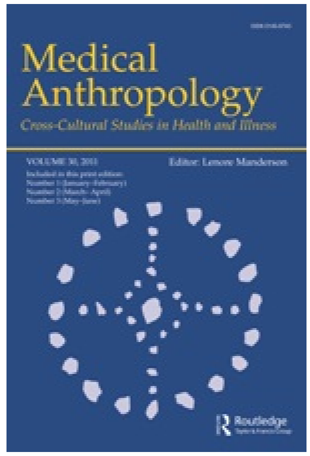

The Ecological Origins and Consequences of the Rodent Bait Station: from WWII Britainto Contemporary California

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The Ecological Origins and Consequences of the Rodent Bait Station: from WWII Britain to contemporary California.

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ABSTRACT

This article describes the origin of the rodent bait station, a globally distributed system for controlling rats, currently creating a secondary ecological crisis affecting wildlife who eat rats that have eaten the poison. I argue that this system is tied to settler colonial places like California and that banning poison will not address the crisis. It details the history of this box as a scientific ecological solution to rat control, created by Charles Elton and his research group during WWII. I pair this account with an account of contemporary science into the ecological crisis of rodenticides.

KEYWORDS: California; ecology; rodenticides; settler colonialism; traps

Media teaser: I explain the history of the modern system of rodent control and why it causes an ecological crisis in settler colonial places like California.

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"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."[1]

{Figure 1 about here}

In November 2019, I was a student at the West Coast Rodent Academy, a school designed for pest control professionals in the Western United States to learn about new technologies, the latest controversies, the science of zoonotic disease, how to hunt and track and exclude rodents—how to think like a rat. [2] The quote above is from an accomplished professional pest control expert I interviewed there. He was referring to the ubiquitous rodent bait station (figure 1). A small black box that can be quickly placed around buildings or neighborhoods, periodically filled with poison, and regularly checked and refilled on a monthly contract to create large-scale, constant, low-maintenance, profitable rodent control. The pest control expert had long experience of how the industry had changed, from the practice of catching and trapping pests, which bears some similarity to hunting or detective work, to a routine practice of mindless distribution of poison into a particular landscape. The bait station, and the industry that depends upon it, are at the heart of his lament about "soul-stealing work."

The bait station has been central to an industry of rodent management for close to 70 years. It is now also at the center of a contemporary ecological crisis in which a range of creatures—hawks, owls, coyotes, mountain lions—suffer collateral damage from its widespread installation through the over-consumption and bio-accumulation of anticoagulant rodenticides. The bait station is part of "the biology of history" (Landecker 2016:21): it is a secondary ecological effect similar to other crises that build on past practices such as the endangerment of right whales by "heritage" lobster trapping (Besky 2021) or the ecological consequences of glyphosate use in agriculture (Adams 2023).

In this article I tell the story of the bait station: where it came from, why it works the way it does, and the consequences of this design for the present. I discovered the bait station through fieldwork with contemporary pest control experts in Los Angeles in 2018-2019. California is key to the story of the bait station, as it is there that the secondary effects have become very clear with a moratorium placed on the use of anticoagulant poisons since 2020. But perhaps even more importantly, California is an exemplary settler colonial place, both politically and ecologically (Whyte 2018). I raise the question of how the "ecological origins of an ecological crisis" typifies aspects of settler colonial ecologies, and how the structure of rodent control is one component of that ecological settlement.

The ubiquity of the rodent bait station became clear to me during fieldwork with pest control technicians. It led me to ask a series of historical questions about the box, and how it emerged at the cross-roads of ecology, agriculture, disease research, and practical design. At the center of this history is the eminent ecologist Charles Elton, well known for his work in defining the science of animal ecology, including disease ecology, and on “the biology of invasions” (Elton 2000). Less well known is that from 1940-1945 Elton converted his famed Bureau of Animal Population to a wartime project on the control of rats and mice, where he and his group created the basic grounds of the device deployment industry I encountered in 2019. This paper documents this relatively understudied system of rodent management, in order to explain why the apparent necessity of killing rats led to an ecological design of the bait station system that has created an ecological crisis.

This apparent contradiction is due to the fact that “ecological” thinking—thinking through the relations of biological organisms among other plants and animals entangled in an environment—is actually very good at establishing how to poison rodents. It clarifies how to get them to consume poison, how to get poison into rodents and not into other animals, how and where to place poison to be effective, how much to use over what area and time period, and so on. Both the design of the rodent control system and the crisis that has emerged are “ecological”—and this confusion means it is necessary to go beyond the word or the theory and look instead at the details of a mostly overlooked object.[3]

Thus, a proposed “ecological” solution (implicitly a “non-toxic” solution) is not a solution, in the sense of an end to a problem. The crisis created by the rodent bait station cannot be fixed by being more environmentally friendly, sustainable, or ecological—because it is already an ecological solution. To paraphrase the claim which Patrick Wolfe makes about settler colonialism: rodent control is a structure, not an event (Wolfe 1999). And as a structure, it has settled into everyday life as a kind of ruins: in fact it is not even clear to many pest control experts that it works anymore for the purpose of controlling rats. As a system, it reflects a deeper logic of settlement, not just a rodent control strategy. As Mahvunga, Whyte, and Heydinger have shown, vermin control often uses the same methods, poisons, and technologies as settler colonial violence against indigenous peoples (Whyte 2018; Heydinger 2020; Mavhunga 2011).

I begin from observations of the rodent control system in southern California because it inherits a particular form of settler colonial ecological transformation needed to simultaneously sustain agriculture and urban life, and also to disempower and displace native populations. Ranching, farming, oil extraction, and even environmental restoration constitute successive waves of ecological transformation in southern California. Each of them is tied intimately to pest control, which enables the transformation of landscapes and relations among plants, animals, microbes, and humans. There is much more to say, ethnographically speaking, about pest control, pest control technicians, the industry, and the ecological features of urban Los Angeles, but for reasons of space, I defer that ethnography to another article. For medical anthropologists, this article demonstrates how scientific ecological ideas—which are increasingly invoked to make sense of things like zoonotic disease, "reservoirs," and spill-overs—can just as easily be used to create a rodent extermination structure tuned to the biological and ecological capacities of the rat. And in turn, it can create an ecological (in the sense of environmental) crisis in the present. The language and theoretical reliance on the terminology of ecology, so widely used in anthropology today, can sometimes mask other relations.

The art and science of killing

Why kill rats?

