Regenerated Nerves Send First Messages

Two new research accomplishments in animals strongly suggest that people who lose motor functions as a result of nerve damage may one day regain some use of their paralyzed limbs. Building upon nearly a decade of neural reconnection attempts, scientists have now demonstrated that severed nerve cells within the hamster central nervous system can regenerate over substantial distances and make functional connections with their target cells in the brain. This represents the first time mature, regenerated cells in a mammalian central nervous system have successfully relayed electrical information to neighboring cells.

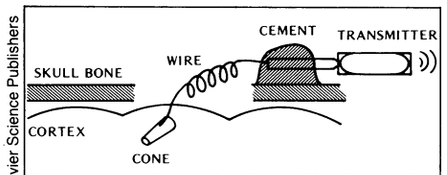
Separately, a biomedical engineer reports development of a permanent, implantable brain electrode that can pick up signals from rat brain neurons for radio transmission to distant muscles.

Although both advances will require considerable refinements, they represent complementary routes to an era of neural restoration for people who today have no hope of recovering lost function.

Not until this decade did scientists begin seriously to suspect that cells in the nonfetal central nervous system—the brain and spinal cord—had any ability to regenerate. Since then, scientists have learned to coax nerve regrowth millimeter by millimeter. In some studies, regenerated nerve endings mingled with surrounding neurons (SN: 2/28/87, p. 135), but until now no one had shown that they could transmit their electrically encoded messages to those cells.

Susan A. Keirstead, Michael Rasminsky and Albert J. Aguayo of Montreal General Hospital and McGill University, with additional colleagues, performed the latest experiments on eight hamsters with severed optic nerves. They removed nervous tissue from each hamster's leg, placing the tissue along the trail they wanted optic nerve regrowth to follow. Transplanted nervous tissue cannot conduct signals but serves to guide regenerating nerves. After about four months, the team detected electrical signals in visual-center brain cells of six hamsters after flashing a light in front of each hamster's eye, they report in the Oct. 13 SCIENCE.

The regenerated neurons grow into the correct portion of the hamsters' brains, but it remains unclear whether the individual cells they engage there are precisely the ones with which they would normally commune. "Whether the animal is 'seeing' anything or not is something we have no information about," says Rasminsky, who adds that such a determination will require behavioral studies. Nonetheless, he says, the work demonstrates that "one can make functional connections between neurons that are widely separated by injury."



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Schematic of new, implantable electrode.

Taking a different path toward that same synaptic end, Philip R. Kennedy of the Georgia Institute of Technology in Atlanta has made a tiny electrode of glass and gold wire for long-term recording of brain signals from individual neurons. Traditional "hatpin" electrodes work fine for short-term neuronal recordings but tend to migrate in brain tissue and lose their ability to pick up signals over time. Kennedy "baits" his hollow electrode with a shred of peripheral nerve tissue, which encourages nearby neurons to grow into the recording cone. Once enmeshed in this neural web, the cone remains anchored in place. The novel electrodes have made continuous recordings in rats for more than a year and boast up to four times the sensitivity of older electrodes, says Kennedy, whose report appears in the September JOURNAL OF NEUROSCIENCE METHODS.

With experiments now ongoing in monkeys, Kennedy foresees using the long-term electrodes to study changes in neural connections that occur with learning and aging, as well as to transmit bursts of electricity from brain cells to muscle stimulators attached to limbs lacking intact neural connections.

The electrodes may help people with neurodegenerative diseases such as amyotrophic lateral sclerosis, says Gerald E. Loeb, a biomedical engineer at Queen's University at Kingston, Ontario. "These patients . . . lose virtually everything [of their motor abilities], yet they are intellectually intact and desperately need a communication channel."

Both Loeb and Kennedy note that preliminary experiments with monkeys hint at the possibility of training people to fire certain brain cells at will as the basis for an electronic communication system. Kennedy says experimental implantation of the new electrodes into terminally ill human volunteers could begin within a year. *—R. Weiss*

Gene-tracking leads to Nobel Prize

Major scientific discoveries often begin with someone studying an intriguing phenomenon for its own sake. So it went for Harold E. Varmus and J. Michael Bishop of the University of California, San Francisco, who in the 1970s became interested in an obscure virus that causes tumors in chickens. Working with Dominique Stehelin and Peter Vogt, they discovered that the gene responsible for the Rous sarcoma virus' deadly effect originates as a normal chicken gene that the virus incorporates as it duplicates itself inside the chicken cell.

This week Varmus and Bishop learned they would receive the 1989 Nobel Prize in Physiology or Medicine for that discovery.

Since the 1976 finding, researchers have uncovered more than 40 other proto-oncogenes—genes that normally mediate cell division and growth but that become potentially dangerous oncogenes under certain circumstances, such as mutation or incorporation by a virus. Oncogenes transform ordinary cells into tumor cells. By studying them, scientists have learned not only about tumor development but also about normal cell function.

"[Varmus and Bishop's] work gave us a new way of thinking about cancer," says molecular biologist David Baltimore of the Whitehead Institute for Biomedical Research in Cambridge, Mass. "Until they made their discoveries, there was only speculation that cancer had a genetic component. Now there is a certainty." Baltimore shared a Nobel Prize in 1975 for his work in discovering the enzyme reverse transcriptase.

Both Varmus and Bishop have maintained their interest in retroviruses and oncogenes. In research reported in the June CELL, they and colleagues found support for their hypothesis that the proto-oncogene normally controls the shape of a cell as it divides, while the viral oncogene probably disrupts the cell's shape.

Nobels notwithstanding, "things are going on as before," says Leon Levintow, who chairs UCSF's department of microbiology and immunology. The day after learning of the award, Varmus gave his scheduled lecture on gonorrhea to the second-year medical students. Adds Levintow, assessing student response to the announcement, "There was more excitement because the Giants won the pennant." *—A. McKenzie*