The Untold Story of the Rodent Bait Station

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ABSTRACT: The rodent bait station is the central technology used in rodent control, and its history is not well known. We present part of a historical and anthropological study of rodent control in which we detail why the rodent bait station was designed the way it was and how it has been taken up by the industry over the last 70 years. The current ecological crisis of secondary poisoning because of anticoagulant rodenticide use is, we argue, better understood when one recognizes that the bait station system ensures widespread use because of the way it has been designed and embraced in pest control.

KEY WORDS: anticoagulant rodenticides, Charles Elton, ecological science, history of science, rodent bait stations, secondary poisoning

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INTRODUCTION

This article tells part of the history of the rodent bait station. It is part of a historical and anthropological inquiry into rodent control, rodenticide use, and secondary poisoning (Kelty 2022). As part of the project, we investigate the social relations among humans that have resulted in an ecological threat to wildlife because of the use of anticoagulant poisons, and the resulting effort to control it through regulation and legislation (e.g., The California Ecosystems Protection Act of 2020).

The argument we make here is that regulating the poison will be less effective than addressing the way the economic system of rodent control is currently structured. Part of that structure is driven not by poison use, but by the rodent bait station itself. Ours is a qualitative argument based in anthropological fieldwork with pest control professionals, an archival research into the history of the bait station and associated technologies.

Methodologically, this paper relies on two kinds of research. One is long term repeated fieldwork with pest control techs, pest control experts and firm owners, wildlife biologists and scientists concerned about human-animal relations. We start with a story from that fieldwork:

The project to study human-wildlife relations in Los Angeles began with a proposal to study coyotes and coyote-human relations. The goal was to accompany pest control professionals as they talked with residents, trapped coyotes and dealt with the results. But, on my first day out with a pest control tech, I didn't see a single coyote. Instead for 12 hours we filled rodent bait stations. Bait boxes. Bend over, open the box, remove debris, insert the poison, move to the next box. Someone committed to studying coyotes might have said, "this is nonsense, I'm not doing this any longer", but the curious anthropologist says, "wait a minute. THIS is what you do all day? I want to understand this."

After just a few ride-alongs, I became exquisitely aware of just how ubiquitous rodent control is in a city like Los Angeles. I started a game. I would travel to iconic LA spots, and within 5 min, see if I could find a bait station. When I realized that I could never lose this game, I started to wonder: how did we get here? Within a year I had learned enough about rats that I could petition Niamh Quinn to let me attend the West Coast Rodent Academy, which is where I heard an industry veteran say this to me:

> "We've become a device deployment industry − you've got a rat problem, we've got a rat-box, unfortunately, that's what the industry has become, and it's soul-stealing work." (Author Field Notes, WRA Nov 2019)

I wanted to know: how did we get here and is this related to the fact that rodenticides cause secondary poisoning in local wildlife like LA's beloved mountain lions?

AN ECOLOGICAL CRISIS

By 2019, the secondary effects of anticoagulant poisoning were well known. In September of 2020, the California assembly managed to pass new restrictions on the use of second-generation anticoagulant rodenticides (SGARs), a long-standing effort led by California assemblyman Richard Bloom (D-Malibu) (Mayer et al. 2022).

There have been dozens of studies on the secondary poisoning effects of SGARs and hundreds more in the literature all over the world (Riley et al. 2007, Serieys et al. 2018, Van den Brink et al. 2018). Banning the poison had started to seem inevitable to both environmentalists and pest control professionals. However obvious it may seem, no one seems to have really asked: assuming you want to stop secondary poisoning of non-target wildlife − is banning or even restricting the poison the right approach?

We argue here that the answer is that this may not be the right approach. Many people in the pest control industry might agree with this answer, but probably for different reasons. A common mantra in pest control is Integrated Pest Management: use many different tools − some poison, some traps, some exclusion etc. But even IPM does not address the question of why secondary poisoning is happening, or whether it is likely to happen in the future (Wolff 2022).

For politicians like Richard Bloom, and for most well-meaning lovers of wildlife, the impulse is to target the poison. In order to understand why this intuition might not be right, it helps to understand two things. First, the story of where the rodent bait station came from and why; and second, the role the rodent bait station in the business plans of the contemporary pest control industry. Together these two things make up the story of how pest control became a device deployment industry, and pest control, soul-stealing work.

WHAT IS A RODENT BAIT STATION?

You could say rat-catching has always been a profession and you would be right. For hundreds of years, the basic ways in which rat-catchers caught rats didn't change much. Traps. Exclusions. A few trustworthy poisons. And the ability to think like a rat (Sullivan 2004, Pemberton 2014).

