid using water as a solvent. As the water evaporates, the glue begins to dry out, harden, and bond surfaces together. Not all structural adhesives require "drying" out. Others, like epoxies, rely on chemical reactions that are independent of exposure to air.

Other common structural adhesives, like hot-glue, use high temperatures to liquify the adhesive material until it can return to normal temperatures and provide a strong bond between surfaces. Structural adhesives, with the exemption of hot glue, are good at doing their job of sticking one thing to another, one time.

After that, should the bond be broken, it can't be reestablished without the addition of fresh adhesive. None of these structural adhesives are going to do us much good with insect trapping which is why we are lucky to have another category called "pressure-sensitive" adhesives.

Pressure sensitive adhesives are types of glue that don't require solvent evaporation or curing of any kind. When it comes to pressure sensitive adhesives, think about tape, adhesive labels, and sticky notes. The glue on these products doesn't have to dry or cure to do its job. Simply press the tape or sticky note onto a surface and there you go, it's stuck.

The precise formulation of these adhesives is usually kept fairly close to the vest by their manufacturers, but they generally feature two main components. These two primary components are an **elastomer**, and a **tackifier**.

In order to work, a pressure sensitive adhesive needs to be able to "wet" the surface that it is applied to in order to provide initial "stick". This is where the tackifier comes in. It provides the initial stickiness in the process, Think maple-syrup, nice initial stick, but doesn't really hold anything together when wet. That's why we need the next step for good adhesion, the elastomer.

The elastomer, combined with the tackifier, adds a "rubbery" component to the mix that helps resist shear and peeling forces. Imagine 3 sticky notes. One has a backing that has the tackifier only. The tackifier is semi-liquid and initially sticks nicely to a horizontal surface but you find that you can still slide it around with relative ease.

The second note has the elastomer only. If has a good "rubbery" quality to it and it resists sliding around, but it's not really attached to the surface at all.

The 3rd note, has the best of both worlds, it sticks to the surface, resists sliding and peeling, and it's perfect for sticking futile reminders to perform tasks that are not worthy of today's efforts and are best left to future you.

The best part about pressure sensitive adhesives in our industry is that the manufacturer can control so much about its adhesive qualities and can even formulate it to continue to perform under harsh conditions, over and over.

Compared to the structural adhesives, that sounds a lot better for our insect trap doesn't it?

In fact, that's why all the sticky insect traps you come across are made with pressure sensitive adhesive of one form or another.

Pressure sensitive adhesives can be manipulated for maximum performance. Cold weather formulas, like on this board, work down to 0 degrees Fahrenheit!

Some sticky trap glues are relatively hard, some are more liquid, some are specially designed to work in extreme low temperatures.

All of them however, are picked purposefully for the kind of insect or pest they are aimed at catching.

The harder glues skew heavy towards elastomer and are good for, stout, crawling pests, and some flying insects.

The more liquid glues skew towards more tackifier and are ideal for catching light, flying insects, by immediately wetting and entangling their wings.

Heavy tackifier glues also have some additional capacity to continue to perform in dusty environments.

The goal when designing a sticky trap adhesive, is to formulate a glue that has the best chance of holding onto the insects that make contact with the glue.

Because the insects resist being caught, the adhesive needs to have the right balance of tackiness to grab them, and elastomer to hold them.

Ultimately, the efficacy of our insect traps relies on its ability to overcome the survival instincts of our insect quarry.

Which is why, when you are choosing a trap for your IPM program, you might take a moment to think about the many factors that go into designing the humble sticky trap.

There is more science to the stick, than meets the eye.

"Wet" glues like in this NoSurvivor™ trap are most common in traps designed to capture flying insects. The tackifier-heavy glue helps to immediately wet and tangle the wings of the insects to disable it inside the trap. Photo by James Feston

Fumigants & Pheromones

Digital Newsletter Delivered by Insects Limited, Inc. *Issue 164*

Drugstore and Cigarette Beetles

Ethan Estabrook, BCE
Research Associate, Insects Limited

Drugstore (*Stegobium paniceum*) and cigarette beetles (*Lasioderma serricorne*) cause serious damage to stored products.

Larvae can chew and burrow holes into some food packaging causing product defects. The larvae also damage products through feeding and introduce contaminants like larval cocoons, frass (excrement), and dead adult beetles.

Drugstore beetles and cigarette beetles carry a symbiotic yeast in their guts that assists them in the digestion of less nutritious foods and can provide resistance to certain toxins. This symbiotic relationship allows these beetles to feed on a wide range of materials including dried foods, grains, seeds, pharmaceuticals, spices, hay, dried fruit, powdered milk, nuts, animal feed, pet food, and many other organic materials. Cigarette beetles get their name from their ability to feed on tobacco which is toxic to most insects. Both can also be a serious pest to museum specimens and have been reported feeding on books, leather, feathers, bamboo, manuscripts, upholstery, and wool.