First: the vilification of the rat as the vector of disease (Lynteris 2019). Rats are famous for their association with the Black Plague in Europe (the bacteria *Yersina pestis* lives in the fore-gut of fleas, typically *X. cheopis*, and is often found on the black rat *Rattus rattus*), and it was the response to the Third Plague Pandemic in the era from 1890-1925 (throughout China and India, as well as other parts of the globe) that drove the device deployment industry of the present. It was during this time that the bacillus and the vector were identified, and rats were newly targeted.

The war on the rat during the Third Plague Pandemic was enthusiastic, especially in the context of the imperial expansion of Britain and France, employing the most modern methods of chemical and biological warfare, in nearly every part of the colonial world (Soppelsa 2021; Engelmann 2019; Vann 2019). Not only was the rat newly vilified in this period, but the widespread *failure* to eradicate rats despite a considerable investment, drove the scientific exploration of alternative ways of dealing with rodent infestations. Thus for the 20th and 21st centuries, rodents have been imagined as a disease threat, and the methods of dealing with them regularly use this danger as justification. This was not always the case (Pemberton 2014).

Second: killing rats is a story of farms, cities, and food (Burt 2006; Sayer 2017). Rats compete with humans: they eat what humans eat, and they often destroy the things humans build to protect what they eat. Just as farms are connected to the cities they feed, so too are rats. The expansion of industrial agriculture in the 19th and 20th centuries distributed rodents all along the circuits of food distribution: rats in fields, barns, trucks, trains and ships, warehouses, neighborhoods, apartments, and suburban housing developments. “Vermin” have a long human history (Fissell 1999), but these relations changed in the late 19th century with the expansion of industrial agriculture. “Modern” rat control is a mix of scientific and economic concerns (Sayer 2017), particularly visible in settler colonial domains, where large-scale transformation of the landscape and the repeated invasion of non-indigenous humans and non-humans alike has driven rodent population fluctuations (Griffiths 1997).

{Figure 2 about here}

The bait station at the center of modern rat control and the contemporary "device deployment industry" emerged out of this context, and is not reducible to any particular element—trap, poison, disease, hunting practices, etc. It is a novel re-combination of some of these elements, which makes the system something specific to settler colonial ecological transformations. The bait station system consists of an architectural design, a bait, and a poison, set up in a "semi-permanent" network, and maintained over time. The word "station" is appropriate: like a train or police station, it is part of a system.

In agricultural settings around the world, the bait station is a familiar invention. The US Patent database is filled with them; they even have their own classification in the US patent system: A01M25/004. Isaac Keyser's "vermin exterminator" (Patent no. 1352067), TH Greenway's "poison holder for rodents" (Patent No. 1471954), FL Bushong's "Rodent destroyer" (Patent No.1579512), and Erickson's collapsible "Poisoned Food Corral" (Patent No. 1569624) are just a few early examples (see Figure 2).

Such patents never question that rats should be exterminated. A few mention that rats eat crops and damage storage sheds, but far fewer the prevention of disease. Across all these patents, alongside their efficacy in killing rats, one concern is clear: devising an architecture that poisons the rat, but does not poison the cat, dog, child, cow, or bird. William Rose of Ohio, inventor of the "poison holder for rodents" sums it up:

> It is my object to provide a poison holder which can be conveniently filled and which will be unavailable to poultry, cattle, dogs, horses and game and song birds, and which will thus only be accessible to the objectionable and destructive rodents which it is my desire to exterminate in the interests of conservation of crops and orchards (US Patent No. 2205125).

Most rat-knowledge before WWII is not laboratory science but practical work, drawing on a rich and long-repeated set of more and less systematic observations and techniques, including the use of common poisons like arsenic, red squill, or strychnine (Burt 2006; Pemberton 2014). By the 1930s, the laboratory rat (a domesticated species of *Rattus norvegicus*) was well-studied (Rader 2004), but the wild rat has always suffered from being too common to be of much scientific interest.

Even the war on the rat during the Third Plague Pandemic lacked systematic scientific study of wild rats. As Soppelsa (2021) shows, the bloodlust of the Imperial war on rats spurred a scaling up of traditional means of dealing with rats: rat-proofing, trapping, poisoning, quarantine, and biological control (cats, dogs, ferrets) and so on. What innovations it brought were derived from new weapons, including biological (the so-called Danysz virus, actually the bacteria *Salmonella entertidis*) and chemical in the form of fumigation with sulfur dioxide, and Chloropicrin (Engelmann 2019; Russell 2001).

This changed in the 1930s, when scientists from outside of the traditional settings of rodent control, agricultural science, and public health turned their attention to wild rats. Christine Keiner (2005) has documented part of this history, especially the work of Curt Richter and his collaborators in Baltimore between 1942 and 1946 (Richter and Emlen 1946, Richter 1968). Richter's work focused on the behavior of rats in response to poisons–especially their physiological reaction to smell and taste and their ability to remember and avoid them. His project honed in on a novel substance, alpha napthyl thiourea (ANTU), which was highly toxic but odorless and tasteless to rats. Richter sought to control rats through their physiology—their "internal milieu"—rather than through ecology or environment. But his aggressive promotion of ANTU was a failure in Baltimore, where resistance developed in rats, as well as from the residents for whom it remained a highly toxic poison.

Baltimore is arguably the world capital of wild rat knowledge: John T. Emlen, David E. Davis, John B. Calhoun, and the "Rodent Ecology Project" flourished at the Johns Hopkins School of Hygiene and Public Health from 1945–1952. Emlen created methods for counting rats, for determining home range, and for studying population fluctuations; Calhoun was famous for his 1950s experiments on overcrowding, in which wild rats (captured from an island in the Chesapeake bay), were confined to an artificially constrained physical space designed to mimic the conditions of crowding in human cities (Ramsden 2011). In the racially charged environment of urban Baltimore, these scientists amplified the issue by using racist language and associated rat infestations with low-income neighborhoods and cleanliness. Such associations are clear in the opening scene of Richard Wright's *Native Son* (1940) (analyzed by Bennett 2020), and scientists like Richter and Calhoun played directly into such well-documented stereotypes (Biehler 2013).

Charles Elton in his British wartime context, brought a different scientific approach to the wild rat, drawing on his extensive work in animal population ecology (and leading to future work on biological invasions), and a concern for understanding rats in their contexts–specifically, their co-existence with human populations, on farms and in cities. In the following section, I detail how Elton's work resulted in the design of a bait station system through his approach to understanding rat behavior, morphology, and population ecology.