But the historian wants to know when this changed − and the answer is that there are basically three eras of rodent science that have changed how we think about, relate to and kill rodents.

The first era is the turn of the twentieth century. The germ theory and the discovery of disease microbes − notably *Yersinia pestis*, (plague) and its vector of the flea coincided with two important events: the peak of the colonization by Europeans of SE Asia, India and Africa, and the Third Plague Pandemic (Lynteris 2019, Skotnes-Brown 2021, Soppelsa 2021).

It was in this period that the rat really received its current reputation as the villain (Lynteris 2019). Even though the rat is just a carrier of a flea, which is in turn a carrier of a bacteria − the rat got all the blame. This new villain unleashed a war. All over the colonial world soldiers in the rat war scaled up old solutions: more exclusion, more traditional poisons like strychnine and red squill, and more traps, baits and bounties (Vann 2019, Soppelsa 2021). But other than a couple of obscure tools, rat control was as it ever was.

This period was also the age of industrialized agriculture: farmers scaled up production, and so did the rat. Grain and produce, thanks to refrigeration, could be shipped globally and so could rats (Sayer 2017). The patent record from the early twentieth century is awash in new devices for trapping and killing rodents, including many for bait stations. Most early patents were designs that attempted to poison rats while protecting other farm animals. Farmers understood the problem of secondary poisoning all too well. But no single contraption for catching or poisoning rats took off more than another.

The second era of rodent control is the period around World War II. The period of the war was a period of massive investment and massive invention. It wasn't just the atomic bomb and Oppenheimer, which for good reason gets all the attention − it included thousands of other innovations spurred on by smart scientists committing themselves to the war.

During this period there was a vibrant group of rodent scientists in, of all places, Baltimore, Maryland (Keiner 2005, Ramsden 2011). Perhaps the most impressive was Curt Richter, an endocrinologist and experimentalist who studied taste and smell and the "internal milieu" of rats and bet his career on an odorless and tasteless poison called alpha naphthyl thiourea or ANTU (Richter 1968). His bet didn't pan out − it was too effective and killed too many dogs and cats and other animals. Richter didn't know about Warfarin, which was discovered just a few years earlier and started on its simultaneous career as both a blood clot remover in humans and a rat poison (Rajagopalan 2018).

Across the pond, one of the scientists engaged in the war effort was a British gentleman named Charles Elton. Elton's name isn't a household one only because he lives in the shadow of Darwin. Elton was one of the first scientists to theorize the concept of the functional niche, the food web and the ecological approach to population fluctuations. He also wrote a book that launched a whole field: *The Ecology of Invasions by Plants and Animals* (Elton 2000). Anyone working to eradicate an invasive species anywhere in the world today has Elton to thank for first describing the dynamics of invasion, and for thinking of it in terms of the dynamics of population ecology and community structure.

When the war started, Elton converted his lab, which was called the Bureau of Animal Population, into a wartime effort to understand rats and mice because with the deployment of hundreds of thousands of troops in close quarters around the globe, the rats came too.

What set Elton apart from other rat researchers is that he was not interested in creating a new poison. Elton had come to California in the 1930s to study plague in rodents and was appalled by the indiscriminate use of poison by large agricultural owners − no science, no measurement, and a desire to eradicate all animals, rather than controlling them (Honigsbaum 2015). For Elton, this approach would never work.

What set Elton apart was his way of thinking about the dynamics of population fluctuations − something he pioneered in his research on other creatures like birds or voles − he wrote a famous book about voles (Elton 1971). Elton saw pests as coming in waves, like diseases do. It was not necessary, and probably impossible, to eradicate rats or any other creature entirely, but rather to "apply planned moderate control over very wide areas at low cost, and to sterilize completely areas where there is serious danger from rodents" (Chitty 1954:148).

Although he didn't use the word, Elton thought of rats as existing in ecological reservoirs that could spill over and infect other areas. The goal should simply be to keep this spillover from happening.

The work of Elton's lab during World War II resulted in one of the most comprehensive books about rats and mice. The three volume *Control of Rats and Mice* covers rodent behavior, habitats, modes of control, and the different types and effects of poison (Chitty 1954).

An unassuming centerpiece of the book is something called the Protected Poison Point, invented by Elton and his colleague Ransom.

