

PARACHUTING CATS AND CRUSHED EGGS

The Controversy Over the Use of DDT to Control Malaria

| Patrick T. O'Shaughnessy, PhD

The use of DDT to control malaria has been a contentious practice for decades. This controversy centers on concerns over the ecological harm caused by DDT relative to the gains in public health from its use to prevent malaria. Given the World Health Organization's recent policy decisions concerning the use of DDT to control malaria, it is worth reviewing the historical context of DDT use.

Ecological concerns focused on evidence that DDT ingestion by predatory birds resulted in eggs with shells so thin they were crushed by adult birds. In addition, DDT spraying to control malaria allegedly resulted in cats being poisoned in some areas, which led to increased rodent populations and, in turn, the parachuting of cats into the highlands of the island of Borneo to kill the rodents, a story that influenced the decision to ban DDT spraying. I focus on this story with the intention of grounding the current debate on lessons from the past. (*Am J Public Health*. 2008;98:1940–1948. doi:10.2105/AJPH.2007.122523)

IN SEPTEMBER 2006, THE World Health Organization (WHO) issued a statement that recommended wider use of dichlorodiphenyltrichloroethane (DDT) through indoor residual spraying to reduce the prevalence of malaria. Among its reasons for reestablishing a malaria control effort first administered in the 1950s, WHO cited DDT's potential to substantially reduce malaria because of its low cost, long-lasting action and ability to kill mosquitoes that land on sprayed surfaces.¹ Given its 40-year history as a substance banned for agricultural use by many countries because of its persistence in the environment and potential for ecological harm, it is not surprising that WHO's statement has reinvigorated the debate over the use of DDT to control malaria.² Although the debate involves a variety of factors, it is centered on the balance between DDT's positive public health effects and its harmful ecological effects. Even the use of DDT for malaria control, however, had some unforeseen negative results. To ground the current debate on lessons

from the past, I review the history of DDT in the context of the unintended consequences associated with its varied uses.

MALARIA ERADICATION IN THE 1950S

Although malaria has plagued mankind throughout history,³ it was not until the Eighth World Health Assembly held in Mexico City in May 1955 that health officials from around the world agreed that a malaria eradication program was feasible and should be initiated by WHO.⁴ Previous successful control efforts in many parts of the world, especially Europe, the United States, and Venezuela, demonstrated that eradication by residual spraying of insecticides was feasible.⁵ A 1952 *New York Times* article described a fall in the overall worldwide death rate and attributed the "spread of the use of DDT" as one of the major contributing factors.⁶ Although DDT resistance by some mosquitoes was observed even then, its use, along with that of other candidate insecticides, was considered an essential aspect of an eradication

program, especially in the remote areas of the world where control efforts would be most difficult.

A report written by members of the WHO antimalarial team working in the Malaysian state of Sarawak, on the island of Borneo, provides an example of the techniques used to conduct an indoor residual spraying campaign in a remote, heavily forested area, typical of many areas of the world where malaria was endemic.⁷ During the initial campaign, both DDT and another insecticide, BHC (benzene hexachloride), were sprayed in Sarawak between 1952 and 1955. Spraying only occurred inside dwellings, which, for each village, consisted of a "long-house," a large thatched-roof building that could house as many as 100 families. Before application, DDT was mixed as a 75% solution in water and then applied on walls and under beds at a concentration of 2 g/m². This application left a visible residue of white spots on surfaces.⁸

The primary intent was to cover walls on which mosquitoes alit with enough residue to kill them before they could transfer

the malaria-causing protozoan parasite to another human.⁹ Because of DDT's persistence, application twice a year was sufficient to maintain a functioning residue. In addition to DDT and BHC, the insecticide dieldrin was used in Sarawak in 1955 because its higher toxicity required less volume to be transported through the jungles, but its use was soon discontinued because of its higher cost and toxicity.¹⁰ During a 21-month period in Sarawak between 1953 and 1955, the percentage of mosquitoes carrying the malaria-causing parasite fell from 35.6% to 1.6%, which prompted the spraying organizers to state that "complete eradication can be expected in the near future."¹¹

