

## **The Mosquito Killer**

**By Malcolm Gladwell**

*Annals of Public Health, The New Yorker - Archive on July 2, 2001*

<http://gladwell.com/the-mosquito-killer/>

Fred Soper was a physically imposing man. He wore a suit, it was said, like a uniform. His hair was swept straight back from his forehead. His eyes were narrow. He had large wire-rimmed glasses, and a fastidiously maintained David Niven mustache. Soper was born in Kansas in 1893, received a doctorate from the Johns Hopkins School of Public Health, and spent the better part of his career working for the Rockefeller Foundation, which in the years before the Second World War—before the establishment of the United Nations and the World Health Organization—functioned as the world’s unofficial public-health directorate, using its enormous resources to fight everything from yellow fever in Colombia to hookworm in Thailand.

In those years, malaria warriors fell into one of two camps. The first held that the real enemy was the malaria parasite—the protozoan that mosquitoes pick up from the blood of an infected person and transmit to others. The best way to break the chain of infection, this group argued, was to treat the sick with antimalarial drugs, to kill the protozoan so there was nothing for mosquitoes to transmit. The second camp held, to the contrary, that the mosquito was the real enemy, since people would not get malaria in the first place if there were no mosquitoes around to bite them. Soper belonged to the latter group, and his special contribution was to raise the killing of mosquitoes to an art. Gorgas, Soper’s legendary predecessor, said that in order to fight malaria you had to learn to think like a mosquito. Soper disagreed. Fighting malaria, he said, had very little to do with the intricacies of science and biology. The key was learning to think like the men he hired to go door-to-door and stream-to-stream, killing mosquitoes. His method was to apply motivation, discipline, organization, and zeal, in understanding human nature. Fred Soper was the General Patton of entomology.

Fred Soper’s big idea came to be known as the Global Malaria Eradication Programme. In the early nineteen-fifties, Soper had been instrumental in getting the Brazilian malariologist Marcolino Candau—whom he had hired during the anti-gambiae campaign of the nineteen-thirties—elected as director-general of the World Health Organization, and, in 1955, with Candau’s help, Soper pushed through a program calling on all member nations to begin a rigorous assault on any malaria within their borders. Congress was lobbied, and John Kennedy, then a senator, became an enthusiastic backer. Beginning in 1958, the United States government pledged the equivalent of billions in today’s dollars for malaria eradication—one of the biggest commitments that a single country has ever made to international health. The appeal of the eradication strategy was its precision. The idea was not to kill every *Anopheles* mosquito in a given area, as Soper had done with *gambiae* in Brazil. That was unnecessary. The idea was to use DDT to kill only those mosquitoes which were directly connected to the spread of malaria—only those which had just picked up the malaria parasite from an infected person and were about to fly off and infect someone else. When DDT is used for this purpose, Spielman writes in “Mosquito,” “it is applied close to where people sleep, on the inside walls of houses. After biting, the mosquitoes generally fly to the nearest vertical surface and remain standing there for

about an hour, anus down, while they drain the water from their gut contents and excrete it in a copious, pink-tinged stream. If the surfaces the mosquitoes repair to are coated by a poison that is soluble in the wax that covers all insects' bodies, the mosquitoes will acquire a lethal dose." Soper pointed out that people who get malaria, and survive, generally clear their bodies of the parasite after three years. If you could use spraying to create a hiatus during which minimal transmission occurred—and during which anyone carrying the parasite had a chance to defeat it—you could potentially eradicate malaria. You could stop spraying and welcome the mosquitoes back, because there would be no more malaria around for them to transmit. Soper was under no illusions about how difficult this task would be. But, according to his calculations, it was technically possible, if he and his team achieved eighty-per-cent coverage—if they sprayed eight out of every ten houses in infected areas.