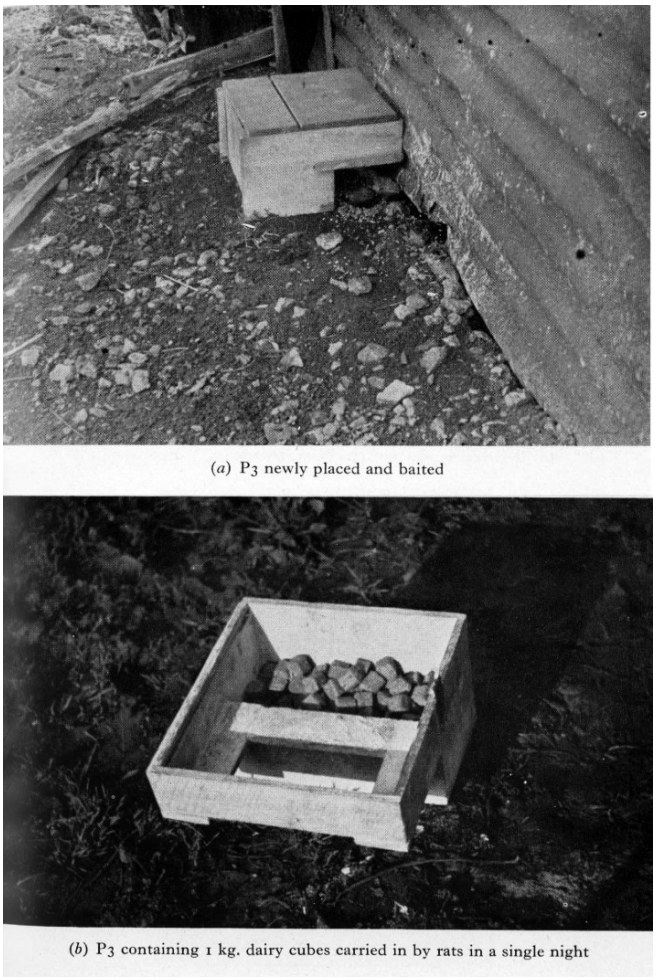
WHY IS THE BAIT STATION THE WAY IT IS?

The Protected Poison Point was the first rodent bait station of the kind we have today. The P3 wasn't defined to solve just one problem − like being tamper proof or keeping bait safe inside − but a box designed entirely around the ecology of the small farm and the body and mind of the rat.

Elton's team spent years during the war studying the behavior and physiology of rats and the P3 is a kind of architectural expression of this study. Elton asked − what will a rat go into? Observations and statistics suggested that Norway rats liked to enter from below, on bare ground, and in a safe place. So the P3 was designed to be entered from below, and to be a safe and enclosed space once entered (see Figure 1).

It was designed to let rodent-sized bodies in but nothing else – no chicken necks or dog snouts or children's hands. This was the original function of the baffle on the inside that prevented bait access and allowed the rat a safe place to consume it.

It was designed not to tip over or spill. It was designed to protect the bait from the weather – and this was based on the same basic understandings they gleaned from farmers who struggled to keep their grain



(*a*) P3 newly placed and baited

(*b*) P3 containing 1 kg. dairy cubes carried in by rats in a single night

Figure 1. (*a*) The original "Protected Poison Point" (P_3) placed at the edge of a building and (*b*) showing that rats used the bait box to store materials collected. Reprinted from Chitty and Southern (1954).

dry and not moldy. Indeed, much of what the rodent bait station is based on is the British grain shed − it is a device designed for the ecology of the small farm, and the rats who live there.

But more than just a simple box, Elton and Ransom understood the P3 as part of a system − a network of semi-permanent stations deployed in a campaign. It was wartime after all.

Elton also recognized what would later be called neophobia, and the need to plan a campaign by placing non-toxic bait before introducing the toxic versions. Ransom, the co-inventor, was confident that rats could be convinced to overcome neophobia and go in this box, in part because he observed just how comfortably they made it their home. He even printed the following charming list of things he found inside the P3:

> Pieces of gristle. Remains of dung beetle (*Geotrupes stercorarius*). Orange peel. Slices of bread and butter. A government form dealing with swine. Empty shell of water snail (*Limnaea stagnalis*). Many partly chewed earthworms (on one occasion 27g). Pieces of fish skin. Potatoes. Stems and leaves of elder (*Sambucus nigra*). Dead young rat (*R. norvegicus*) slightly gnawed. Willow (*Salix*) leaves. Knuckle bone. Leaves of plantain (*Plantago media*). Lumps of suet. Empty packet of 'Woodbine' cigarettes. Piece of electric cable. Piece of ox stomach. Sheep's wool. Head of a starling (*Sturnus vulgaris*). 1000g 'Dairy nuts' cattle cake brought in during one night [a picture is included in the text as Plate 1]. 27g. cotton seed cake brought in during one night. General rubbish such as grass, stones, hay, straw, sticks, & etc. (156).