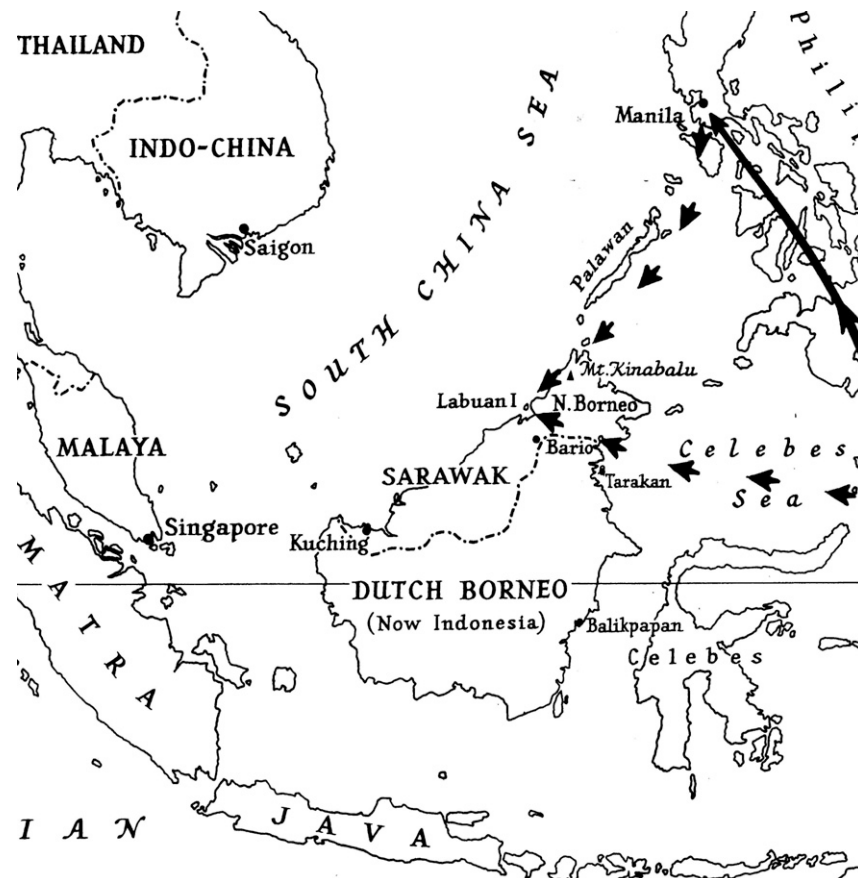
As in Sarawak, WHO efforts to eradicate malaria in many other parts of the world during the initial stages of this eradication effort were largely successful. For example, the number of malaria cases in Ceylon (currently Sri Lanka) fell from 2.5 million in 1945 to less than 100 in 1963.¹² However, the success of indoor residual spraying campaigns like those conducted in Sarawak depended on a number of factors, some of which were not achievable in other parts of the world, especially Africa. These factors included whether the mosquito species present in the area had a natural tendency to rest indoors before and after feeding and whether the local human population lived in stable communities containing walled structures.

Despite its initial success, there were a limited number of countries in which the many logistic, human, and financial resources needed to maintain the eradication effort were consistently available. In many places, the lack of

resources eventually led to the abandonment of eradication as a viable goal.¹³ In Sri Lanka in 1954, for example, where there were only a few cases of malaria in remote areas, the government scaled back its eradication efforts for financial reasons. This small reservoir of infected people led to 258 cases of malaria in 1966; by 1969, nearly 500 000 people were infected.¹⁴ Randall Packard argued that, in addition to technical and organizational problems, the excessive optimism in the postwar world regarding economic and social development heavily contributed to the failure of many eradication efforts, including that of malaria.¹⁵

UNINTENDED CONSEQUENCES

Indoor residual spraying remains the primary method of vector control in the world's malarial areas.¹⁶ Factors that have reduced its effectiveness include resistance by inhabitants to the discoloration of the interior walls of their homes, poor planning or poor application, and most notably, vector resistance, which here refers to evolutionary changes in the mosquito that result in its ability to be unaffected by the insecticide. This resistance was often hastened by the agricultural use of DDT in the same areas where vector control was



A map of the island of Borneo showing the Malaysian states of Sarawak and North Borneo (currently Sabah) and the location of the village of Bario.

Source: Tom Harrison, *World Within: A Borneo Story* (London: Cresset Press, 1959). Used with permission from Oxford University Press (China) Ltd.

occurring. Resistance to DDT then led to increased costs for replacement insecticides, which further diminished indoor residual spraying efforts.