Beginning in the late fifties, DDT was shipped out by the ton. Training institutes were opened. In India alone, a hundred and fifty thousand people were hired. By 1960, sixty-six nations had signed up. "What we all had was a handheld pressure sprayer of three-gallon capacity," Jesse Hobbs, who helped run the eradication effort in Jamaica in the early sixties, recalls. "Generally, we used a formulation that was water wettable, meaning you had powder you mixed with water. Then you pressurized the tank. The squad chief would usually have notified the household some days before. The instructions were to take the pictures off the wall, pull everything away from the wall. Take the food and eating utensils out of the house. The spray man would spray with an up-and-down movement—at a certain speed, according to a pattern. You started at a certain point and sprayed the walls and ceiling, then went outside to spray the eaves of the roof. A spray man could cover ten to twelve houses a day. You were using about two hundred milligrams per square foot of DDT, which isn't very much, and it was formulated in a way that you could see where you sprayed. When it dried, it left a deposit, like chalk. It had a bit of a chlorine smell. It's not perfume. It's kind of like swimming-pool water. People were told to wait half an hour for the spray to dry, then they could go back."

The results were dramatic. In Taiwan, much of the Caribbean, the Balkans, parts of northern Africa, the northern region of Australia, and a large swath of the South Pacific, malaria was eliminated. Sri Lanka saw its cases drop to about a dozen every year. In India, where malaria infected an estimated seventy-five million and killed eight hundred thousand every year, fatalities had dropped to zero by the early sixties. Between 1945 and 1965, DDT saved millions—even tens of millions—of lives around the world, perhaps more than any other man-made drug or chemical before or since.

What DDT could not do, however, was eradicate malaria entirely. How could you effectively spray eighty per cent of homes in the Amazonian jungle, where communities are spread over hundreds of thousands of highly treacherous acres? Sub-Saharan Africa, the most malarious place on earth, presented such a daunting logistical challenge that the eradication campaign never really got under way there. And, even in countries that seemed highly amenable to spraying, problems arose. "The rich had houses that they didn't want to be sprayed, and they were giving bribes," says Socrates Litsios, who was a scientist with the W.H.O. for many years and is now a historian of the period. "The inspectors would try to double their spraying in the morning so they wouldn't have to carry around the heavy tanks all day, and as a result houses in the afternoon would get less coverage. And there were many instances of corruption with insecticides, because they were worth so much on the black market. People would apply diluted sprays even when

they knew they were worthless.”

Typical of the logistical difficulties is what happened to the campaign in Malaysia. In Malaysian villages, the roofs of the houses were a thatch of palm fronds called atap. They were expensive to construct, and usually lasted five years. But within two years of DDT spraying the roofs started to fall down. As it happened, the atap is eaten by caterpillar larvae, which in turn are normally kept in check by parasitic wasps. But the DDT repelled the wasps, leaving the larvae free to devour the atap. “Then the Malaysians started to complain about bedbugs, and it turns out what normally happens is that ants like to eat bedbug larvae,” McWilson Warren said. “But the ants were being killed by the DDT and the bedbugs weren’t—they were pretty resistant to it. So now you had a bedbug problem.” He went on, “The DDT spray teams would go into villages, and no one would be at home and the doors would be locked and you couldn’t spray the house. And, understand, for that campaign to work almost every house had to be sprayed. You had to have eighty-per-cent coverage. I remember there was a malaria meeting in ’62 in Saigon, and the Malaysians were saying that they could not eradicate malaria. It was not possible. And everyone was arguing with them, and they were saying, ‘Look, it’s not going to work.’ And if Malaysia couldn’t do it—and Malaysia was one of the most sophisticated places in the region—who could?”

At the same time, in certain areas DDT began to lose its potency. DDT kills by attacking a mosquito’s nervous system, affecting the nerve cells so that they keep firing and the insect goes into a spasm, lurching, shuddering, and twitching before it dies. But in every population of mosquitoes there are a handful with a random genetic mutation that renders DDT nontoxic—that prevents it from binding to nerve endings. When mass spraying starts, those genetic outliers are too rare to matter. But, as time goes on, they are the only mosquitoes still breeding, and entire new generations of insects become resistant. In Greece, in the late nineteen-forties, for example, a malariologist noticed *Anopheles sacharovi* mosquitoes flying around a room that had been sprayed with DDT. In time, resistance began to emerge in areas where spraying was heaviest. To the malaria warriors, it was a shock. “Why should they have known?” Janet Hemingway, an expert in DDT resistance at the University of Wales in Cardiff, says. “It was the first synthetic insecticide. They just assumed that it would keep on working, and that the insects couldn’t do much about it.” Soper and the malariologist Paul Russell, who was his great ally, responded by pushing for an all-out war on malaria. We had to use DDT, they argued, or lose it. “If countries, due to lack of funds, have to proceed slowly, resistance is almost certain to appear and eradication will become economically impossible,” Russell wrote in a 1956 report. “TIME IS OF THE ESSENCE because DDT resistance has appeared in six or seven years.” But, with the administrative and logistical problems posed by the goal of eighty-per-cent coverage, that deadline proved impossible to meet.