The P3 soon found success. Elton and Ranson patented the design for the P3 and contracted with Imperial Chemical Industries (makers of Paraquat and the anticoagulant Brodifacoum) to manufacture and commercialize it. War shortages being what they were, they even designed a flat pack version that would put Ikea furniture to shame (see Figure 2). But perhaps the most significant thing is that Elton actually warned of the problem of secondary poisoning from the very beginning:

> The danger to animals takes two forms, that due to eating prepared baits, and that due to eating dead or dying rats… The danger to cats, and to a lesser extent to dogs and pigs, is from secondary poisoning. Cats should, of course, be shut up during a campaign, but this is not always possible, particularly on farms. The advantage of zinc phosphide in producing corpses in the open is considerably offset by the increased danger to cats. It spoils the effect of showing the kill to the farmer if his cats are included (Chitty p. 32).

I mentioned there were three eras of rodent science. There are of course other innovations since Elton's invention − specifically the development of poisons themselves and the development of paraffinized bait blocks, attractants, and a few other key elements (Kaukeinen 2007, Marsh 2012, Rajagopalan 2018). But by World War II, Elton and colleagues knew enough about rodents to basically invent the rodent bait station and the system of semi-permanent baiting used to control rodents over a large area.

The third era of rodent science is different. From 1970 to 2010 we learned about the ecological role that rodents play − both in the conservation sciences, where invasive rats on islands have become a new kind of villain, but also the role that rats play as food for other animals and the impact of secondary poisoning on wild animals that we now value (Van den Brink et al. 2018).

When Elton recognized secondary poisoning as a problem of the system he had created, he understood the site and ecology to be that of the small farm, or perhaps the neighborhood of a city, but he restricted this concern primarily to other creatures on a farm or in a household. By the late 20th century this would change.

FROM A SEMI-PERMANENT NETWORK TO AN ECOLOGICAL CRISIS

From the 1960s to the 2000s the pest control industry adopted the rodent bait station enthusiastically and scaled up its use to the level where, by 2019 one could drive anywhere in an American city and within 5 minutes, find a rodent bait station.

This scaling up changed many things. First, the bait station became the gold standard**.** In the 1980s the EPA made "tamper-resistant" boxes a requirement to protect dogs and children, and to a lesser extent non-target wildlife (Jacobs 1990). The EPA thought it was protecting the world from poison, but it was actually telling the industry to deploy bait boxes as widely as possible, including, perhaps especially, in cities. It took a box designed for agricultural ecologies and implemented it everywhere − inside and outside, rural and urban − and it had the EPA's blessing and encouragement to do so.

