sible through the air between ferrets (the best animal model for studying the impact of disease on humans). The news caused a storm of controversy in the popular press and heated debate among scientists over the ethics of the work. For Lipsitch and many others, the creation of the new strain was cause for alarm. "H5N1 influenza is already one of the most deadly viruses in existence," he says. "If you make [the virus] transmissible [between humans], you have to be very concerned about what the resulting strain could do."

To put this danger in context, the 1918 "Spanish" flu—one of the most deadly influenza epidemics on record—killed between 50 million and 100 million people worldwide, or roughly 3 to 6 percent of those infected. The more lethal SARS virus (see "The SARS Scare," March-April 2007, page 47) killed almost 10 percent of infected patients during a 2003 outbreak that reached 25 countries worldwide. H5N1 is much more dangerous, killing almost 60 percent of those who contract the illness.

If a transmissible strain of H5N1 escapes the lab, says Lipsitch, it could spark a global health catastrophe. "It could infect millions of people in the United States, and very likely more than a billion people globally, like most successful flu strains do," he says. "This might be one of the worst viruses—perhaps *the* worst virus—in existence right now because it has both transmissibility and high virulence."

Ironically, this is why Ron Fouchier, the Dutch virologist whose lab created the new H5N1 strain, argues that studying it in more depth is crucial. If the virus can be made transmissible in the lab, he reasons, it can also occur in nature—and researchers should have an opportunity to understand as much as possible about the strain before that happens.

Lipsitch, who directs the Center for Communicable Disease Dynamics at HSPH, thinks the risks *far* outweigh the rewards. Even in labs with the most stringent safety requirements, such as enclosed rubber "space suits" to isolate researchers, accidents do happen. A single unprotected breath could infect a researcher, who might unknowingly spread the virus beyond the confines of the lab.

In an effort to avoid this scenario, Lipsitch has been pushing for changes in research policy in the United States and abroad. (A yearlong, voluntary global ban on H5N1 research was lifted in many countries in January, and new rules governing such research in the United States were expected in February.) Lipsitch says that none of the current research proposals he has seen "would significantly improve our preparational response to a national pandemic of H5N1. The small risk of a very large public health disaster…is not worth taking [for] scientific knowledge without an immediate public health application." His recent op-eds in scientific journals and the popular press have stressed the importance of regulating the transmissible strain and limiting work with the virus to only a handful of qualified labs. In addition, he argues, only technicians who have the right training and experience—and have been inoculated against the virus—should be allowed to handle it.

These are simple limitations that could drastically reduce the danger of the virus spreading, he asserts, yet they're still not popular with some researchers. He acknowledges that limiting research is an unusual practice scientifically but argues, "These are unusual circumstances."

Lipsitch thinks a great deal of useful research can still be done on the non-transmissible strain of the virus, which would provide valuable data without the risk of accidental release. In the meantime, he hopes to make more stringent H5N1 policies a priority for U.S. and foreign laboratories. Although it's not a perfect solution, he says, it's far better than a nightmare scenario.

~DAVID LEVIN

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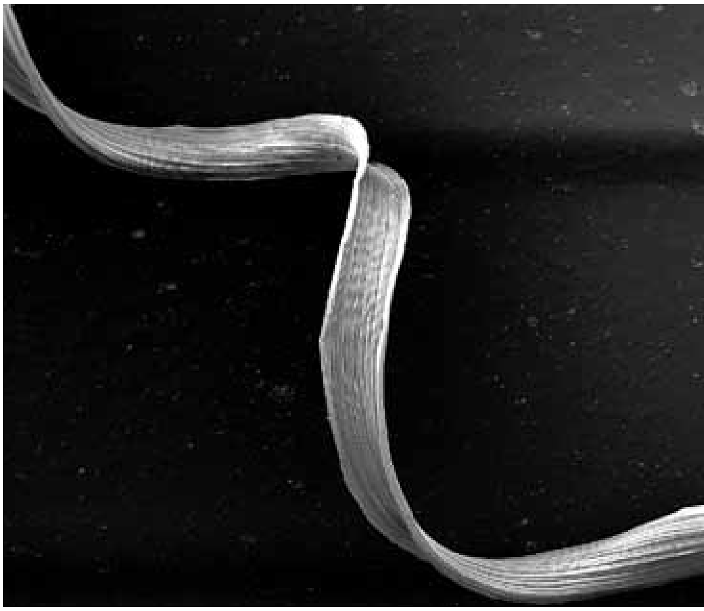
TOUGH OR TENDRIL?

A Cucumber Coil Conundrum

THE CUCUMBER TENDRIL has long fascinated observant gardeners. This specialized plant stem grows straight at first—until it reaches the nearest trellis or fence post. Then it changes shape, wrapping around the object, twisting into tiny coils, and gaining a support structure for its efforts to grow toward the sun.



Grasping cucumber tendrils, opposite, coil in two different directions. Close study led to the discovery of a new type of spring. At left, a lignified fiber from a coiled tendril, greatly magnified

These grasping tendrils have also intrigued scientists for centuries; Charles Darwin explored the topic in *On the Movements and Habits of Climbing Plants*, published in 1865. He noted that a coiled cucumber tendril twists in one direction and then the other, with the two sections joined in the middle by a straight piece that he termed the "perversion." Many scientists have studied cucumber tendrils since then, but important questions remained unanswered: Just how does the tendril curl? And how do these coils benefit the plant?