As an important aside, the success of the bait station system also rests on the development, in this same period, of what has since become the most widely used kind of rat poison—anticoagulants. First and Second Generation Anticoagulant Rodenticides (FGARs and SGARs) affect rats by thinning the blood until the rat dies. Neither Charles Elton nor Richter's group were much aware of them at the time of their research, and the story of their discovery is a fascinating subject for another paper (Rajagopalan 2018).

The protected poison point

In 1939, recognizing the call of war, Elton converted the Bureau of Animal Population to a project on the biological control of rats. From 1939-1947, the famous ecologist was engaged in the "technical improvements in the means of rodent destruction (traps, poison, baits, &c.)" as well as a "general policy of control" of pests given the specific constraints of wartime ("stoppage of imports" and diversion of labor and materials) (Chitty 1954:1).[4]

The fruits of this work are collected in the three-volume work from 1954 *Control of Rats and Mice*. Elton's guiding influence on the project is evident both in his contributions, and in the general ecological view taken of rodent populations and their dynamics. Elton claimed to have conceived a method of control in 1938 based on previous work on voles and "the background of the sylvatic plague problem in western United States (147)" which led him to the idea that controlling rats was primarily an issue of the density and dynamics of rat populations.

Elton was in dialogue with the new ideas about disease ecology. He consulted with Karl Meyer on plague in California, and became aware of the vested interests of California agricultural powers and their attempts at control and eradication, which Elton suggested was being conducted with "a degree of blindness and a scarcity of scientific measuring of results that is rather astonishing" (Honigsbaum 2015:298).

Elton suggested that rather than a costly eradication campaign it "is possible to apply planned moderate control over very wide areas at low cost, and to sterilize completely areas where there is serious danger from rodents" (148). This would achieve "rational control in the light of definite knowledge of the habits and population dynamics of the various species" (148). Elton was less interested in disease prevention than in devising a way of controlling the size of populations such that rats could be confined to their niche, thus limiting disease transmission. It was an ecological solution to the threat of rodents, in the sense that it relied on an understanding of rats not as crafty, devious, invading individuals, but as a pool that can be more or less full.

The idea of a "reservoir" of disease therefore, though it was not used explicitly by Elton, was clearly part of his thinking. The control of rats meant finding a way to manage that reservoir, to keep it at safe levels, and to prevent its overflow. Indiscriminately killing animals without measurement was guaranteed to fail according to Elton. As Keiner points out, Elton's group critiqued Richter's approach for just this reason, saying that it would be a "futile endeavor to eliminate rats by poisoning alone" (Keiner 2005:123)

The Control of Rats and Mice is full of experiments, measurements, data, and analysis of rats. It focused on where rats live, especially among humans; much energy was focused on census methods—rats, it turns out, are harder to count than one might think—as well as intensive experimentation with different poisons, exclusion methods, and designs for distributing the poison. As Elton put it: "It did not dawn on us for a little time that the then existing methods of preparing and laying baits might need drastic revision" (11).

Thus, Chapter 3: "Containers for Baiting" whose authors are (poignantly) listed as "Charles Elton and the late R.M. Ranson." Ranson was the chief inventor, especially of the *pièce de résistance* the "Protected Poison Point" or P3. Elton contextualized the need for such a box in "epidemiological" terms, suggesting that the right way to address the presence of rats is not to treat them as an acute infection, but a chronic one in need of a "network of semi-permanent poison bait points" (147). This solution is "ecological" not in the sense of "non-toxic" but in the sense of controlling the overflow of population dynamics.

The black box (open or not, and readers trained in science and technology studies can be forgiven for their inevitable intuitions) is less important than the "semi-permanent network." It combines multiple boxes placed in strategic locations, regular refilling of the boxes with poison, and "pre-baiting" used to accommodate rats to this new architecture. In the following sections I detail how the design of this network draws on the biology and the ecology of the rat: its morphology, its behavior, its physiology, its temporality, and its population dynamics.

The three-dimensional rat

{Figure 3 about here}

The most obvious aspect of Elton and Ransom's P3 is its architectural design, shaped by the traditional concerns to limit the poison to only the rodents. Previous designs (as well as subsequent debates about the meaning of "tamper-proof") privileged this protective program of the bait box. What set Elton and Ranson's approach apart was their particular rodent mindset:

> The essential thing that makes P3 specific (in Britain at any rate) to rats (and other small rodents) is that a rat entering the tunnel has to turn through three planes in space to get into the inner bait compartment (149).

This "line of reasoning" is described in detail. These architectural elements thus connected the *res extensa* of the rat body, its behavior, British agricultural settings, poison containment, human observation and reasoning, unpredictable weather, and the morphology of other animals together in a design consisting of three parts: a tunnel, a "go-up," and a baffle.

Getting rats to go into something is, ironically, very difficult for the people trying to keep rats out of things. Thus, a bait box needs to provide a way for rats to enter that appealed to the rodent mind and body. This is accomplished by allowing rats to enter the box, as it were, from their natural starting position, which is to say, from below and on familiar ground. The box is designed in such a way that a rat can go into a sort of tunnel, but stay on familiar (dirt or concrete) ground. Unlike a tunnel made from a pipe, therefore, the ingenious solution looked a bit like the contemporaneous *Villa Savoye* of Le Corbusier with an entrance underneath an overhang creating a natural tunnel.

Once in this tunnel, rats can "go up" a step into the box where the analogy with Le Corbusier ends, for this was instead a design based on the humble British shed. "In searching for new rat colonies one feature of habitat choice was noticed; wherever a shed is put up near a rat infestation, rats very soon come to live under it unless the shed is built on piles well clear of the ground" (151). As Ranson reasoned: "it is common for rats to gnaw their way through the floor from underneath" (151) when they enter a shed or home.

This construction created a safe space inside the bait station, at the same time that it limited access of the baits to the world (spillage), and the world to the baits (children and other animals). Targeting rats and their three-dimensional capacities, while simultaneously excluding non-rats, necessitated the baffle: “The reason for making the baffle overlap the inner compartments is partly to make it more difficult for the poison bait to spill out if the P3 is accidentally tipped over, and partly to add to the rat-specific qualities of the container by keeping out long-necked birds” (152).

Such architectural rat-specific elements are repeated throughout subsequent bait station designs. The gracefulness of the Corbusier tunnel on bare ground would eventually be abandoned for the Brutalism of the EZ Klean station in Figure 1. Nonetheless, even that exemplar retains a focus on the three-dimensionality of rats, and the inner compartment hidden by horizontal or vertical baffles that limit access to non-rodents. As Ranson concludes: “In the light of 6 years’ experience, it can be claimed that the combined effects of the tunnel, the go-up and the baffle, are to give a container which is almost entirely specific for rats and mice: the size, athletic limitations, and habits of other animals making it so” (152).