Indoor residual spraying also led to completely unforeseen events with negative consequences. For example, during early use of DDT as part of an indoor residual spraying program in British Guiana between 1946 and 1950, the *Anopheles darlingi* mosquito responsible for transmission of malaria was successfully exterminated. However, two other species of mosquito, *A. aquasalis* and *A. albicansis*, which fed primarily on animals, survived the spraying. The subsequent reduction in the malaria rate contributed to a 68% increase in the human population by 1964, which in turn led to a corresponding increase in land used for rice cultivation, making less land available for cattle. With the loss of cattle, *A. aquasalis* changed to drawing blood from humans, with a resulting increase in the prevalence of malaria.¹⁷

Another incident occurred after the indoor residual spraying campaigns in Sarawak and the adjoining state of North Borneo (now called Sabah). During a local conference on malaria, the local people complained that the spraying was causing the deterioration of the thatched roofs of their buildings.¹⁸ The WHO team sent to investigate determined that moth larvae (caterpillars) living in the thatch were able to distinguish the presence of DDT and so avoided eating thatch sprayed with the chemical, whereas their parasites, small chalcid wasps that injected their larvae into the caterpillars, were highly susceptible to DDT, causing their decline and the subsequent increase in caterpillar

numbers. A caterpillar population study in villages of Sabah determined that DDT spraying caused a 50% increase in the number of caterpillars per roof area, but when huts were sprayed with the more toxic insecticide, dieldrin, almost all caterpillars were killed and there was no roof decay. (Ironically, then, there would have been no complaints had the more toxic insecticide been used everywhere, thus killing both moth caterpillar and wasp.)

One of the most controversial side effects of indoor residual spraying of DDT was the deaths of domestic cats reported in a variety of areas throughout the world. These deaths were invariably associated with an increase in rodents and the additional negative effects they caused. A 1962 article in the *New York Times* began, "American DDT spray killed the cats that ate the rats that devoured the crops that were the main props against Communist agitation in the central lowlands."¹⁹ The author went on to say that "this highly oversimplified explanation of the disaster in six provinces overrun by field rats is believed by many Vietnamese." He conceded that some cats were killed after huts were sprayed with DDT, but added that experts believed the explosion in the rat population was more likely caused by a combination of factors, such as moisture, climate, availability of food, and primarily "the Government's failure to insure adequate supplies of rat poison."

Likewise, a 1959 annual report on conditions in Sabah contained the remark, "Field rats were a greater menace than usual, partly as a result of antimalarial spraying which accidentally killed many cats."²⁰ Furthermore,

in his text on malaria, Robert Desowitz mentioned that cats died in villages in Thailand after homes were sprayed with DDT, which also resulted in an increase in the rat population.²¹ Desowitz further commented, without reference, that there were "numerous reports of village cats dying within one week after malaria-control teams sprayed DDT onto household walls."²¹

In one case, the deaths of cats as a result of antimalarial spraying resulted in the creation of another human disease problem. An investigation conducted in 1965 by Karl Johnson determined that an outbreak of Bolivian hemorrhagic fever was "due to invasion of houses by rodents" as a consequence of cat deaths after the spraying of DDT.²² During the investigation, the villagers remarked that the cats "would have the shakes, get sick, linger for a few days, and die."²³ Johnson had one dead cat analyzed by a toxicologist at the Centers for Disease Control and Prevention in Atlanta after noting that other malaria experts had commented on cats ingesting a lethal dose of DDT by licking the insecticide from their fur. The DDT concentrations found were determined to be high enough to kill cats.

A 1977 *Time* article also reported on cats dying from ingesting DDT on their fur. In a footnote to an article on the resurgence of malaria in many parts of the world, the author mentioned that exterminators in Oaxaca, Mexico, were called *los matagatos*, "the cat killers," because "the cats lick the DDT residue off their paws and die of a disease of the nervous system."²⁴ Two anthropologists who worked in the southwest Pacific when malaria spraying occurred there also observed cat deaths

caused by the animals licking DDT off their fur; one stated that her own cat had probably died in that manner within 2 weeks of spraying, because the cat was otherwise fed pet food (Susan Montague and Gene Ogan, written communications, May 16, 2007).

