# Defanging Disease:
## A New Approach To Tick-Borne Illness

BY JAMES SCHULTZ

HE DOESN'T MUCH CARE FOR THE CRITTERS HE HAS SPENT THE ENTIRETY OF HIS SCIENTIFIC CAREER STUDYING. IT'S TRUE THAT, IN THEIR OWN WAY, THEY'RE INGENIOUS, HARDY CREATIONS OF NATURE. BUT CERTAIN VARIETIES ARE RELENTLESS IN THEIR SPREAD OF DISEASE. THE PAIN THEY HAVE CAUSED, WILL CAUSE, IS INCALCULABLE. THEY'RE A TOUGH PROBLEM WITH SEEMINGLY NO SOLUTION.

But now, Dan Sonenshine, Old Dominion eminent professor of biological sciences and one of the world's leading experts on ticks, thinks he may have identified the beginnings of a strategy. It's difficult and will require years of preparation and implementation. But theoretically, it's doable. And it's vastly preferable to the alternative: attempted total eradication, with the prospect of harsh chemicals causing severe environmental damage.

Part of Sonenshine's answer has to do with a simple question. If the array of maladies ticks transmit to humans are so virulent — such as Lyme disease and Rocky Mountain spotted fever — what is it that keeps ticks healthy? Shouldn't they be afflicted as well, with pathogens that would injure or kill them long before they could bite and do damage to human immune systems?

"We all understand that blood-feeding arthropods like mosquitoes and ticks transmit infectious disease," Sonenshine says. "What we don't understand is why they don't succumb themselves. What is it that keeps these creatures safe?"

Sonenshine believes he, collaborator Wayne Hynes (a colleague and an Old Dominion associate professor of biological sciences) and their research team of graduate students may have found the basic protective mechanism. If so, modifying the ticks' own biological blueprint might eliminate the health threat they have historically posed.

Modifying the ticks' own biological blueprint might eliminate a serious health threat

## Helping Millions

Ticks weren't, however, on Sonenshine's mind as a young man growing up in the New York City borough of Brooklyn. He fancied himself a future football and baseball player, dreams that quickly dissipated from a perennial perch on the bench. But he was good with books, in particular enthralled with descriptions and stories of wildlife. As a Boy Scout, Sonenshine was able to combine that interest with a growing fascination with the outdoors on a variety of camping, canoeing and hiking expeditions in the Adirondack Mountains. Although keenly interested in a career as a doctor, he was rejected by the six medical schools to which he had applied as an undergraduate biology major at the City College of New York. It took a graduate assistantship offer in biology from the University of Maryland to steer Sonenshine to the profession he has practiced for more than four decades.

"Right from the very beginning I was offered problems related to ticks and tick diseases," Sonenshine recalls. "I loved the research. I made rapid progress."

Sonenshine has lost none of his enthusiasm since his appointment at Old Dominion as a junior faculty member in 1961. A raft of papers and a major textbook later — Sonenshine's 1993 tome Biology of Ticks is one of the standards in the field — plus recognition in 1994 as Virginia's Outstanding Scientist leaves him as motivated as when he first arrived in southeastern Virginia. It's a good thing, given the uncountable, relentless legions of ticks in the world and the dangers posed by their human blood meals.

"Conducting research that could ultimately help millions of people is something that is really exciting," Sonenshine says. "As knowledge develops, it leads you in more deeply, to a much better understanding. We wouldn't put in the long

hours that we do, during weekdays and on weekends, unless we thought we could make a difference. We're not indifferent scientists; we really care about what we're doing."

## Transforming Ticks

Sonenshine's understanding of ticks has deepened with the identification of a crucial component of the creatures' immune systems. He and his research team have identified a protective agent, an antimicrobial protein, which is a constituent of the fluid known as hemolymph that circulates throughout tick bodies (strictly speaking, not blood, at least in the way it's normally defined). The protein exists in great quantities in the hemolymph of dog ticks, which don't infect humans with the Lyme-disease bacterium via their bites, but appears to be absent or exists in vanishingly small quantities in deer ticks, which do transmit illness through biting.