Ranson insisted that no non-rodents could be poisoned with this system. Small animals and pets were not the only vulnerables to be protected. Children, though equally constrained by size and athletic limitations, could be protected by “a simple locking spring…too strong for a child to open” (152) and as for older people, interference was to be reduced by “stenciling a warning on the lid of the box” (152), a hopeful appeal to human capacities for literacy and reason.

Despite all this, Ranson was presciently aware of the problem of the secondary poisoning of rat-eating creatures:

> Though it should be noted that no amount of precautions in covering in poison bait can prevent the risk of illness or death in domestic animals such as dogs and cats if they happened to eat poisoned rats dying or dead in the open (152).

Just because you’re paranoid…

The bait box is built not only around the morphology of the rat and the non-rat, but also around behavior. Like Curt Richter’s Baltimore lab, Elton’s wartime rodent group rediscovered what is now called "neophobia" in rats. The "new object reaction," as they extensively describe, was of obvious relevance to the problem of killing rats with poison. For Elton's group "this behaviour was first encountered by Ranson during the design of the P3 […] , since rats seldom entered and took poison baits until after a lag of some days" (307). Rats are very sensitive to such changes, such that moving stations "even a few inches" (155) can disrupt the operation. In part this discovery came through the use of the P3 as a census tool for counting rats, as its novelty disrupted the count. In Chapter 5, an extensive set of experiments are documented related to the strategy of "pre-baiting"—acclimatizing rats to baits and the P3 before adding the poison.

Novel object reactions give an ecological temporality to rat control. One cannot just poison rats, one must first entice them to the place, the food, and the pathway to where the poison will eventually be placed. This is why the network must be "semi-permanent." It is not a question of treating an infestation by suddenly laying out poison, or even bait boxes; rather one must commit to a settlement, a long-term assimilation of rats to their new architecture, by working with not against their suspicion. This temporality is a kind of domestication, not of the rats but in preparation for the rats.

Once rats become accustomed to objects they move in. They will visit regularly whether or not it is baited. Ranson observed bait box use, before and after baits were placed inside: "rats will to some extent go into P3s for their own sake, presumably because they provide safe cover" (155). To be sure, the box protects the rats from predators. But perhaps more interestingly, the box also protects the rats' *belongings* just as human architectures are intended to protect our belongings. Ranson noted this as well, and made a list of things he recovered from his bait boxes:

> 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, &c (156).

Ranson dryly concludes that this "strange collection of objects from civilization and from nature does suggest that some rats regard P3 as a safe storage place and a refuge." There is something poignant about the "government form dealing with swine" ending up as nesting material for rats poisoned by ecologists.

De gustibus non disputandem est

Taste and smell were a key subject of study for Elton's group. What is now called "bait-shyness" concerns the ability of a nauseated rat to remember the effects of a poison that does not kill them, and to avoid it in the future. A significant scientific sub-field concerns itself with the design of poisons and the physiological response to consuming or sensing them. Chapter 7 of *Control of Rats and Mice* is devoted to the study of the consumption of plain and poisoned baits, and reports on experiments with dry and moist baits, wheat, sugar-meal, "sausage" rusks (unleavened biscuits), and bread mash.

The question of taste is janus-faced: the ability to entice rats to eat something palatable (the bait) which also contains a poison differs from the ability to taste or smell the poison itself (thus the high value placed on odorless/tasteless poisons). The two can also interact: "wheat grains coated with pure starch and dusted with arsenious oxide quickly develop an unpleasant smell which makes them unpalatable…" (43). Add to this the complexity of adding a warning color to the poison (required by law in Britain at the time), which itself may not be palatable.

Elton's group considered arsenic, red quill, zinc phosphide, and other poisons according to their temporality of action, their chemical stability, and their palatability. The search for a well-tuned poison concerned not only its effectiveness in killing rats, but the tricky calculus of finding a tasteless poison that persists outdoors as part of the "semi-permanent network," is palatable to rats but safely disgusting to humans or livestock: "Unpalatability is an important safeguard with squill, which is intensely bitter to man and is usually strongly refused by domestic animals but apparently not by rats" (32).

Bait and poison palatability are questions not only of immediate sensibility, but also of the rats' "internal milieu"—the association of particular tastes or smells with experiences of sickness. This highlights the importance of the temporality of a poison's effect. As Chitty suggests in Chapter 4, "the most valuable property a poison could have would be slowness of action" (240). They tested this inverse relation between the amount of poison in a sample and the amount consumed by rats: increasing the toxicity makes the bait unpalatable, but too low a toxicity gives the rat a chance to be poisoned, survive, and then hold a grudge.

While taste and palatability do not immediately seem to have much to do with the bait station itself, the interactions have frequently been noted by pest experts: how to prevent "moldy bait" or control "loose" bait (like grain). Various solutions have emerged: forming cakes or biscuits from grain, "wrapping" baits individually, or using baits that are, ironically, more valuable for feeding humans (like honey and eggs). Sadly there is not enough room here to detail the 1960s California invention of the "paraffinized bait block" designed to make the poison and the bait cohere together (using wax), useful in moist conditions (like sewers), having more integrity than loose bait, and appealing to the gnawing and scraping action of the rat (Marsh 2012).

Lastly, not only the bait station and the behavior of rats, but also the behavior of humans must be considered in finding a total solution. As Elton warns, prefiguring the problem that will come to pass:

> 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 (32).

The ecological creation of an ecological crisis

The secondary ecological crisis of anticoagulant poisons is not just one more event in the 20th century overuse of toxic substances, but a *structure* of rodent control shaped by the scientific ecological thinking about rodent-human relations. Elton's approach did not oppose "ecology" to poisons, but rather embraced ecology to use poisons well. Similarly, he shared the disease ecology approach with the work of Karl Meyer, Theobald Smith, and F. MacFarlane Burnett, deeming rodents, like the parasites they carried a feature of ecosystem dynamics to be modulated, not eradicated (Honigsbaum 2015; Anderson 2004, 2004).