Michael Colbourne, who worked for WHO during the 1950s, conceded that malaria eradication campaigns in the western Pacific caused the death of some “domestic animals,” although he states, “such killings can be reduced, but not wholly prevented, by adequate precautions.”²⁵ This remark made in 1962 was one of the few made by a WHO representative on the unintentional deaths of cats via indoor residual spraying of DDT during the height of the eradication program. In 1969, Anthony Brown of WHO prepared an address to members of a convention on the biological impact of pesticides in the environment, in which he stated, “DDT as applied has not caused any side-effects among domestic animals.”²⁶ Several years later, however, Brown conceded that there were undocumented cases of cats dying from contact with DDT in Bolivia and Sabah “because of their habit of continually cleaning themselves by licking.”²⁷

ECOLOGICAL CONCERNS

During the early 1960s, a time that saw the large-scale reduction of malaria in many parts of the world as a consequence of the WHO eradication effort, resistance to the use of persistent insecticides for agricultural purposes was increasing in the United States. This opposition was spearheaded by the publication of Rachel Carson’s 1962

book *Silent Spring*, which, for the first time, suggested that a pollutant in the environment can cause biological harm not only by direct ingestion but also through ingestion of a food source that contains the pollutant. In singling out DDT, Carson stated, “[O]ne of the most sinister features of DDT and related chemicals is the way they are passed from one organism to another through all the links of the food chains.”²⁸ This process results in an ever-increasing concentration of DDT in organisms progressively higher in the food chain, a concept now referred to as “biomagnification” or “bioconcentration.” A notable example occurred in Clear Lake, California, between 1948 and 1957.²⁹ During 3 spraying campaigns over that time period, the compound DDD (dichlorodiphenyldichloroethane, a breakdown product of DDT with insecticidal properties) was sprayed over the lake to control a biting gnat. The total applied each time resulted in a mass ratio of 1 part DDD to 70 million parts of water, a concentration considered low enough to avoid poisoning aquatic organisms. Nevertheless, large numbers of the western grebe, a waterfowl, died soon after each event. Analysis of their fatty tissue revealed concentrations approaching 2000 parts per million.

During the late 1960s, the first scientific studies conducted to verify biomagnification in natural ecosystems were conducted. In one study, Tony Peterle measured DDT in various parts of the food chain of an aquatic system, ranging from the sediment of a pond to ducks confined to its surface, immediately after a spraying episode in which DDT was labeled with radioactive chlorine.³⁰

DDT accumulation in most organisms spiked hours after the application and then dropped to residue levels that were increasingly higher with each step through the food chain. At about the same time, Charles Wurster, a biologist at the State University of New York at Stony Brook, was gaining a reputation as an expert in the analysis of pesticide residues in the environment.³¹ In the late 1960s, Wurster teamed with a lawyer, Victor Yannacone, and several other environmentalists living in Long Island to form the Environmental Defense Fund, which aimed to stop DDT spray-

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ing through lawsuits. One of their first acts was to sue the Suffolk County (New York) Mosquito Control Commission to stop aerial spraying of DDT over local marshes. The suit resulted in the first countywide ban against the use of DDT in the United States.

At the time that bioaccumulation studies were being conducted, it became apparent to ornithologists that populations of birds of prey were falling dramatically, and insecticides, especially DDT, were suspected to be the cause. The eventual explanation was that the ingestion by female birds of DDE (dichlorodiphenyldichloroethylene), a derivative of DDT, caused them to produce eggs with shells so thin that they

were crushed when an adult bird covered them.³² The state of Wisconsin stressed this effect when it ruled against the use of DDT in May 1970.³³ Likewise, William Ruckelshaus, the administrator of the Environmental Protection Agency, specifically addressed eggshell thinning in his justification for a ban on the use of DDT in the United States in 1972. Ruckelshaus listed other reasons for the ban, including DDT's persistence in the environment and its ability to be "concentrated in organisms and transferred through food webs," but eggshell thinning was the only adverse outcome listed that was associated with top-of-the-food-chain organisms.³⁴

Tom Harrisson with a native of Sarawak, Indonesia, in 1945.

Source. Tom Harrisson, *World Within: A Borneo Story* (London: Cresset Press, 1959). Used with permission from Oxford University Press (China) Ltd.