In 1963, the money from Congress ran out. Countries that had been told they could wipe out malaria in four years—and had diverted much of their health budgets to that effort—grew disillusioned as the years dragged on and eradication never materialized. Soon, they put their money back into areas that seemed equally pressing, like maternal and child health. Spraying programs were scaled back. In those countries where the disease had not been completely eliminated, malaria rates began to inch upward. In 1969, the World Health Organization formally abandoned global eradication, and in the ensuing years it proved impossible to muster any great enthusiasm from donors to fund antimalaria efforts. The W.H.O. now recommends that countries treat the disease largely through the health-care system—through elimination of the parasite—but

many anti-malarial drugs are no longer effective. In the past thirty years, there have been outbreaks in India, Sri Lanka, Brazil, and South Korea, among other places. “Our troubles with mosquitoes are getting worse,” Spielman concludes in “Mosquito,” “making more people sick and claiming more lives, millions of lives, every year.”

For Soper, the unravelling of his dream was pure torture. In 1959, he toured Asia to check on the eradication campaigns of Thailand, the Philippines, Ceylon, and India, and came back appalled at what he had seen. Again and again, he found, countries were executing his strategy improperly. They weren't spraying for long enough. They didn't realize that unless malaria was ground into submission it would come roaring back. But what could he do? He had prevailed against *gambiae* in Brazil in the nineteen-thirties because he had been in charge; he had worked with the country's dictator to make it illegal to prevent an inspector from entering a house, and illegal to prevent the inspector from treating any open container of water. Jesse Hobbs tells of running into Soper one day in Trinidad, after driving all day in an open jeep through the tropical heat. Soper drove up in a car and asked Hobbs to get in; Hobbs demurred, gesturing at his sweaty shirt. “Son,” Soper responded, “we used to go out in a day like this in Brazil and if we found a sector chief whose shirt was *not* wet we'd fire him.” Killing mosquitoes, Soper always said, was not a matter of knowledge and academic understanding; it was a matter of administration and discipline. “He used to say that if you have a democracy you can't have eradication,” Litsios says. “When Soper was looking for a job at Johns Hopkins—this would have been '46—he told a friend that ‘they turned me down because they said I was a fascist.’” Johns Hopkins was right, of course: he was a fascist—a disease fascist—because he believed a malaria warrior had to be. But now roofs were falling down in Malaysia, and inspectors were taking bribes, and local health officials did not understand the basic principles of eradication—and his critics had the audacity to blame his ideas, rather than their own weakness.

It was in this same period that Rachel Carson published “Silent Spring,” taking aim at the environmental consequences of DDT. “The world has heard much of the triumphant war against disease through the control of insect vectors of infection,” she wrote, alluding to the efforts of men like Soper, “but it has heard little of the other side of the story—the defeats, the short-lived triumphs that now strongly support the alarming view that the insect enemy has been made actually stronger by our efforts.” There had already been “warnings,” she wrote, of the problems created by pesticides:

On Nissan Island in the South Pacific, for example, spraying had been carried on intensively during the Second World War, but was stopped when hostilities came to an end. Soon swarms of a malaria-carrying mosquito reinvaded the island. All of its predators had been killed off and there had not been time for new populations to become established. The way was therefore clear for a tremendous population explosion. Marshall Laird, who had described this incident, compares chemical control to a treadmill; once we have set foot on it we are unable to stop for fear of the consequences.

