

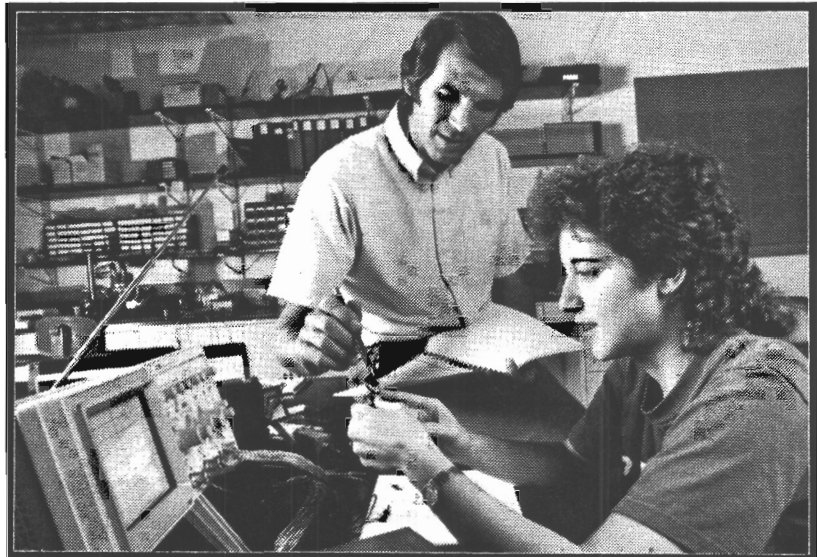
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POUNDING THE PAVEMENT FOR RESEARCH: SCIENTIST WILL RUN 26-MILE MARATHON TO BOOST FUNDING FOR PROSTHETICS WORK

Increased competition for research support has sent university scientists scrambling for funds from every possible source, but few probably would be willing to follow in the footsteps of Dr. Philip R. Kennedy.

A neural prosthetics researcher at the Georgia Institute of Technology, Kennedy hopes to raise at least \$50,000 by pounding the pavement for 26.2 miles in the Atlanta Track Club's Thanksgiving Day Marathon. Kennedy will obtain pledges of support for each mile he runs, and those funds will be matched by the non-profit Georgia Tech Research Corporation.



Dr. Phillip Kennedy and Cindy Linker examine an electronic component which would be used to capture and transmit motor control signals from a cone electrode. (Color/B&W Available)

The 44-year-old Kennedy has run Atlanta's Peachtree Road Race several times, the half-marathon once and last Thanksgiving finished the marathon for the first time.

He hopes the money will allow him to continue work on a "cone electrode" that could one day help severely disabled persons communicate with a computer -- and perhaps allow quadriplegics to regain limited

control of their limbs.

"I hope it will tide us over in making the transition from basic research to applications," Kennedy explained. "If we can get a few good sponsors, maybe we can raise enough to continue the work."

Kennedy, whose studies have been supported by the National Institutes of Health,

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American Paralysis Association and the Emory-Georgia Tech Biomedical Technology Research Center, has applied for additional funding from a number of agencies.

"Research grants are difficult to obtain these days," said Dr. Frederick A. King, director of the Yerkes Primate Research Center of Emory University, where Kennedy is evaluating the electrode in rhesus monkeys. "But we have good expectations that Kennedy will succeed."

King added: "Dr. Kennedy is a talented young scientist who wants to help people who are paralyzed to gain control over their lives. They may never be able to run 26 miles, but through Dr. Kennedy's research, they may be able to participate more fully in the world."

Over the past five years, Kennedy and co-workers at the Yerkes Center and the Veterans Administration Medical Center have been developing a "cone electrode" that records signals from the brain's cerebral cortex, the area that controls voluntary activities such as hand or arm movements.

Kennedy, a collaborative scientist in neurobiology at Yerkes, believes those signals could be used to operate devices such as computer word processors -- or even to control muscle stimulators in a hand or arm.

In Yerkes studies, the researchers have been able to reliably record electrical signals from a rhesus monkey for 15 months, and they are now attempting to determine whether the monkey can learn to control those signals through a kind of biofeedback.

Earlier research has shown that humans can "condition" the EEG signals produced by their brains, but to make the electrode useful, Kennedy must demonstrate that the control extends down to the signals produced by individual brain cells, or neurons, from which the cone electrode records.

If a monkey is successful at learning to control the signals, Kennedy would like to move on to the next step -- testing in humans. Before that can be done, however, electrical engineers must complete the miniaturization of a transmitter to collect and send the signals to a receiver.

The device would be located under the skin surrounding the skull, operated with current provided by a power induction system -- all without troublesome batteries or switches.

"When we feel comfortable working with the device in rhesus monkeys, we'll apply for permission to try it in humans," he said. "There is no theoretical reason why the electronics shouldn't work."

For years, scientists have attempted to record muscle control signals directly from the brain as a way of bypassing damaged spinal nerves or muscles paralyzed by degenerative diseases. Electrodes placed in the brain tend to move about, however, preventing the consistent recording of signals, and they eventually become insulated from the brain by the growth of protective tissue.

Kennedy's cone electrode appears to overcome both of those problems. The electrode consists of a tiny insulating glass cone into which Kennedy places two thin gold wires and a strand of tissue taken from a nerve in the leg. The electrode is placed into the area of the cerebral cortex which controls the voluntary movements of certain muscles.

Once the electrode is in place, brain tissues -- including myelinated axons and dendrites and blood vessels -- grow along the nerve strands and into the electrode, holding the device in place and creating an electrical connection between the wires and individual brain neurons. After a few weeks, the electrode begins to record signals which eventually grow in strength.

Using sophisticated digital signal processing techniques, Kennedy has identified two or three separate waveforms from each electrode. By correlating these signals to the monkey's movements, Kennedy believes he is recording from brain neurons that control the monkey's arm and hand.

If a person unable to communicate could learn to control those signals, they could be used to move a cursor on a computer screen, control an electrical appliance, or operate a robotic arm. The signals could also be used to regain rudimentary control over a paralyzed hand or arm.

Kennedy estimates that it will take as much as \$1 million to complete the work necessary to implant transmitters in three initial human patients.

Co-workers in this research include Steve Sharpe, Cindy Linker, A. Hopper, R.A.E. Bakay and S. Mirra, of the Neural Prosthetics Lab at Yerkes Primate Research Center, the Veterans Administration Medical Center, and the Neuroscience Laboratory of Georgia Tech.

EDITOR'S NOTE: Research results were presented in October at the 22nd Annual Neural Prosthesis Workshop at the National Institutes of Health, and were presented at the Society of Neuroscience Annual Meeting November 10-15 in New Orleans.