The 20th century story of pesticides is often one of chemicals vs. "the ecology." Though simplistic, it is a powerful opposition structuring the way scholars understand the various crises of the overuse of pesticides. Similarly, in the history of medicine "disease ecology" is often narrated as an approach that, although influential by the 1930s, was drowned out by the eradication fantasies of antibiotics and vaccines, until the "emergence of emergence" in the time of AIDS and Ebola (King 2004). Anticoagulant rodenticides kill rats, but also poison the animals that eat rats.

Paradoxically, the very insights of scientific ecology virtually guarantee the production of a toxic environment today. Elton's design of the semi-permanent network of bait stations, based on wild rat morphology, behavior, and population dynamics targets the dynamics of animal populations instead of eradication. Eradication rarely works because killing rats is itself an ecological parameter of such dynamics. Killing drives these dynamics and can lead to explosive growth. Rather, a measured ecologically-informed strategy can still require some killing and by no means rules out the widespread use of poison.

Rodent populations, for Elton, are “reservoirs” of disease that can spill over into humans. “Spill-over” is not just an issue of contagion or virulence, but an issue of ecologically-dependent population fluctuations. Hence, the bait station is a system for controlling the reservoir—the population of rats. The “reservoir” in this case is not the parasite-containing body of the rat, but the fluctuating populations of rats in a neighborhood or farm. It is not only disease that exists in this reservoir, but also the other undesirable (to humans) capacities of rats, including their tendency to eat what humans eat, and to damage what humans build. They are thus both pest as a species and *la peste* in the sense of disease vector, which interferes with human flourishing by flourishing itself.

Controlling the reservoir is not just a project of disease prevention, but also a project of settlement and empire. The ecology of Elton and others was very much a settler colonial endeavor (Griffiths 1997; Anker 2001). Sayer makes the point that Elton’s “ecological” work is itself enmeshed in the techniques of farmwork methodology and agricultural economics (Sayer 2017:255). Elton focused not only on disease suppression in cities, but also on the stabilization of settler and imperial agricultural production around the globe. An ecological approach stabilized this empire.

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. The shortage of appropriate wood, and the bulkiness of the bait station, led Ranson to design a sectional flat-pack version of the P3 requiring only a hammer to construct (figure 4). “Five hundred were sent to Malta in 1945 to assist the rat campaign during a small plague outbreak on the island” (154). The UK Ministry of Food was by 1954 the largest purchaser, who distributed 7600 of them. By the 1960s and 1970s, the rodent bait station would be in widespread use around the globe eventually becoming the system at the heart of the soul-stealing “device deployment industry” of today, and with it, the ecological crisis of secondary poisoning that now faces us.

{Figure 4 about here }

The contemporary ecological crisis concerns the widespread use of bait stations in semi-permanent networks which constantly leak rodenticides into the environment, killing animals that eat either the poison, or the animals that eat the poisoned animals. As the previous section indicates, the risk of secondary poisoning was recognized, but under-valued by both Elton and Ranson. The cause of the crisis is not the over-use of poison. If anything, poison is used fairly judiciously and efficiently. Rather it is the very design of the system which over-flows in the attempt to control rat population fluctuations.

In what follows I detail how the design of a scientific "ecological" solution generated new environmental "ecological" effects. The bait station system makes the poison mobile via rats and other channels. By building the rodent bait station around the morphology of the rat, by designing poisons around the sensory and behavioral capacities of the rat, and by finding ways to make the large-scale poisoning of rats labor-efficient and routine in particular kinds of environments (agricultural settings, warehouses, and suburban neighborhoods), the most effective method for controlling rats turned out to be the best way to distribute poison efficiently throughout the food chain and environment.

Scientific and public attention to the environmental danger of SGARs began around 2010, but the dangers were clear long before that. A kind of doppelgänger volume to Elton's *Control of Rats and Mice* is thus the 2018 collection *Anticoagulant Rodenticides and Wildlife*, a volume of scientific review essays and proposals to limit the effect of anticoagulant rodenticides on wildlife (Van den Brink et al. 2018).

Other dimensional creatures

The P3 was designed around rat morphology in order to prevent larger animals accessing the poison. As such, it fails to protect animals similar to, or smaller than rats. Chapter 6 of Brink et al. (2018) reports that animals of all kinds eat the bait directly. Even protected inside the box, it targets rodents who together make up 40 percent of the mammalian life on this planet. Affected "Non-target" rodents like *Apodemus* in Europe or *Peromyscus* in North America are similar in shape and size can become a way for the reservoir to "leak" into the environment.

The effect is that the amount of poison is "greater in individuals and species when they are targets rather than non-targets" (144). A non-target can be a bird, child, or horse, but other kinds of rodents are, by design, collateral targets. The problem is not simply that some rodents might "accidentally" consume poison, but that the system is designed to poison specific morphologies. Animals smaller than rodents also find their way into the bait station easily. I have seen the novel ecologies that emerge in a bait station: slugs, crickets, black widow spiders, lizards, snakes, a veritable horror show in a box. Implicit in the P3's design is that such creatures are not worth saving, not a threat, or not valuable. But it also ignores the role that such creatures can play, ecologically speaking, as part of the bait station system.

{Figure 5 about here }

There is emerging evidence that many organisms die from the poison, or become vectors of it, like earthworms (Liu et al. 2015) and fish (Regnery et al. 2018). At first I thought the snails were another feature of rats hoarding things (Figure 5). But such boxes also contain massive amounts of snail poop, a substance I had not considered before this project. Snails who find refuge in these boxes also find the poison bait block nourishing. Anticoagulant poison does not kill the snail because snails do not have a circulatory system. Whether it has other effects is unstudied.

{Figure 6 about here }

Although snails do not die from consuming the poison, they can nonetheless serve as a vector. In Figure 6, a photo taken 2 meters from the nearest bait station, the bright blue of the poison block is clear in the snail poop on the wall. Current research is limited, but in the case of slugs, at least, this route of distribution of poison in the environment is confirmed (Alomar et al. 2018). The vectors of poison distribution are as numerous as there are smaller-than-rat animals that can consume and excrete the poison or live long enough to be eaten.

…doesn't mean they aren't out to get you.

The "novel object reaction" of the suspicious rat, was a central concern for Elton and his colleagues. To get rats to go into a station, and consume a poison therein, a number of elements were designed into the bait-station system: careful placement of the P3, pre-baiting using non-poison food, and a "semi-permanent" approach. "Semi-permanence" indicated that a rodent infestation takes time to treat; a "campaign" would involve multiple stages of assessment, deployment, waiting, killing as necessary, and then retreat. Contemporary use of the bait station system, however, has removed the "semi" to make the system permanent, which has its own ecological consequences:

> This virtually perpetual deployment, for obvious reasons called permanent baiting, ensures an almost constant "leakage" of AR into the environment via both target rodents and non-target wildlife such as field mice and voles (Van den Brink et al. 2018:15).