It is hard to read that passage and not feel the heat of Soper's indignation. He was familiar with “Silent Spring”—everyone in the malaria world was—and what was Carson saying? Of course the mosquitoes came back when DDT spraying stopped. The question was whether the mosquitoes were gone long enough to disrupt the cycle of malaria transmission. The whole point of eradication, to his mind, was that it got you *off* the treadmill: DDT was so effective that if you

used it properly you could stop spraying and not fear the consequences. Hadn't that happened in places like Taiwan and Jamaica and Sardinia?

"Silent Spring" was concerned principally with the indiscriminate use of DDT for agricultural purposes; in the nineteen-fifties, it was being sprayed like water in the Western countryside, in an attempt to control pests like the gypsy moth and the spruce budworm. Not all of Carson's concerns about the health effects of DDT have stood the test of time—it has yet to be conclusively linked to human illness—but her larger point was justified: DDT was being used without concern for its environmental consequences. It must have galled Soper, however, to see how Carson effectively lumped the malaria warriors with those who used DDT for economic gain. Nowhere in "Silent Spring" did Carson acknowledge that the chemical she was excoriating as a menace had, in the two previous decades, been used by malariologists to save somewhere in the vicinity of ten million lives. Nor did she make it clear how judiciously the public-health community was using the chemical. By the late fifties, health experts weren't drenching fields and streams and poisoning groundwater and killing fish. They were leaving a microscopic film on the inside walls of houses; spraying every house in a country the size of Guyana, for example, requires no more DDT in a year than a large cotton farm does. Carson quoted a housewife from Hinsdale, Illinois, who wrote about the damage left by several years of DDT spraying against bark beetles: "The town is almost devoid of robins and starlings; chickadees have not been on my shelf for two years, and this year the cardinals are gone too; the nesting population in the neighborhood seems to consist of one dove pair and perhaps one catbird family. . . . 'Will they ever come back?' [the children]ask, and I do not have the answer." Carson then quoted a bird-lover from Alabama:"There was not a sound of the song of a bird. It was eerie, terrifying. What was man doing to our perfect and beautiful world?" But to Soper the world was neither perfect nor beautiful, and the question of what man could do to nature was less critical than what nature, unimpeded, could do to man.

Here, from a well-thumbed page inserted in Soper's diaries, is a description of a town in Egypt during that country's *gambiae* invasion of 1943—a village in the grip of its own, very different, unnatural silence:

*Most houses are without roofs. They are just a square of dirty earth. In those courtyards and behind the doors of these hovels were found whole families lying on the floor; some were just too weakened by illness to get up and others were lying doubled up shaking from head to foot with their teeth chattering and their violently trembling hands trying in vain to draw some dirty rags around them for warmth. They were in the middle of the malaria crisis. There was illness in every house. There was hardly a house which had not had its dead and those who were left were living skeletons, their old clothing in rags, their limbs swollen from undernourishment and too weak to go into the fields to work or even to get food.*

It must have seemed to Soper that the ground had shifted beneath his feet—that the absolutes that governed his life, that countenanced even the most extreme of measures in the fight against disease, had suddenly and bewilderingly been set aside. "I was on several groups who evaluated malaria-eradication programs in some of the Central American countries and elsewhere," Geoffrey Jeffery recalls. "Several times we came back with the answer that with the present technology and effort it wasn't going to work. Well, that didn't suit Soper very much. He harangued us. We shouldn't be saying things like that!" Wilbur Downs, a physician who worked

for the Rockefeller Foundation in Mexico in the fifties, used to tell of a meeting with Soper and officials of the Mexican government about the eradication of malaria in that country. Soper had come down from Washington, and amid excited talk of ending malaria forever Downs pointed out that there were serious obstacles to eradication—among them the hastened decomposition and absorption of DDT by the clays forming adobe walls. It was all too much for Soper. This was the kind of talk that was impeding eradication—the doubting, the equivocation, the incompetence, the elevation of songbirds over human life. In the middle of the meeting, Soper—ramrod straight, eyes afire—strode over to Downs, put both his hands around his neck, and began to shake.