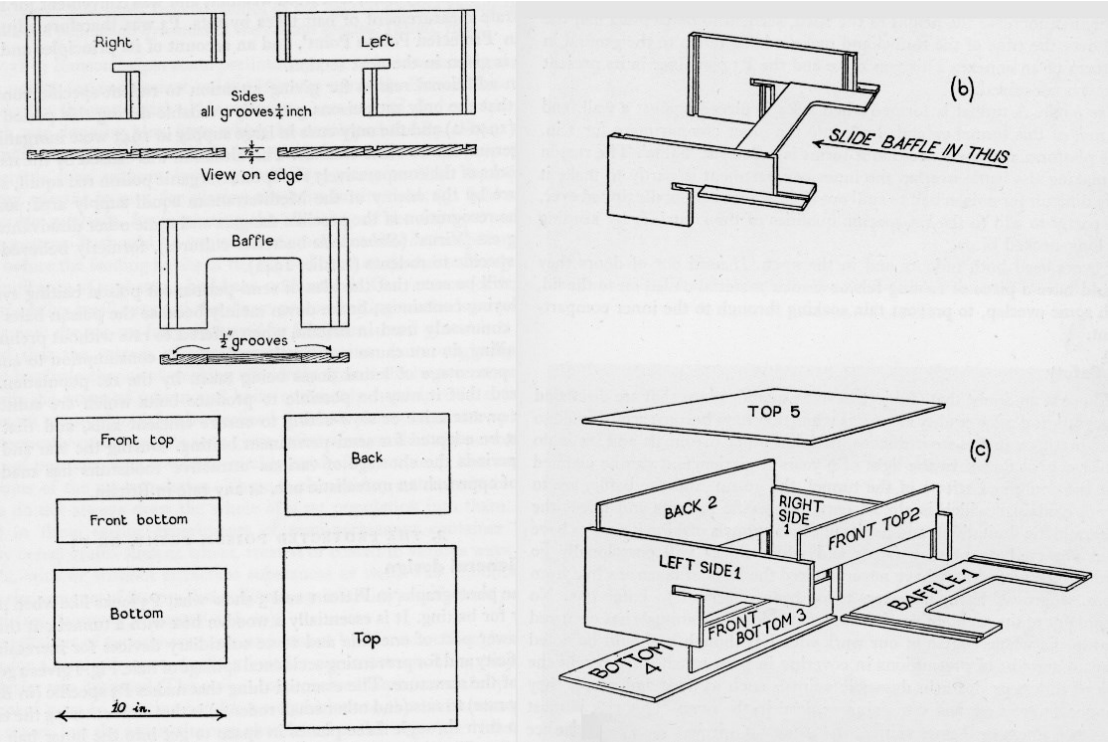


Figure 2. Two schematic illustrations for construction of a "flat-pack" version of the P_3 designed by Elton and Chitty. Reprinted from Chitty and Southern (1954).

Second, the box lets in anything smaller than a rat, and lets out anything that the poison doesn't kill**.** The bait station is designed around rodents, which means that if you are using a Brown Rat-sized box, you are using a box that anything smaller than that can also enter. And plenty of things do. Snails, for instance, which are also pests, are ubiquitous in California bait boxes. But they don't have a circulatory system, so SGARs don't hurt them. But that doesn't mean they can't take the poison with them, and in turn be fed upon by birds, rodents, and reptiles. Which is to say, the bait box is designed to keep some kind of animals out, but it accidentally also lets some kinds of animals in − and back out again. Rats are not the only vector of poison, therefore.

Third, the idea of a semi-permanent campaign transformed into the idea of a permanently installed infrastructure. From a brief battle, the rodent bait station led to a permanent war on rats. For pest control professionals, this created a new business opportunity: the large-scale repeating contract. Now rather than the strategic detective work of exclusion and rat-trapping, the industry started to deploy devices permanently on a subscription model.

As a result, and lastly, this meant that large customers became the key market for rodenticide use. This new business model meant that the highest margins could come from the largest customers. The biggest customers turn out to be large residential communities, especially those governed by Homeowners Associations (HOAs) or community boards. They represent a single payer for hundreds and some cases thousands of houses. One of the pest management professionals we worked with showed us a bag full of the business cards of over a thousand HOAs and property management companies in Southern California. These represented his core customers.

But while this situation makes excellent business sense, it makes bad ecological sense. For one thing, most of the large housing developments are suburban − often at the urban wildlife interface, precisely the place most likely to contain wildlife at risk.

Recall that Elton's bait station was designed around the ecology of rodents on farms − but at the risk of stating the obvious, suburbs aren't farms. There is no harvest season during which you might see significant resource-dependent pulses of rodent activity. Suburbia also isn't a food safety risk. All the food that humans consume enters through their garages. A consumer living in a suburb is probably at greater risk from a poorly managed rat control program in a warehouse thousands of miles away than they are from one in their house.

But scavengers and carnivores at the edges of a city are now at much greater risk. What is all this telling us?

WHAT DO WE DO NOW?

Several concluding thoughts follow from these stories: First, perhaps banning poisons is not the right approach if your goal is to stop the ecological crisis of secondary poisoning. The reason for this is simple: *something else is going to go in the box*. Most likely that is going to be another poison, because this is what the system demands. Indeed, evidence exists that secondary Bromethalin poisoning is already possible (Sant et al. 2019).

Second, we need poisons for some purposes. Antibiotics are an apt comparison − overuse has led to dramatic risks of antibiotic resistant organisms and thus greater risks in the case of the extreme illnesses (Landecker 2016). In this case it is not the resistance of rats that is at stake − though the evidence exists that FGARs and SGARs both cause resistance in rats − rather, what is at stake is the decimation of other animals, and the consequent effect on biodiversity. Overuse of rodenticides,

like that of antibiotics, both reduces their effectiveness, and creates its own, unforeseen risks. Even in the current legislation it's clear that rodenticides are essential: the carve-outs in the existing bans include health care, food production facilities, CAFOs, and government users.

Third, regulating consumers might be more important than regulating applicators, but consumers must mean first the largest buyers: HOAs, municipalities, large landowners, corporate users.

Fourth, the industry needs new business plans: the world the rodent bait station was originally designed for in the work of Elton and his colleagues is no longer the world we live in today. We need an equivalent system tuned to the needs of wildlife and humans alike − one that treats rats according to the threat they actually pose, rather than catering to the horror that humans have developed.

Finally, such a business plan might be better for pest control employees as well, if it could be designed. No one wants to do soul-stealing work.

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