Making bait stations permanent turns out not just to be a solution to a rat problem, but also a solution to an economic one. The bait station future-proofs the pest control industry. Bait stations gradually became permanent in the period from 1970 to 2000. In the US, to protect children and pets, the Environmental Protection Agency began to require the use of tamper-proof bait stations in the 1980s wherever poison baits were used in urban, suburban, and non-field agricultural settings (EPA 2008). Pest control firms realized that they could be treating rodent infestations chronically, rather than as one-off hunting expeditions.

Perpetual bait station deployment combined the ecological approach of Elton with the legal requirements of safety from the EPA. But it also had sound business justifications. Pest control firms prefer regular, repeating, unending contracts. Large contracts are the most valuable: warehouses, food preparation facilities, malls, golf courses, and industrial animal farms. In American cities, "Home Owners Associations" (HOAs) are large privately governed neighborhoods that can occupy a significant portion of suburban space in settler societies (McCabe 2011).

My own experience confirms the "soul-stealing" work of pest control in such HOAs, which can include hundreds or even thousands of bait stations. Techs work twelve-hour days, six days a week going from station to station checking and refilling them with poison. Because the HOA is a single customer, not a hundred or a thousand, the simple, repeating contract is a powerful force for keeping bait stations in place and constantly "leaking" into the environment where it threatens wildlife.

Ironically, HOAs often sit at the so-called Urban-Wildland Interface, where dying wildlife are likely to be most visible, and they become de facto spaces of private governance of land use and environmental regulation (Turner 2022). Eventually they might be the same communities that end up banning the use of the poison, but not the system.

Tempus fugit

As Elton's team noted, "slowness of action" was a valuable property in a poison. Anticoagulants triumphed in the control of rodents for this reason: they kill at the right speed. The faster a poison acts, the more likely it will induce bait-shyness; but slow acting poisons will accumulate in the still mobile bodies of slowly dying rodents. For killing rats, this is an excellent and proven strategy: they don't die in the bait box, and they keep coming back for more.

The secondary and tertiary effects on animals that eat rats are directly tied to this temporality. Scavengers and predators face complementary risks from this temporal feature of a poison, which is related to the total amount of poison in a rodent when it dies (Van den Brink et al. 2018:7). If a rat is alive, it may not have eaten enough poison to be significant (which is good news for predators); if the rat is dead, it may mean its body contains more than enough to have killed it (which is bad news for scavengers). Conversely, poisoned animals may stop eating as they begin to die, and therefore end up having less poisons in their stomachs when they expire (which is good news for scavengers), whereas a live animal that has just eaten a stomach full of poison but not yet died may be chock full (which is bad news for predators). The careful analysis of bait shyness by ecologists and poison designers doesn't end at the rat. The rat-poison system it produces ends up overflowing to target the behaviors of other animals, predators, and scavengers, and the ways they acquire and consume food.

Evidence is also mounting that anticoagulant rodenticides accumulate both in the environment and bio-accumulate in bodies of animals. Bioaccumulation is common, especially when various animals are consuming sub-lethal amounts and are then consumed by predators. Cooper's hawks, buzzards, kites, kestrels, owls, foxes, bobcats, feral cats, martens, stoats, and weasels are the most common victims of this accumulation (Van den Brink et al. 2018: Table 7.4).

The effects of this accumulation are not well understood. Animals can and do die from the direct effects of ARs, but there is also evidence that they are subject to physiological overflows of other kinds. In Los Angeles, concerns about bobcats and mountain lions has been ongoing, including one of the few genomic analyses, which suggested that SGARs can affect gene expression related to immune function, leading to greater susceptibility to other diseases (Serieys et al. 2018). Resistance to SGARs is also a concern. SGARs replaced First Generation rodenticides like Warfarin for exactly this reason: widespread resistance was noted by the late 1960s (Van den Brink et al. 2018:10). Rats, by being on the front line, will develop a resistance that their predators will not.

Conclusion: trapped by ecology

In September 2020, the "California Ecosystems Protection Act" placed a moratorium on anticoagulant poisons pending review by the California Department of Pesticide Regulations. I asked my contacts in pest control how they would respond to this ban. All of them planned to continue exactly as they had before but with a non-anticoagulant poison. Bromethalin, Cholecalciferol, Sodium Fluoroacetate (1080) are options; but older poisons like Zinc Phosphide, Red Squill or Strychnine are commonly used. Given the ecological permanence of the bait station system, this is virtually guaranteed to create the same problem all over again. Indeed, evidence of secondary Bromethalin poisoning already exists (Sant et al. 2019).

What if we banned all the poisons? Many companies choose to put snap traps, high-voltage shock plates, sensors, and counters in these boxes. Indeed, one company even offers a blockchain-enabled wifi-connected rodent bait station that mints crypto-coins as it kills, making it possible to imagine a slough of permission-less, venture-capital-funded rat-killing business plans. But it is clear that the problem is not the mode of killing (poison or no poison) but the further sedimentation of a structure; a “non-toxic” solution is not the same as an “ecological” one.

In their analysis of traps as cultural and ecological objects, Corsín Jiménez and Nahum-Claudel (2019:395) argue that

> traps are not artefacts mediating relations, but rather sources of relational agency in their own right. They are forms that help us see the vital and dynamic materialities accompanying multispecies social processes (395).

Is the rodent bait station a trap? Yes and no. Like the Kalahari traps that Corsín Jiménez and Nahum-Claudel describe, the bait station has trap-like elements: rodents must be enticed, their shape must be correct, the object familiar—all the things Elton, as a scientist, built into the system he created. However, contemporary pest control techs are not hunters, they don’t outsmart the rodents so much as unthinkingly install hundreds of bait stations. The bait station in turn does not capture animals the way a landscape trap does, but simply tries to disappear them. It is an architecture of repulsion whose goal is not capture but elimination of certain relations. The goal is to clear some animals (rats) from a place to be inhabited by some humans (settlers). It is in this sense much more obviously a device for dwelling than for hunting. Indeed, Corsín Jiménez and Nahum-Claudel invert the relation of hunting and trapping, and suggest that

> traps embody the architectures of care and understanding through which human and nonhuman persons share residence in an environment. They are designs for co-habitation (397).