Fred Soper ran up against the great moral of the late twentieth century—that even the best-intentioned efforts have perverse consequences, that benefits are inevitably offset by risks. This was the lesson of “Silent Spring,” and it was the lesson, too, that malariologists would take from the experience with global eradication. DDT, Spielman argues, ought to be used as selectively as possible, to quell major outbreaks. “They should have had a strong rule against spraying the same villages again and again,” he says. “But that went against their doctrine. They wanted eighty- per-cent coverage. They wanted eight out of ten houses year after year after year, and that’s a sure formula for resistance.” Soper and Russell once argued about whether, in addition to house spraying, malaria fighters should continue to drain swamps. Russell said yes; Soper said no, that it would be an unnecessary distraction. Russell was right: it made no sense to use only one weapon against malaria.

Spielman points out that malaria transmission in sub-Saharan Africa is powerfully affected by the fact that so many people live in mud huts. The walls of that kind of house need to be constantly replastered, and to do that villagers dig mud holes around their huts. But a mud hole is a prime breeding spot for *gambiae*. If economic aid were directed at helping villagers build houses out of brick, Spielman argues, malaria could be dealt a blow. Similarly, the Princeton University malariologist Burton Singer says that since the forties it has been well known that mosquito larvae that hatch in rice fields—a major breeding site in southeast Asia—can be killed if the water level in the fields is intermittently drained, a practice that has the additional effect of raising rice yields. Are these perfect measures? No. But, under the right circumstances, they are sustainable.

In a speech Soper presented on eradication, he quoted Louis Pasteur: “It is within the power of man to rid himself of every parasitic disease.” The key phrase, for Soper, was “within the power.” Soper believed that the responsibility of the public-health professional was to make an obligation out of what was possible. He never understood that concessions had to be made to what was practical. “This is the fundamental difference between those of us in public health who have an epidemiological perspective, and people, like Soper, with more of a medical approach,” Spielman says. “We deal with populations over time, populations of individuals. They deal with individuals at a moment in time. Their best outcome is total elimination of the condition in the shortest possible period. Our first goal is to cause no outbreaks, no epidemics, to manage, to contain the infection.” Bringing the absolutist attitudes of medicine to a malarious village, Spielman says, “is a good way to do a bad thing.” The Fred Soper that we needed, in retrospect, was a man of more modest ambitions.

But, of course, Fred Soper with modest ambitions would not be Fred Soper; his epic achievements arose from his fanaticism, his absolutism, his commitment to saving as many lives

as possible in the shortest period of time. For all the talk of his misplaced ambition, there are few people in history to whom so many owe their lives. The Global Malaria Eradication Programme helped eliminate the disease from the developed world, and from many parts of the developing world. In a number of cases where the disease returned, it came back at a lower level than it had been in the prewar years, and even in those places where eradication made little headway the campaign sometimes left in place a public infrastructure that had not existed before. The problem was that Soper had raised expectations too high. He had said that the only acceptable outcome for Global Eradication was global eradication, and when that did not happen he was judged—and, most important, he judged himself—a failure. But isn't the urgency Soper felt just what is lacking in the reasonableness of our contemporary attitude—in our caution and thoughtfulness and restraint? In the wake of the failure of eradication, it was popular to say that truly effective malaria control would have to await the development of a public-health infrastructure in poorer countries. Soper's response was, invariably: What about now? In a letter to a friend, he snapped, "The delay in handling malaria until it can be done by local health units is needlessly sacrificing the generation now living." There is something to admire in that attitude; it is hard to look at the devastation wrought by H.I.V. and malaria and countless other diseases in the Third World and not conclude that what we need, more than anything, is someone who will marshal the troops, send them house to house, monitor their every movement, direct their every success, and, should a day of indifference leave their shirts unsullied, send them packing.

Toward the end of his life, Soper, who died in 1975, met with an old colleague, M. A. Farid, with whom he had fought *gambiae* in Egypt years before. "How do things go?" Soper began. "Bad!" Farid replied, for this was in the years when everyone had turned against Soper's vision. "Who will be our ally?" Soper asked. And Farid said simply, "Malaria," and Soper, he remembered, almost hugged him, because it was clear what Farid meant: Someday, when DDT is dead and buried, and the West wakes up to a world engulfed by malaria, we will think back on Fred Soper and wish we had another to take his place.