In deer ticks, there is a less aggressive immune-system response to menacing microbes. Deer-tick defenses do eventually capture and destroy infectious agents. But the process is a sluggish one that allows many of the agents to escape and invade salivary glands for transmission to other animals and humans in bites. So, posits Sonenshine, what if there's a way to change the immune-system response in deer ticks to mirror that of dog ticks?

It may be difficult to imagine fighting ticks without pesticides or powerful drugs. But employ genetic techniques, Sonenshine points out, and the whole nature of the problem changes. Rather than attempting to kill every single tick — given the reality of the sheer profusion of individuals worldwide, an impossible task in his view — a basic genetic modification could suffice. And history would change.

"What if we could transform ticks so they couldn't transmit disease at all?" Sonenshine says. "It's not an outrageous idea. If you could genetically alter ticks and other insects, they would become little more than pests. The human benefit is that

**Until tick-borne disease is eradicated, genetically or otherwise, anyone working or playing outdoors in the year's warm months can take simple steps to ward off potential health threats. To echo the age-old adage: an ounce of prevention is worth a pound of cure.**

**BEFORE GOING OUTSIDE ...**

Avoid known tick-infested areas, especially in May, June and July. Information on the local distribution of ticks can be obtained online or in person from local health departments; national, state and local parks; and agricultural extension services.

Wear light-colored clothing so that ticks can be spotted more easily.

Tuck pant legs into socks or boots and shirt into pants. Since ticks climb from below, not above, preventing access is crucial.

**WHEN HIKING OR WALKING THROUGH FORESTS OR WOODLANDS ...**

Tape the area where pants and socks meet so that ticks cannot crawl under clothing.

Spray insect repellent containing the ingredient DEET on clothes and on exposed skin other than the face, or treat clothes (especially pants, socks and shoes) with the pesticide permethrin, which kills ticks on contact.

Wear a hat and a long-sleeved shirt for added protection.

Walk in the center of trails to avoid grass and overhanging brush.

**WHEN COMING INSIDE ...**

Remove clothing promptly and wash and dry it at a high temperature.

Inspect body carefully. If you find a tick, remove it with tweezers. Grasp the tick as close to the skin surface as possible and pull straight back with a slow, steady force. **Do not attempt to suffocate the tick with lotions or gels, since this may force the tick to burrow more deeply into the skin.**

Avoid crushing the tick's body, thereby releasing infectious agents. In some areas, ticks saved in a sealed container can be submitted to the local health department for identification and analysis.

The bottom line, according to Old Dominion biologist and tick expert Dan Sonenshine: "There's no need to be terrified of a tick bite. Treat ticks with respect, take adequate precautions, and you'll be fine."

*Guidelines courtesy of Don Sonenshine and the Centers For Disease Control*

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The process would likely be long and difficult. Researchers must surmount a number of obstacles, not the least of which is precisely identifying the gene that makes the protective antimicrobial protein. Then scientists would have to figure out a way to transfer the protein-producing gene into the deer ticks' DNA. And there would be regulatory hurdles to clear as well: The federal government would have to approve field trials and face the prospect of unprecedented and widespread genetic alteration of a hyperabundant, if parasitic, species.

"There's a gene lurking somewhere in the [dog tick] responsible for making this protective protein," Sonenshine says. "It's inactive until it's needed. Bacterial challenge turns the gene on, and the protein is synthesized. If we could take the protein-making gene from the dog tick and put it in the deer tick, then we could transform the tick into a creature incapable of transmitting disease. That's the payoff. That's where our research is heading."