Click to watch a time-lapse GIF of drugstore beetle (Stegobium paniceum) damage to dog treats over 6 months. 100 adult drugstore beetles were introduced and maintained at 82°F (28°C) and 50% relative humidity. You can see how quickly these insects can cause major damage to stored products over time.

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Dorsal view of a cigarette beetle (Lasioderma serricorne).

Dorsal view of a drugstore beetle (Stegobium paniceum).

Notice the two main physical distinguishing characteristics from the drugstore beetle and cigarette beetle images above. Drugstore beetles have three largely clubbed antennae segments and deeper longitudinal rows of pits on the elytra (wing covers) while cigarette beetles have smaller, more numerous, serrated antennae segments and smooth elytra (wing covers).

Although the drugstore and cigarette beetles look very similar, they are distantly related and require different monitoring practices as they do not share the same sex pheromone. Both of these beetles are in the family Pitinidae which include anobiid beetles that are more commonly known as “woodworm” or “wood borers.” The furniture beetle (Anobium puncatatum) is a commonly found insect in this family and is known to damage wooden furniture and house structures.

Insects Limited is a leading pheromone technology company that researches, tests, develops, manufactures and distributes pheromones and trapping systems for insects in a global marketplace.

Insects Limited specializes in a unique niche of pest control that started out as an idea and has developed into a business that provides products and services that are mainstream in protecting stored food, grain, museum collections, tobacco, and fiber worldwide.

Shop Drugstore Beetle Pheromone Traps and Cigarette Beetle Pheromone Traps from Insects Limited

Insects Limited
INCORPORATED

Quality Pheromones and Trapping Systems

Insects Limited was established in 1982. It was founded on a statement made by an entomology professor at Purdue University while founder Dave Mueller was attending college: ***"The future of pest control is without the use of toxic chemicals".***

Today, **Insects Limited, Inc.** researches, tests, develops, manufactures, and distributes quality pheromones and trapping systems for food infesting insects to a global marketplace with a focus on the statement above. At our core, Insects Limited focuses on bring **Science, Education, and Innovation to the Stored Product Industry**.

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The Worst Pest Invasion of Stored Products in Recorded History (With Pictures!) – Part 1

Quinn Schroeder
Fumigants & Pheromones Guest Contributor

The staff of Insects Limited had the pleasure and the opportunity to work alongside Quinn Schroeder during his time in the industry. We observed his abilities to think through situations as a keen observer, questioning occurrences that might seem normal to others. Even though we are very happy for him, unfortunately, Quinn left the industry and is now in his third year as a medical student in Phoenix, AZ.

We were however very excited when he contacted us asking if he could contribute to the Fumigants & Pheromones Newsletter by writing informative essays on a broad range of topics including ecology, biology, and biomedicine.

Please enjoy this article and keep an eye out for more from Quinn Schroeder.

Do you have an elusive family of mice giving your pest control operator headaches? Rest peacefully knowing he's not up against 126,000 mice!

A few years back, while navigating the back allies of Google Scholar, I came across an entry that referenced a 1922 manuscript. An internet search for it came up nearly empty. The book had been out of print for the better part of a century, but its synopsis intrigued me, so I forked over $20 for the only copy available. The fabric-bound covers were bare, and the firsthand accounts on the pages between were just as monotone. The book's mannerism was overcast and informative, but the grotesque black and white photos enthused me. I felt compelled to blow off the dust and share this forgotten narrative with a modern perspective.

Just after morning's break, in Crystal Brook, South Australia, the mainland's southcentral state, a young lad trots around stacks of bagged wheat and grabs a waterfilled bucket out of the ground with last night's casualties. Dead mice! Hundreds of them in this bucket alone. He decants the water and transfers the bodies into a large sack, then refills the bucket with fresh water and places it back in the hole. Each bucket sits positioned into openings between a wall that encircles the wheat stacks.

His morning stroll also involves retrieving any carcasses that did not make it into his traps. Sometimes the perpetrators get stuck between the sheet metal walls and die of heart attack, or are crushed from falling bags, or even cannibalized by their contemporaries. Other times they may succumb to the deadly gas injections from the night before. The boy is responsible for retrieving all dead bodies, and for the last couple of months, his routine involves precisely this. It takes him hours and is mundane but vital to control the situation.

