an inability to recall a traumatic experience at one point and the subsequent recovery of that memory.

In a report of their findings published in *Psychological Medicine,* Pope and his colleagues concluded that the absence of dissociative amnesia in works prior to 1800 indicates that the phenomenon is not a natural neurological function, but rather a "culture-bound" syndrome rooted in the nineteenth century. They argued that dissociative amnesia falls into the diagnostic category "pseudo-neurological symptom" (or "conversion disorder")—a condition that "lacks a recognizable medical or neurological basis."

The authors have also refuted a number of alternative hypotheses that might explain their survey results. For instance, they argued, the fact that pre-nineteenth-century societies may have conceptualized memory differently than we do cannot account for the lack of recorded descriptions of dissociative amnesia. "Our ancestors had little understanding about delusions and hallucinations," Pope points out. "They didn't know about dopamine in the brain or things we now know cause paranoia or auditory hallucinations, but descriptions of hallucinations [appear] in literature for hundreds of years and from all over the world." Similarly, "If an otherwise lucid individual spontaneously develops complete amnesia for a serious traumatic event, such as being raped or witnessing the death of relations or friends," the researchers explained, "a description of such a case would surely be recognizable, even through a dense veil of cultural interpretation" such as spirit possession or some other supernatural event.

What, then, accounts for "repressed memory's" appearance in the nineteenth century and its endurance today? Pope and his colleagues hope to answer these questions in the future. "Clearly the rise of Romanticism, at the end of the Enlightenment, created fertile soil for the idea that the mind could expunge a trauma from consciousness," Pope says. He notes that other pseudo-neurological symptoms (such as the female "swoon") emerged during this era, but faded relatively quickly. He suspects that two major factors helped solidify "repressed memory" in the twentieth-century imagination: psychoanalysis (with its theories of the unconscious) and Hollywood. "Film is a perfect medium for the idea of repressed memory," he says. "Think of the 'flashback,' in which a whole childhood trauma is suddenly recalled. It's an ideal dramatic device."

Shortly after publication of their paper, the investigators awarded the $1,000 prize to the nominator of *Nina,* an opera by Dalayrac and Marsollier performed in Paris in 1786. (Forgetting that she saw her lover apparently lying dead after a duel, the heroine waits for him daily at an appointed spot. When the young man reappears, Nina first seems to recognize him, then doubts his identity, and only slowly accepts him for who he is.) Pope says he and his colleagues were a few years off their threshold of 1800, but he believes their argument holds: "The challenge falls upon anyone who believes that repressed memory is real to explain its absence for thousands of years."

~ASHLEY PETTUS

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WINGED MIMICRY

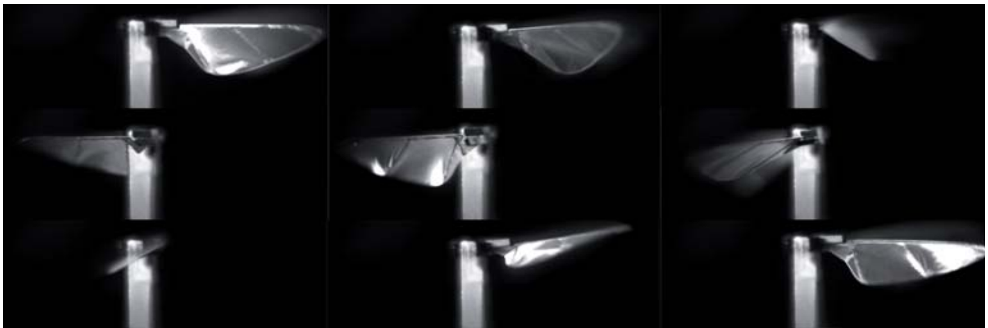
Tinker, Tailor, Robot, Fly

A breakthrough in microrobotic engineering, this artificial fly weighs as much as a few grains of rice, and may prove useful for search and rescue operations, hazardous environment exploration, environmental monitoring, and reconnaissance.

Small, winged insects have a reputation for accidentally buzzing into closed windows or swooping into your eye during a bike ride. But the research of Robert Wood, assistant professor of engineering and applied sciences, may cause you to look twice at your next fly.

