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A NEW WEAPON IN THE WAR ON TICKS

By Jason Fagone August 27, 2013

In 2006, a friend of James Squire handed him a child's toy, a remote-controlled vehicle with tank tracks instead of wheels, that he had picked up for free at a conference, and suggested that Squire find something interesting to do with it. Squire stared at it for a while. He soon found himself thinking about ticks. He'd recently discovered a few of the small arachnids on the skin of his eighteen-month-old son and had plucked several from his dog. Meanwhile, Lyme disease seemed to be exploding. He wondered if he could make a robot that would roam the outdoors and kill ticks.

It turns out there aren't many good ways to kill ticks: one of the most common is the blunt-force use of permethrin, a pest-control agent that is available in granule form for spreading on lawns. But permethrin is known to sicken cats and fish, and the Department of Defense has funded research into whether it played a role in Gulf War syndrome. Another option is to deploy guinea hens, large birds that resemble pheasants and like to eat ticks, which some landowners buy to keep on their lawns.

Squire, a reedy, energetic forty-five-year-old man, is a prolific inventor who teaches electrical engineering at the Virginia Military Institute. Although he graduated from West Point and was an Army intelligence officer in the Gulf War, he's always been more nerd than soldier; at West Point, his cadet buddies used to make fun of him for leaving his calculator out in his messy, book-strewn dorm room, which they called "the de-militarized zone." One of Squire's inventions is a system for communicating with miners trapped deep underground; it uses acoustic speakers to produce seismic waves that ripple through soil and rock. Another creation, a modified karate mat, is embedded with microchips to help students train more effectively.

After receiving the tank toy, seven years ago, Squire huddled with David Livingston, a friend and officemate at V.M.I. and a professor of electrical and computer engineering, to brainstorm designs for a mobile robot that could destroy ticks. "Our first ideas were what most people would try to come up with," Livingston said. "Build an arm to grab the ticks, or squash them." Then Squire called Daniel Sonenshine, a tick expert at nearby Old Dominion University, who had written one of the most comprehensive texts in the field, the two-volume "Biology of Ticks." He said that Squire was thinking about the problem all wrong.

Ticks are amazing hunters. They can smell the exhaled carbon dioxide of a mammal five minutes after the mammal has passed by, and they can also sense minute changes in temperature caused by the motion of a potential host. ("They remind me of 'The Predator,' " Squire said, referring to the 1987 alien-hunter film.) Sonenshine told Squire and Livingston that a smarter approach would be "biomimicry": instead of hunting ticks, the robot should be hunted by them.

So Squire, Livingston, and another V.M.I. colleague, a mechanical engineer named Jay Sullivan, tried to build a robot that would make the ticks think the robot was alive. The system began with a perforated tube that oozed carbon dioxide, which was placed in the ecotone between groomed lawn and the woods, where ticks like to hang out. Ideally, ticks would sniff the leaking carbon dioxide and run toward the tube. Inside the tube was a small wire that sent out a pulsating magnetic field.

This was where the tick robot, the size of a twenty-pound dog, came in. A miniaturized version of a type of rugged off-road vehicle called a rock crawler, it had four wheels and a front-mounted plow to push aside vines. Sensing the magnetic field, it drove toward the tube then crawled slowly around, dragging a square piece of white denim—the material excites ticks. The denim was impregnated with permethrin, but in a way that wouldn't leave any behind in the environment; the ticks would simply attach themselves to the denim, thinking that it was a living host. Within a few minutes, they'd figure out that the robot wasn't alive, but not before absorbing enough permethrin to kill them.

Squire tested the robot for the first time in his own back yard. He caught zero ticks. He thought the robot was a failure until he called Sonenshine, who told him that he'd simply missed the season when young, so-called nymphal ticks emerge. Sonenshine invited Squire and his colleagues to his lab. Sonenshine grabbed a vial full of what looked like tiny pulsing black jelly beans—hungry nymphal ticks. He went outdoors and emptied fifty from the vial into a field where Squire, Livingston, and Sullivan set the robot to work. It picked up forty-five of the fifty ticks. It might have picked up more, but at least one had already crawled up a student's leg.

Encouraged, the team continued to tweak the robot's design. Last year, they decided that it was ready for a more rigorous test, at the Hoffler Creek Wildlife Preserve, a hundred-and-forty-two-acre sanctuary in Portsmouth, Virginia. The preserve is so tick-infested—in particular by "lone star" ticks, which are extremely aggressive and cause ehrlichiosis, a set of bacterial diseases similar to Lyme—that local schools no longer book field trips there. "More than forty per cent of the ticks we collect in a year, we collect from this one site," said Holly Gaff, a tick biologist at Old Dominion.

When Gaff first heard about the robot, she thought it would never work. But she agreed to supervise a test anyway. She picked spots on three trails at the preserve. At each spot, she dragged a white denim cloth across some vegetation to collect ticks. A graduate student painted the ticks with fingernail polish, so Gaff would later be able to distinguish them from dirt. Then she released the ticks and the robot. After the robot traversed the area, she collected the ticks by hand, using the white denim cloth again. On certain runs, as a control Gaff attached a non-treated plastic cloth to the robot. On the other runs, she used the cloth soaked with permethrin. She repeated the procedure four times, every other week. Examining the data, she found that the robot with the non-treated cloth had not affected the tick population at all, but the robot with the treated cloth had reduced the tick density in the area by between seventy-five and ninety per cent after just an hour. After four hours, it had killed nearly a hundred per cent of the ticks. "We were able to sit down in this park and have lunch without ticks crawling up our legs," Gaff said. "You would *never* sit in this park."

A number of technical and practical hurdles remain before the tick robot begins exterminating ticks en masse. For one, it won't be fully tested in a residential area until late next spring, the height of nymphal-tick season in Virginia, when it will be let loose in lots that resemble suburban back yards. (In fact, several technology-licensing experts have told Squire that his tick robot can't possibly work, because if it did somebody would have already invented it.)

Perhaps most important, the technology faces a pest-control industry that's historically conservative when it comes to innovation: according to Elizabeth Baker, an assistant professor at the Wake Forest Schools of Business who is helping Squire and his colleagues commercialize the robot, "The pest people and the robot people don't talk to each other." So even if Squire makes the robot easy enough for exterminators to operate and inexpensive enough for them to be willing to purchase it (he believes he can manufacture the robot for a thousand dollars apiece), the robot might be a radical solution for a field that's simply not seeking one at the moment. But if tick-borne illnesses like Lyme continue to attract attention, particularly with C.D.C.'s report, last week, noting a ten-fold increase in Lyme diagnoses, the hunt for new ways to kill ticks may take on a new urgency, even in a field that would rather take it slow.

Jason Fagone is a contributing editor at Wired and the author of "Ingenious," a book about inventors and cars, which will be out in November.

Photograph: Stephanie Klein-Davis/The Roanoke Times/AP.