PARACHUTING CATS

During the years immediately preceding the ban on DDT, another incident involving the unintended consequences of DDT use was reported in magazines and the news media.³⁵ Although different versions of the story exist, the following provides a typical example:

In the early 1950s, there was an outbreak of a serious disease called malaria among the Dayak people in Borneo. The World Health Organization tried to solve the problem. They sprayed large amounts of a chemical called DDT to kill the mosquitoes that carried the malaria. The mosquitoes died and there was less malaria. That was good. However, there were side effects. One of the first effects was that the roofs of people's houses began to fall down on their heads. It turned out that the DDT was also killing a parasitic wasp that ate thatch-eating caterpillars. Without the wasps to eat them, there were more and more thatch-eating caterpillars. Worse than that, the insects that died from being poisoned by DDT were eaten by gecko lizards, which were then eaten by cats. The cats started to die, the rats flourished, and the people were threatened by outbreaks of two new serious diseases carried by the rats, sylvatic plague and typhus. To cope with these problems, which it had itself created, the World Health Organization had to parachute live cats into Borneo.³⁶

At first glance, this story appears to be a combination of the previously mentioned events involving the use of DDT for malaria control that resulted in both the rapid decay of thatch roofing material and the deaths of cats. From an ecologist's perspective, however, this story is significant because it would mark the first known instance of mammalian deaths through the biomagnification of DDT. That, together with

the unique solution to the problem created—parachuting cats—is perhaps why it has persisted to this day in books, Internet sites, and peer-reviewed journals, most recently in 2001.³⁷ The many printed versions of the story, however, often emphasize different aspects of the story—for example, that plague actually broke out among the people affected,³⁸ that as many as 14 000 cats were involved,³⁹ or that dieldrin, not DDT, was used.^{40,41} These discrepancies tend to diminish confidence in the story's veracity.

The versions of the story printed in the late 1960s⁴² all had one quality in common: either no reference was given for the originator of the story or the author heard the story from another source. Regardless, the story can be traced back to Tom Harrisson, who in a 2-page description of the events written in 1965, claimed to be personally involved in the "cat drop" in 1965.⁴³ Harrisson did not mention the problem of the thatch-eating moths, but he stated that the cats died as an "obvious result" of eating cockroaches that had died from the insecticide sprayed to prevent malaria. (He did not mention which insecticide was used.) He also praised the positive effect of the antimalaria effort in the region but lamented the consequences of the rat infestation resulting from the loss of the cats, especially in the Kelabit Highlands, an upland area of eastern Sarawak. Harrisson went on to state that new cats were collected in coastal towns by the WHO, placed in "parachute-borne containers bulging with cats of every degree of age and rage," and dropped in "the interior uplands" with help from the Royal Air Force (RAF) flying out of

Kuching, the capital of Sarawak. The format of his article, however, which contains story-telling prose and drawings—similar to those appearing in a children’s book—depicting cats with parachutes attached to diaperlike harnesses around their bodies, undermines its validity.

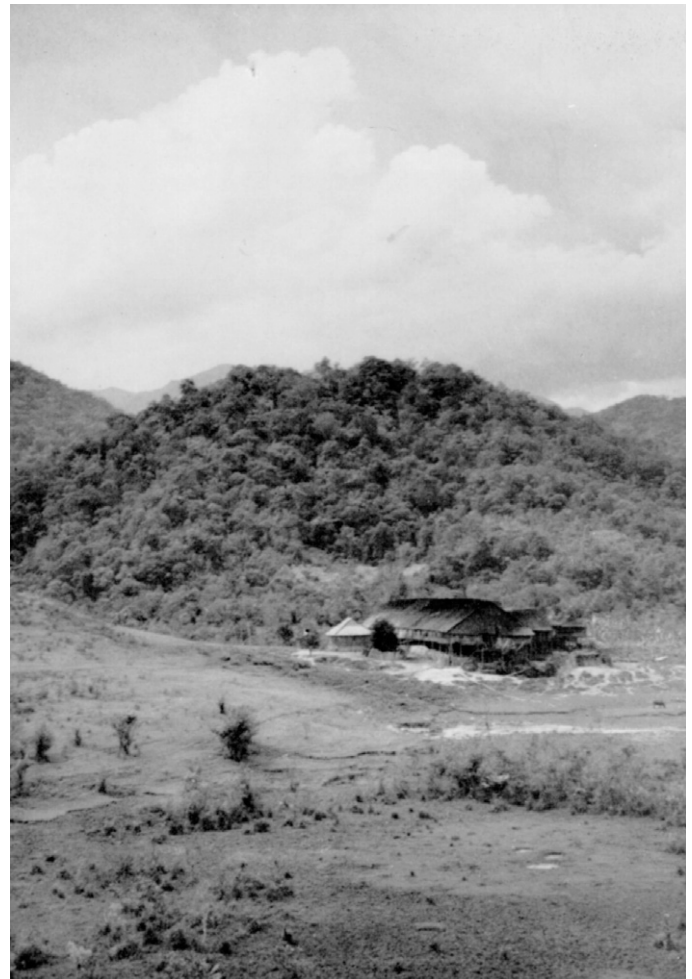
Born in England, Tom Harrison first traveled to Borneo to lead an expedition into the jungles there for a group from Oxford University. During World War II, he returned to lead a guerilla operation in which he and a squad of commandoes parachuted into a remote area near Bario, Sarawak, and convinced the local tribesmen to kill Japanese soldiers occupying the island.⁴⁴ He lived in Borneo after the war as curator of the Museum of Sarawak, while involving himself in studies associated with sociology, anthropology, archaeology, and ornithology. Despite his many academic interests, he was also a maverick regarding his scholarly activities and readily alienated others. His obituary states that “his publications were the petrol-pumps that refueled his ego” and that “sometimes his intuition tempted him to make dangerous imaginative leaps.”⁴⁵ The title of Harrison’s biography, *The Most Offending Soul Alive*,⁴⁶ further suggests an irascible nature.