There is more than one way for humans and animals to co-inhabit. In a settler colonial ecology, the rodent bait station allows the removal of one set of ecological relations and their attempted replacement by another (Whyte 2018). Just as the epic 19th century slaughter of Bison on the US plains could never properly be called "hunting," the rodent bait station system is not fully a trap. If it were such a technology of inhabitation, it must be understood as having a very specific "habitat filter": one that privileges grain storage, the prevention of plague, large-scale agricultural cultivation, and a highly developed cultural horror of rats—all things that are, to be clear, concerns of the colonists, not the colonized. The bait station system creates relations incompatible with those previously in place, such as relations created by the ingenious eagle traps of the Hidatsa of North Dakota, which Levi-Strauss analyzed and Corsín and Nahum-Claudel take up as a model.

Perhaps this non-trapness is why the "device deployment industry" despised by pest control techs is labeled "soul stealing." The low status work of pest control techs is rendered even lower status by removing from it the relation-making capability of a rodent trap like a snap trap or a cage. It is replaced by the back-breaking tedium of checking 1000 rodent bait stations per day, never seeing or thinking about (or like) a rat. One could, without being too metaphorical about it, argue that this is a soul-less kind of labor.

More than one human soul is at stake. The rodent bait station system seeks to replace one ecology—one set of relations—with another; and it does that *through* the science of ecology, which has long considered itself a science of relations. But the replacement of relations backfires, creating not a replacement but a disruption: an ecological crisis in the present. The overuse of poisons leads to the biological transformation, and ultimately death (repulsion) of valued co-inhabitants: lions, coyotes, bobcats, raptors, dogs, and cats, etc. It creates not only new relations, but also altered bodies capable of some new relations and incapable of others (Landecker 2016).

At the heart of the rodent bait station system is a particular model of flourishing—call it the 20th century American Dream, for lack of a better word. In this dream, biological and ecological relations can be tamed and tuned to become rodent-and-insect-free places filled with fruited plains and charismatic animals like birds, bobcats, and mountain lions. But the dream turns nightmare when it becomes apparent that the rodent bait station creates a set of relations in which little survives except humans—and rats. Perhaps the only greater nightmare would be to imagine living with them.

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Captions

Figure 1: The EZ Klean rodent bait station. Marketing photo by Bell Labs, 12.8 in. L x 8.8 in. W x 3.45 in.
Figure 2: Four US Patents for Bait Stations from before WWII. Images compiled by author.
Figure 3: The P3. Plate 1, (a) and (b) originally in Chitty 1954.
Figure 4: The P3 as Flat-pack in Chitty 1954, p. 150-151.
Figure 5: A typical southern california bait station on the inside, with snails and snail poop. Photo by author.
Figure 6: Blue snail poop on a wall above a bait station. Photo by author.

Notes

[1]Fieldnotes, "West Coast Rodent Academy", Nov 2019.

[2]My fieldwork consisted of two years of participant-observation through ride-alongs, attendance at company meetings, interviews with employees and firm managers, attendance at pest control trade shows and conferences, discussions with residents who employ pest control, and occasional serendipitous encounters with pest control professionals in the city. All the work took place in Los Angeles, with the exception of conferences and trade shows elsewhere in California.

[3]Choy (2011) distinguishes three senses of the term ecology: 1) the general meaning of "environmental", 2) the science of ecology in the twentieth century, and 3) the analytic of mutually interacting relations ("ecosystem").

[4]In this and the following two sections, page numbers refer to this text, unless otherwise cited.

Figure 1: The EZ Klean rodent bait station. Marketing photo by Bell Labs, 12.8 in. L x 8.8 in. W x 3.45 in.

529x529mm (72 x 72 DPI)