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His sack is waterlogged, with fluids leaking through the stitching voids – a mixture of last night's water, blood, and byproducts. He is careful not to breathe in the fumes. Usually, he drags his heavy burlap sack to the burn-pile, or maybe a trench for burial to rid the air of the lingering stench. Instead, this morning, per his manager's request, he dumps the contents adjacent to the wheat stacks. Each sack-full adds a little more to the growing pile of carcasses. He returns to the wall and repeats the process many more times. ***In only a day, he amasses 126,000 rodents*** **from this site alone!** After his efforts, a cast of eight workers in their rustic corduroy suits and wide-brimmed fedoras coalesce around the boy, behind the pile he has built (Figures 1A). Debris left over from the stacks can be seen in the background – once tidied bags are now piles of loose wheat.

Figure 1A (Left): 126,000 mice caught at Crystal Brook, South Australia. ***Figure 1B (Right)*****:** A similar case in Lascelles, Victoria, the mainland's southeastern state, where 500,000 mice were caught in four nights.

This holocaustic polaroid is a fulcrum in pest-vs-product history – the only known invasion of this magnitude! As horrid as the situation appears, it is not an outlier nor a one-off, but rather a representation of a plague besieging agrarian estates. It is early 1917, summertime in temperate Australia, and the country is in the midst of 'the greatest battle man has had to fight against stored grain pests anywhere and at any time,' as one historian points out. Alarming numbers of rodents are being extinguished at hundreds of locations around the country, similar to this site in Victoria (Figure 1B above). A war within a war is underway. Some men take up arms on the frontlines while others fight to secure the food supply.

Ninety-nine years after this period of agroeconomic depression, Fumigation Service & Supply and Insects Limited hosted their 12th International Fumigants & Pheromones Conference in the stunning city of Adelaide, South Australia – just a short drive south of Crystal Brook. Manufacturers, grain traders, investigators, and field technicians gathered to discuss hot topics throughout the industry, each bringing nuggets of expertise from their areas of the world. Attendees entertained state-of-the-art gadgets, in-depth analyses on the latest research topics, and practical solutions to combat pest attacks in food facilities – including rodent management. Australia had come a long way in just a century.

For several decades now, Aussies have rightfully boasted themselves global exporters of bona fide cereal grains, devoid of imperfections or contaminants, and on par with any other supplier worldwide – a poster child for purity by international standards. Nationwide decrees have been written into law to ensure their crops' protection – lauding that 'no wheat berry be left behind.' Strict rules make it easier to eliminate rodents and insects while transitioning from farm equipment to shipping vessels. Australia's cleanliness has rightfully earned it a chest-puffing reputation, but as the opening story depicted, the Land Down Under was once the global underdog; a victim of ill-timed intercontinental instability, domestic neglect, pest-provoking conditions, and downright poor luck.

Today we live in privileged times. First world citizens have grown numb to the hygiene of processing facilities and foodstuffs, the outcome of a century of protection regulations, audits, and research-supported installments. Developed nations are indebted to pest control companies, corporate and family-owned, which have carried out much of the heavy lifting. More than ever before, ingredients are wholly unadulterated by the time they reach the consumer. Products endure such refined physical, pneumatical, and chemical processing that a miller can fillet a wheat kernel into flour within minutes. Sifting and sorting that flour in precise combinations creates unique mixtures that can expand several inches into a sourdough bread loaf or harden to a crisp for a thin-crust pizza – just add water and set the oven to 400oF. Pest invasions of the past play an essential role in shaping the food industry seen today.

Let's return to the assault at large. One must wonder what led to such rapid and extreme chaos in 1917? Why were the rodents unbearable in Australia but not in other wheat-growing nations? How had storage depots flipped from minimal pest invasion to 100,000+ rodents killed each night? Four significant "strikes" confronted the Aussies throughout this plague.

Before 1917, bags of wheat hot off the field went to the nearest depot, whereupon laborers assembled them into grid systems for temporary storage (Figures 2 and 3). If time and materials permitted, the men blanketed the stash with iron roofing to keep out the rain and tarped it along the sides. Foreign governments purchased the wheat within several months, and the stacks were deconstructed quicker than they arose.

Wheat was money, and with exportation in high demand, cashflow trumped savings. In previous years, international trade alliances naturally accepted Australia's overflow wheat but instead shut down most of their ports while World War I was in full swing [Strike 1!]. The 1915 harvest rewrote Australia's almanacs. Farmers sickled 180 million bushels at the stalk, crushing the previous year by 42%! (It took only 30 million bushels to feed its citizens). 1916 and 1917 bested these numbers still. Wheat yields were skyrocketing [Strike 2!!]. The country's shallow pockets filled in a fortnight as crop productions increased with neither the structural capabilities nor the workforce to support them. Where to put the excess wheat became a serious conundrum, and with more wheat than mouths to feed, Australia fell behind the 8-Ball. Families could easily stock appropriate rations in a cupboard; why have expensive silos and elevators? Amid war and overproduction, for the first time, a need arose to handle and condition the remaining crop, but established systems for this did not exist [Strike 3!!!]. Like mister nozzles releasing water out of a high-pressure manifold, hundreds of makeshift depots were built on a whim to reduce congestion in the wheat trafficking system. And the mice took notice!