Nevertheless, Harrison’s story was given credence by Gordon Conway, an entomologist who worked in Sarawak in the early 1960s. In a publication printed for a conference held in 1968 on the ecological aspects of insecticide spraying, Conway cited Harrison as the primary source of information for the events associated with the cat story.⁴⁷ In his report, Conway also described the problem of the thatch-eating

moths (independent of the cat story) and the events leading to rat outbreaks in both Sarawak and Sabah. Conway claimed that in Sarawak, DDT was passed from cockroaches to cats, whereas in Sabah, it was passed from “insects” to small geckos (“house lizards”) and then to cats who ate the lizards. He explained that in Sabah, cats were rounded up in towns and transported (presumably by truck) to the upland areas, whereas they had to be parachuted into the remote upland villages of Sarawak. Anthony Brown, however, declared that no domestic animals had been killed by DDT, adding that “the matter of the North Borneo cats as misinterpreted in *Time* concerned dieldrin, not DDT.”⁴⁸ This suggests that dieldrin was used more heavily in North Borneo (Sabah) and may have caused the cat deaths in that region.

The article by Conway incorporates most of the different variants of the cat story and is the only publication to cite Harrison as the source of the “cat drop” event. However, Conway was in Borneo after these events took place and did not provide a source for his information of events in Sabah. Another rendition of the cat story was published in 1968 in a popular magazine, *Natural History*, by Gordon Harrison, who did not name his source but instead referred to “a biologist who had served five years as a pest control officer in Borneo.”⁴⁹ Given that both Harrison and Conway had ties to the Ford Foundation, this was almost certainly a reference to Conway. Because Gordon Harrison’s report appears to have been more widely read, however, the tie to Tom Harrison was lost.

Another detail of the cat story worth exploring involves the use



The longhouse at Bario, Sarawak in 1959.

Source: Tom Harrison, *World Within: A Borneo Story* (London: Cresset Press, 1959). Used with permission from Oxford University Press (China)

of planes and parachutes to deliver cats to jungle villages. In support of this as a typical delivery method used in the region, Tom Harrison mentions in a separate publication that the Sabah government “pioneered the use of supply drops for out-stations and field parties” and also states that these drops were used “with effect for the World Health Organization” in Sarawak.⁵⁰ An example is given in a WHO report by de Zulueta and LaChance on the initial antimalaria campaign in Sarawak, in which an airdrop by the RAF in 1954 to replenish their stock of DDT is mentioned.⁵¹ Special airdrops in the region are also described in an Internet site dedicated to the

RAF supply–transport airplane the *Blackburn Beverley*, used for these efforts.⁵² The author mentions the creation of special cages to parachute “live chickens and even cats to alleviate rat problems in jungle forts.” A 1954 *New York Times* article also described the parachuting of cats into the jungle to fight rats, and a 1955 article told of beavers being parachuted into wilderness areas of California.⁵³