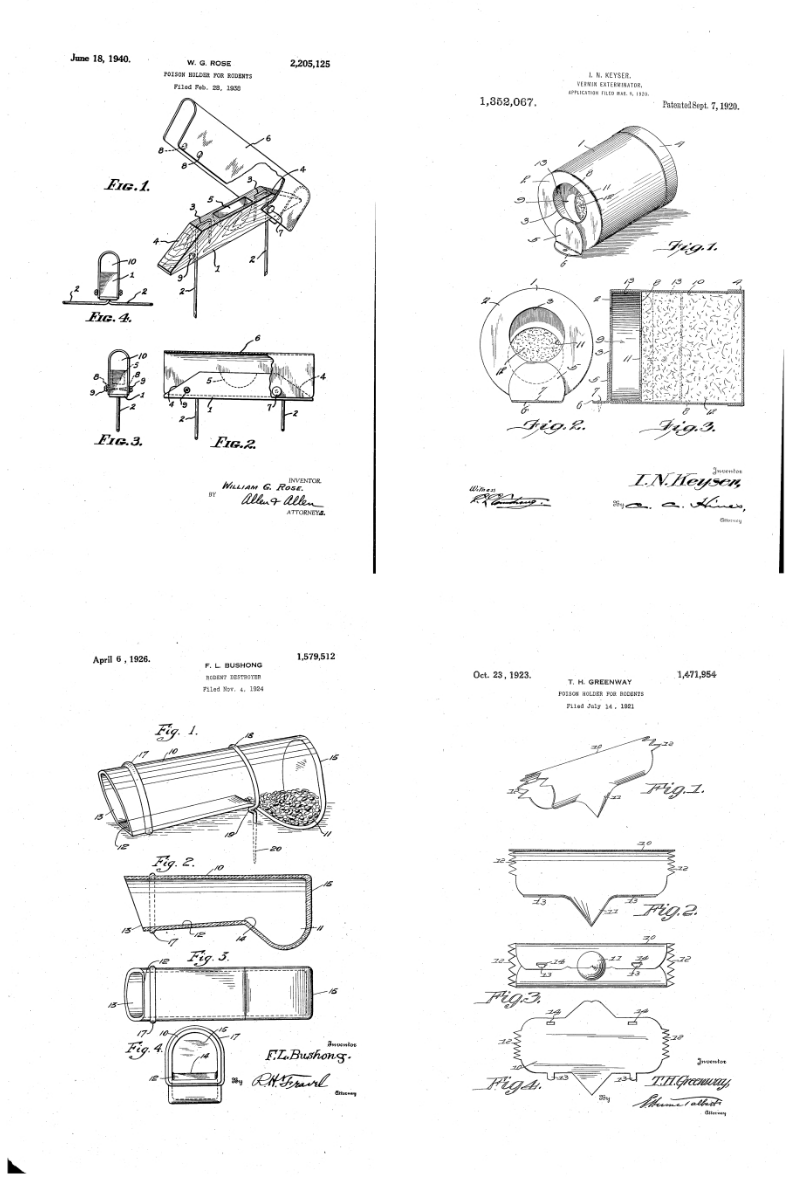
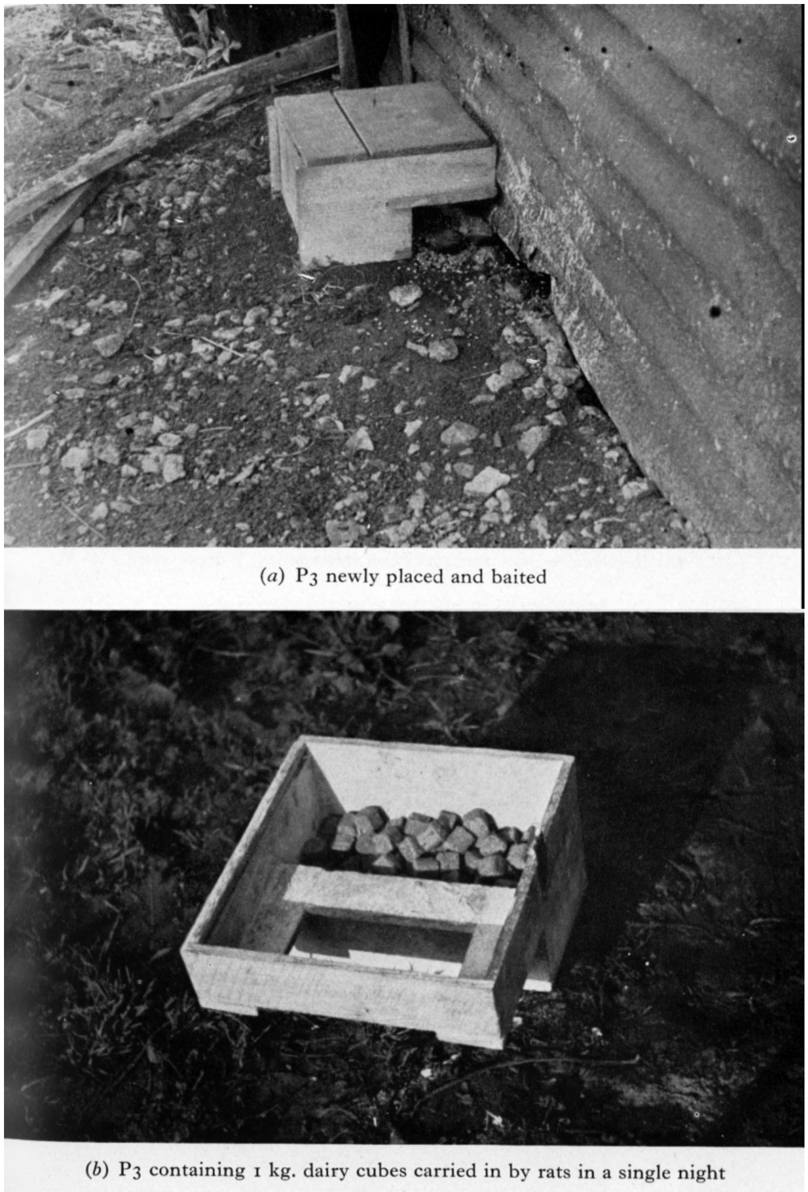


Figure 2: Four US Patents for Bait Stations from before WWII. Images compiled by author.

392x577mm (300 x 300 DPI)



(*a*) P3 newly placed and baited

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

Figure 3: The P3. Plate 1, (a) and (b) originally in Chitty 1954.

113x169mm (300 x 300 DPI)

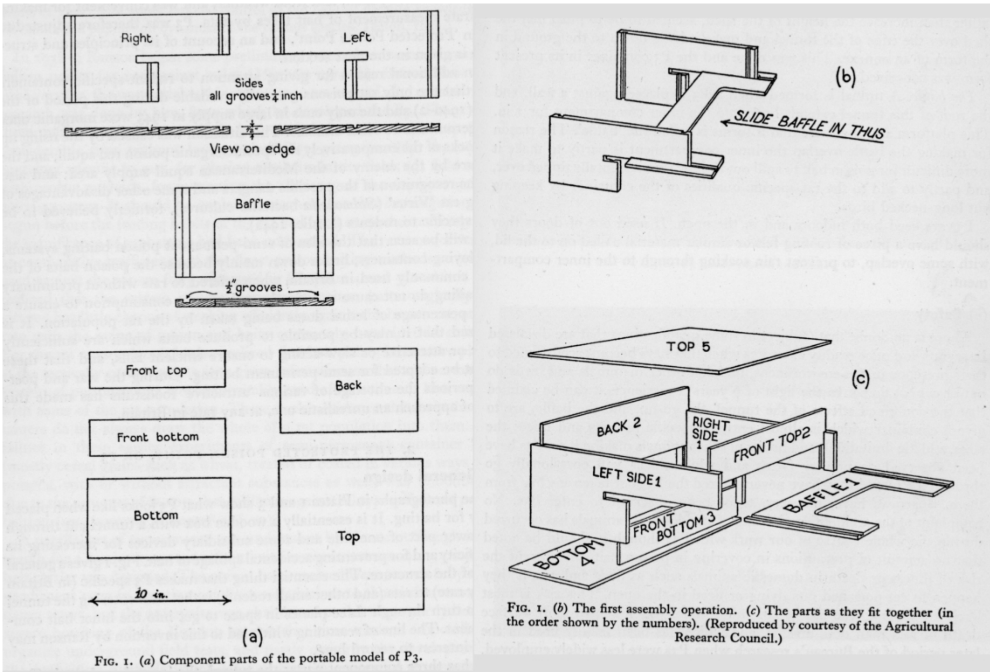


FIG. 1. (*a*) Component parts of the portable model of P3.

FIG. 1. (*b*) The first assembly operation. (*c*) The parts as they fit together (in the order shown by the numbers). (Reproduced by courtesy of the Agricultural Research Council.)

Figure 4: The P3 as Flat-pack in Chitty 1954, p. 150-151.

228x152mm (300 x 300 DPI)

Figure 5: A typical southern california bait station on the inside, with snails and snail poop. Photo by author.

1422x1066mm (72 x 72 DPI)

Figure 6: Blue snail poop on a wall above a bait station. Photo by author.

1422x1066mm (72 x 72 DPI)