All civilizations have been shackled by famines that dwindle the food supply. But coincidentally, the issue here was overabundance, more food than the nation could handle, which jammed the wheat trade and led to social unrest. With most global commerce still shut down, an exodus of wheat was unavailable, as two-and-a-half years' worth of the crop accumulated and sat dormant.

More numerous and overloaded than ever before, these virgin sites provided rodents with a new avenue to lodge and feed. Mice swarmed out of the countryside in waves of "teeming millions" to feast on the wheat, weakening the stacks at their base and imploding the depots (Figure 4). In just a few months, the mice terrorized hundreds of sites in this manner. In their minds, they had hit the lottery and were living in excess. Food. Family. Shelter. Some depots tried cleaning and re-bagging, but it was an exhausting effort. Others shoveled up the wheat, pests and all, and sent it to coastal terminals. The worst of sites cut their losses altogether and buried or burned the grain.

Figure 2: A depot containing 6,000,000 bags of wheat in roofed stacks in Brooklyn, Victoria during the 1916-1917 season.

Figure 3: Wheat stacking at Port Adelaide, South Australia, 1918.

Entire storage facilities tumbled to the ground each day and exposed the kernels to the heavens, soils, and pests of all types. It also rained more than any recent year, which accentuated the damage [Strike 4!!!!]. Mass amounts of exposed wheat swelled with moisture and decayed even faster. Horrid odors whisked through the air, a concoction of dead mice and spoiled grains, creating "conditions so bad that often strong men were overcome with nausea, and had to drop out."

Figure 4: (Top Left): Collapsed stacks at Barellan, New South Wales. ***(Top Right and Bottom Left):*** Collapsed stacks, location unknown. ***(Bottom Right):*** Collapsed stacks in Crystal Brook, South Australia.

Today's food protection principles mimic those since the dawn of agriculture: the best forms of pest control prevent the pest from ever reaching a product. With that in mind, officials enforced a two-part scheme: 1) stop the mice coming in from the fields and 2) terminate the mice already inside the stacks. Many sites scurried to erect mouse-proofing barriers around the piles. Tall iron sheets were mounted in concrete footers running the perimeters.

But vermin often breached the obstacles by scaling up the walls or tunneling under the footers instead. Officials instructed workers to tidy-up the depots, but the orders were not well received, and compliance was lackluster. Most did not understand the importance, nor embraced the laborious tasks to keep the structures rodent-proof – akin to the same challenges many facilities and employees face today! Men filled burrows around the borders, removed carcasses daily to neutralize further rodent attraction, and buttoned up voids in the walls – monotonous chores for rugged countrymen working for small paystubs. Additionally, until they experienced it firsthand, usually too little too late, most men could not fathom the speediness at which depots crumbled when under attack. But when they maintained with their exclusion apparatuses, the mice numbers thankfully curtailed.

With the rodent influx addressed, the bleeding slowed, officials shifted to engineer new methods for exterminating the mice already inside, including the following: Walls opened every 25 feet, where a bucket of water was sunk into the ground. Rodents searching for a drink – marching in from the fields or wandering out of the wheat stacks – would fall into the buckets, overexert in a panic, and drown. Some sites combined this method with overnight fumigations. Men draped calico curtains over the stacks and injected hydrocyanic acid gas. When it could not kill the rodents, alternatively, it flushed them out and into the drowning buckets – like a hunter smoking a fox out of its den. Laborers spent long hours disposing of the bodies just as the young boy did in the opening story.

Adversity can be a true testament of a nation's merit and can drive innovation and prosperity if mistakes are understood, and a cure is prioritized. Australia bounced back from this catastrophe in the coming years. Wheat trading rebounded when the war cleared and ports reopened. In the decades to come, Australia followed suit of other developed nations and established storage facilities across its crop-growing states. The government allocated additional land to accommodate the annually increasing yields, which doubled as a safety net the next time an unforeseen event occurred.

The year of the mice was a roadblock indeed, even though historians give no estimation of the total amount of wheat lost. But it was only the beginning of an intensifying issue. This plague paved the way for one far worse. With sites still vulnerable and exposed, the doors stood wide open for other intruders, and a new wave of pests bombarded in. As the mice populations tapered off, the notorious weevil insect carved out a place in Australian history. The following year amounted to destruction far worse than what the rodents instigated – and it is the infamous reign of weevil, not the mice, credited as the alpha invaders of the era.

Story to be continued in Part 2

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