Although seemingly bizarre in nature, this method of delivery was not uncommon. Furthermore, the incident directly associated with the cat story is described in a report provided in the “Operations Record Book” of flight logs kept by the RAF, in which it is stated that on March 13, 1960, a crew in a Beverley transport plane flew out of Changi, Singapore, and “carried out a unique drop to Bario in the Kelabit Highlands in Sarawak.”⁵⁴ The items dropped were a total of “7000 pounds of stores” including “over 20 cats to wage war on rats which were threatening crops.”⁵⁵ The report states that a reply was received from a person on the ground, who thanked RAF and the “cat donors and cat basket makers” and added that “all cats safe and much appreciated.”

Tom Harrison’s was not the only version of events in Bario at the time of the cat drop. Harrison’s biographer, Judith Heimann, states that another person besides Harrison also came up with the idea of a cat drop.⁵⁶ Heimann located the transcript of a wireless message to Borneo Airways from Harrison requesting a plane to carry collected cats to the Bario airstrip and then fly him out of Bario after their delivery. This message proves Harrison’s attempt to acquire cats;

however, a plane was not available for landing on Bario’s short airstrip. Heimann then reports that a district officer, Malcolm McSporran, in Bario at the time to oversee a rebuilding of the airstrip, related that he (independently) arranged with RAF to drop cats along with materials for the airstrip. This version of the story explains the “7000 pounds of stores” dropped with the cats as most likely those needed for the airstrip. McSporran’s account of events is also detailed in a book by Alastair Morrison, a civil servant in Borneo at the time.⁵⁷ Morrison claimed to have discovered the “true background to the cat drop”—McSporran’s request for cats came after a rat ate a hole in his pillow while he was sleeping to remove the contents for a nest lining.

Although its origins may not be entirely clear and some details are compilations of events that occurred in both Sarawak and Sabah, the basic components of the cat story seem to be true. However, the principal aspect of the story, which claims that the biomagnification of DDT caused the cat deaths, has never been verified. This unintended consequence of the use of DDT was initially put forth by Tom Harrison, was later accepted by Conway and Gordon Harrison, and was then disseminated in all subsequent renditions of the story. Although purely conjecture, it is possible that the genesis of Harrison’s story was the publication of *Silent Spring* in 1962, between the cat drop in 1960 and Harrison’s publication in 1965. Given his interest in the natural environment, Harrison probably read the book, realized his association with a DDT-related event, and naively ascribed the cat deaths in Bario to the

biomagnification of DDT in the manner explained by Carson.

The only published argument directly addressing the validity of this theory was written in 1971 by Thomas Jukes, a strong advocate for the use of DDT to control malaria.⁵⁸ Jukes used an LD₅₀ (the dose that is lethal to 50% of the test population) value of 300 mg/kg of body weight to calculate that a 5-kg cat would have to eat 60 000 cockroaches in one day to ingest a lethal dose of DDT, assuming the cockroaches themselves consumed a lethal dose estimated at 25 µg per insect.⁵⁹ Coincidentally, the cat story was cited by an opponent of DDT during the same US Senate hearings held in 1969 during which Jukes provided an opening statement in favor of its use.⁶⁰

FINDING COMMON GROUND

Although the cat story was published a number of times prior to 1972 and appeared in the summary of a US Senate hearing on DDT, it is difficult to ascertain how much influence it had on the decision to ban DDT. Regardless, it certainly served to underscore the tension between environmentalists and public health officials over DDT, given that an incident from public health practice was used to demonstrate adverse ecological consequences resulting from the use of DDT. An example of that tension from the standpoint of public health practitioners is given by Robert Desowitz in his text on malaria, in which he reveals some animosity toward environmentalists of the time by referring to them as “Silent Springers” who did not recognize that “DDT used for medicinal purposes never killed an osprey.”⁶¹

Gordon Harrison would later write a complete and unbiased account of the use of insecticides to battle malaria, without referring to the cat story.⁶² In his *Natural History* article of 1968, however, he mentions that cats were airdropped into Borneo “to restore the balance of populations that the people [i.e., WHO spray crews], trigger-happy with spray guns, had destroyed.”⁶³ This sentiment is still expressed in contemporary versions of the cat story, such as that quoted at the beginning of the previous section, where it is made clear that the problem was caused by WHO.⁶⁴ The tension between environmentalists and public health practitioners was most apparent during the years leading up to a ban on DDT in the United States. In fact, the ban did not include the use of DDT to fight malaria. Anthony Brown, however, who at the time feared that DDT production would be completely halted for environmental reasons, concluded his address by stating, “Certainly an attempt to force the pace by advocating the immediate discontinuation of the use of DDT would be a disaster to world health.”⁶⁵