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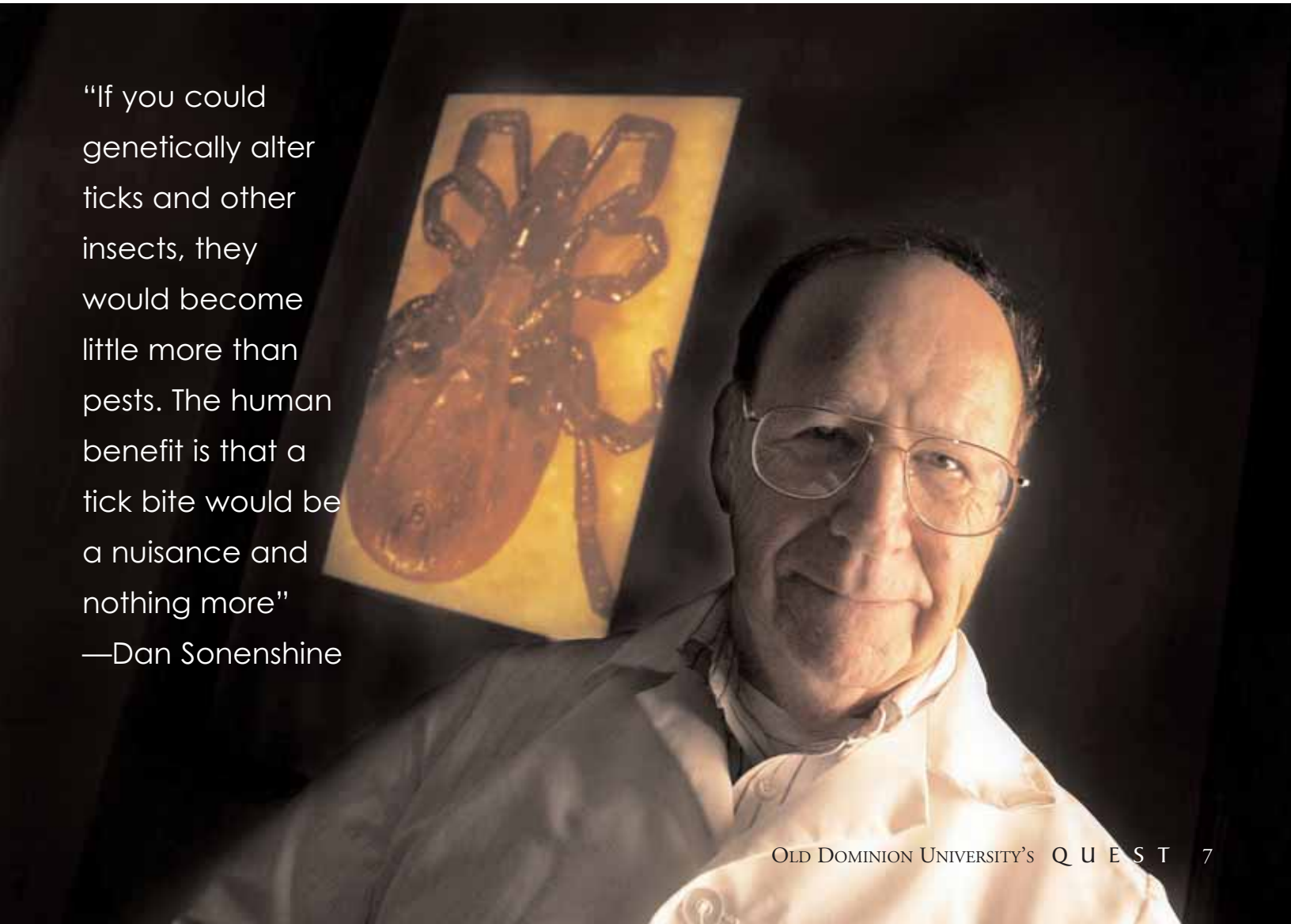
Sonenshine has submitted a proposal to the National Science Foundation to fund the gene hunt. If monies are approved, he estimates the effort could take up to three years. Then protocols would have to be developed for field trials; should the trials begin, they could last five years. Then, and only then, would it possible to create a world in which ticks, for all their bother, could never again threaten human health.



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—Dan Sonenshine