These were ideal questions for the team led by L. Mahadevan, de Valpine professor of applied mathematics. Mahadevan's research seeks to explain everyday phenomena, such as how flags flutter, why Venus flytraps snap shut, or how the petals of a lily form and unfurl; he describes himself as part applied mathematician, part physicist, and part biologist (See detailed coverage of this earlier work in "The Physics of the Familiar," March-April 2008, p. 46). He first wondered about cucumber tendrils as a graduate student, but didn't pursue the topic until postdoctoral student Sharon Gerbode (now assistant professor of physics at Harvey Mudd College) joined his lab. Aided by graduate students Josh Puzey (biology) and Andrew McCormick (physics), the researchers used their mix of disciplines to understand the elusive tendril. "We do whatever it takes to study problems in my group," Mahadevan says. "We are not just theorists, or just experimentalists, not just mathematicians or physicists or engineers. Nature certainly does not care; she is subtle, and it is up to us to tease out how she works."

The team began by dissecting the tendril at various points in its development and found a thin ribbon of gelatinous fibers, running the length of the stem, that becomes woody—or "lignifies"—over time. As it ages, this rigid strand also loses water and shrinks, and that combination of lignification and shrinkage pulls the entire tendril into its coiled shape.

Once they understood the biological mechanism of the coil, the team wanted to represent it with physical models. "As a scientist, if I understand something, I should be able to recreate it," Mahadevan explains. Using ordinary materials including rubber, glue, copper wire, and tape, the researchers made numerous tendril models until they arrived at one that behaved like a real cucumber tendril. It allowed them to explore something surprising that they'd noted in live tendrils: when pulled from opposite ends, the coil does not straighten, but first overwinds, adding more turns to both helices before it eventually straightens.

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Visit harvardmag.com/extras to view time-lapse footage of the strange phenomenon of "overwinding."

The team also developed mathematical models that allowed it to understand the mechanical properties of the coil. Mahadevan points out that Darwin presciently called the cucumber tendril "an excellent spring," and the Harvard researchers quantified the structure, discovering in the process a new type of spring. With its two opposite-handed helices joined by the straight perversion

Photographs by Josh Puzey

in the center, the spring responds flexibly to varying levels of force. It's pliant when pulled gently, and grows stiffer when pulled more forcefully. The stiffer the spring becomes, the more tightly it curls, and the presence of the perversion allows it to freely overwind or underwind. The team's findings appeared in the journal *Science* last summer.

Mahadevan sees benefits for the cucumber: when a tendril is young and especially tender, and first winding onto a nearby trellis, a weak connection would be helpful. "If the wind blows or there is a disturbance of some other kind, then you don't want the whole thing to fall apart," he explains. "You want a relatively soft response." But as the tendril develops tighter connections to a trellis over time, it grows woodier and reacts more strongly to any pulling, protecting the mature plant.

Mahadevan stresses that his team didn't set out to discover a new type of spring, and he's unconcerned about future applications of these and other discoveries. He explains that his research is motivated by pure curiosity. "I work on things because I want to understand how the world works," he says. "I'm fortunate to be part of a system that still in some small degree, I hope, will value it. The deep truth is that I worked on this the way I have worked on other problems—because it is human to be curious."

~ERIN O'DONNELL

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ISTOCK

EXERCISE, PRESCRIBED

Cheating the Reaper

For patients with high blood pressure, doctors are likely to prescribe antihypertensive medication and provide detailed instructions about how much to take, and when. They have been less able to provide detailed dosage recommendations for exercise. Research shows that a regular walking, swimming, or tennis habit reduces chronic disease risk, but it's been unclear just how much different levels of exercise might extend our lives. Now, a study coauthored by epidemiologist I-Min Lee, a professor of medicine at Harvard Medical School and professor of epidemiology at Harvard School of Public Health, offers specific exercise prescriptions.

Lee and her colleagues pooled data from six large studies that included information on the leisure activities and body mass index of more than 650,000 people older than 40, each of whom was followed for an average of 10 years. The researchers' analysis revealed that subjects who completed the equivalent of 75 minutes of brisk walking each week—roughly 11 minutes a day—lived 1.8 years longer than those who didn't exercise at all. Those who got the federally recommended minimum of 150 minutes of moderate-intensity exercise a week—22 minutes every day, or 30 minutes a day, five days a week—gained 3.4 years.

Lee was somewhat surprised that even small amounts of movement made such a difference. "What we found is really encouraging," she says. "If you do a little, you get a fairly good gain in years."

That's promising news, given that more than half of all Americans don't meet those federal physical-activity guidelines. "It's very daunting for someone who never does physical activity even to think of 150 minutes a week," Lee says. "This research suggests that while 150 minutes is a target, we can ask people to start off slowly and work their way up. Doing something is better than doing nothing." The more people exercised, the more years they gained, Lee says, although the benefits begin to plateau at