More than three decades after the ban on DDT in the United States, the conflict between the use of DDT as part of a public health practice and its potential to harm the environment is still evident. Despite its September 2006 recommendation of more-widespread indoor spraying of DDT to reduce malaria, WHO in April 2007 affirmed its commitment to the Stockholm Convention on Persistent Organic Pollutants, which aimed to reduce and ultimately eliminate the use of DDT for vector control.⁶⁶ This policy has been strongly criticized by the organization Malaria

Foundation International.⁶⁷ A solution satisfactory to both sides of this contentious issue will be difficult to obtain. Given the fact that information on the negative environmental effects of DDT spraying—both indoor and outdoor—has long been available, however, any debate should proceed on the basis of objective and unbiased information and reasoning. To that end, it is perhaps time to retire the “cat story” given its many variants and obvious bias against spraying DDT to control malaria. It is fitting to give the person who initiated the story, Tom Harrison, the last word because it concisely advocates for both parties of this debate. When speaking of the outbreak of rats among the Orang Ulu tribesmen of Sarawak, Harrison wrote, “All who wish the ulu well should daily repeat this motto: DO GOOD CAREFULLY.”⁶⁸ ■

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 54. Royal Air Force, "Operations Record Book," report of Beverley Flight of 48th Squadron, March 1960, Changi, Singapore, compiled by Flying Officer Humphrey.
 55. The drop also included "4 cartons of stout for a recuperating chieftain!"
 56. Heimann, *The Most Offending Soul Alive*, 328. Heimann also brings up another element of the cat story not reported elsewhere: the decline in cockroach numbers from the insecticide spraying caused a proliferation of bedbugs in the longhouses.
 57. Alastair Morrison, *Fair Land Sarawak: Some Reflections of an Expatriate Official* (Ithaca, NY: Cornell Southeast Asia Program, 1993). Morrison mentions the antimalaria campaign in the region in a section of his book but then does not connect the increase in rats in Bario with the loss of cats killed via DDT spraying as part of the campaign.
 58. Thomas Jukes, "Letters to the Ed: Further Words About DDT," *California Medicine* 114 (1971): 53–57. In his letter, Jukes was critical of a previously published article that mentioned the cat story: Edgar Wayburn, "Man, Medicine and Ecology—An Overview," *California Medicine* 113 (1970): 1–6. Wayburn briefly related the cat story as part of an overview of the relationship between medical practices and ecology and cited another article by Audy ("Man-Made Maladies and Medicine") as the (apparent) source of the cat story. Audy also related the basic cat story but only provided the "dead-end" source of a "recently publicized situation in Sarawak" (p. 52).
 59. Other oral LD₅₀ values reported for cats in the literature ranged from 250 mg/kg to 300 mg/kg. See, for example, Pesticide Action Network, "PAN Pesticide Database," available at <http://www.pesticideinfo.org>, accessed March 13, 2007; V. V. St Omer, "Chronic and Acute Toxicity of the Chlorinated Hydrocarbon Insecticides in Mammals and Birds," *Canadian Veterinary Journal* 11 (November 1970): 215–226.
 60. United States Senate, Committee on Commerce, Subcommittee on Energy, Natural Resources, and the Environment, *Effects of Pesticides on Sports and Commercial Fisheries: Hearings, Ninety-first Congress, First Session to Consider the Effects of Pesticides on Sports and Commercial Fisheries*, part 1, May 19, 1969, serial no. 91–15 (Washington, DC: US Government Printing Office). The "cat story" appears in part 2 of this hearing, September 29–30, 1969.
 61. Desowitz, *The Malaria Capers*, 214.
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 64. The WHO never published a report acknowledging their involvement in the cat drop. A short article in the *Quarterly News of the Association of Former WHO Staff* of April–June 2005 mentions that the WHO library staff receives many queries about the cat story and "library staff wondered whether cats had been really parachuted over Borneo" (p. 6).
 65. Brown and Wright, "The Present Place of DDT in World Operations for Public Health," 197.
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