Wood has been perfecting a robotic fly whose eventual applications might include locating survivors trapped in mines and spying in wartime. (The research is funded by the Defense Advanced Research Projects Agency, within the Department of Defense.) Now in his second year at Harvard, he began working on the project while a graduate student at the University of California, Berkeley in the late 1990s. The ambitious undertaking was, in many ways, the

Photographs courtesy of Robert Wood



The fly's wings, made of polymers that respond to an electric current, flap and rotate like those of a real fly, beating 120 times per second.

wrong project for Wood at the time. His interest in control theory—an engineer's perspective on how systems work—made him eager to develop a way to manage such a device. One small problem: "If you want to control them, you'll have to build them first," his adviser told him. Wood, with a background in electrical engineering, would have to become a mechanical engineer.

That crossover, which has lasted almost a decade, began with months of research alongside biologists to study the complex wing movements of houseflies, bees, and fruit flies to better mimic the mechanisms that give them flight. Then came the hard part.

Designing an automated fly implied having the ability to make lightweight, miniature working parts, a process that Wood says took up the bulk of his doctoral study, because of the lack of any previous research on which to draw. "For years, the thrust of our work was 'How do we do this?'" says Wood. "There was no existing fabrication paradigm, given the scale we were operating on, the speed we wanted to operate with, and things like cost, turnaround, and robustness." His research group developed and fabricated a laser carving system that could meticulously cut, shape, and bend sheets of carbon fiber and polymer—both strong but lightweight materials—into the necessary microparts.

And how to power those wings to beat 120 times per second? To keep this 60-milligram robot (the weight of a few grains of rice) with a 3-centimeter wingspan to a minimal size and weight, Wood says, you can't simply use a shrunken version of the heavy DC (direct current) motors used in most robots. So he and his team settled on a simple actuator: in this case, a layered composite that bends when electricity is applied, thereby powering a microscale gearbox hooked up to the wings. Wood says the actuator works even better than its biological inspiration. The power density—a measure of power output as a function of mass—of a fly's wing muscles is around 80 watts per kilogram; Wood's wing design produces more than 400 watts per kilogram.

The first takeoff occurred late one evening last March, as Wood worked alone in his office, his colleagues gone for the evening. As the fly rose, Wood jumped up in celebration, quickly verified that his camera had captured the flight, and let out a sigh of relief.

Success meant that Wood could finally turn to those questions that weren't worth asking until the fly took off: Is the shape of a fly's wings (a less-than-optimal design which Wood improved on in his robotic version) a biological limitation, or does it somehow aid the fly's aerodynamics? Does a four-winged insect offer a design improvement? Even questions of evolutionary biology come into play: Why did all the four-winged arthropod flyers of the late Carboniferous period evolve to have two wings?

Visit harvardmag.com/extras to watch a microrobotic fly from Wood's laboratory

Wood figures he is still only one-third of the way toward his goal of creating an autonomous flying robot. But the next step should be at least as rewarding, considering that it will include a focus on control of the insect—the reason he first got involved in the project years ago. His fly now runs on electricity transmitted via thin wiring from high-voltage amplifiers, but he aims to add an onboard power source. Initially, he hopes for five minutes of flying time, which will be extended as the battery options improve.

Eventually, he hopes to program insect

robots to work in a group. "We want a human operator to be able to take out his batch of flies and say, 'I want you guys to search for carbon dioxide'—a survivor breathing in a collapsed building," he explains. From there, Wood sees the possibility of building group behaviors into a swarm: a means of pursuing his interest in the study of emergence, which examines how simple organisms such as ants can produce complex group structures.

Wood's efforts to replicate nature extend beyond the fly: he has worked on a robotic minnow-sized fish, a cockroach-sized crawling robot, and even a "hummingbird." These experiences in engineering biological structures left him awed and inspired. "If I could go back in time and choose again the field I would get into," he says, "it might be a toss-up between engineering and biology."

~DAN MORRELL

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GOING WITH THE GRAIN

When Farmers Met Foragers

A QUESTION MARK has long hovered over human transitions from hunting and gathering to farming: did agriculture spread by communication—in archaeological parlance, by diffusion? Or did the early practitioners of farming migrate, carrying their technology with them, and displace native hunter-gatherers? In the American Southwest, at least, a tentative answer may be in hand, stored in some of the most banal artifacts held by Harvard's Peabody Museum: prehistoric wads of chewed leaves called "quids," and thong-like "aprons," fashioned from shredded juniper bark, stained with what is presumed to be menstrual blood.

STEVEN LEBLANC

Prehistoric quids—wads of masticated leaves found in dry rock shelters—are yielding DNA clues to the origins of farming in the American Southwest.