Biochemistry

Christopher Vaughan reports from Santa Barbara, Calif., at the NIMH Conference on Molecular Neurobiology

Neurons: Different jolts, different notes

Certain neurons strongly involved in memory formation have two distinct ways of transmitting information, reports Charles Stevens of Yale Medical School in New Haven, Conn. In addition to simply passing along a received signal, these neurons have a "special mode" of signal transmission that is activated only if the cell receives two signals in a row.

"The first signal cocks the gun and the next signal fires it," Stevens says. This special type of signal transmission gives the neuron a different way to process information, he says — in effect providing the neuron the ability to remember it had been fired shortly before and to act differently when fired the second time, probably by releasing different neurotransmitters.

The cells in question are those with so-called NMDA receptors, intensively studied because the NMDA receptors have recently been recognized as playing a key part in the formation of memories. Blocking the NMDA receptors leads to an inability to form new memories, other scientists have found. Stevens finds that the second mode of signal transmission is made possible by the special ion-transporting properties of the NMDA receptor.

Hallucinogenic drugs such as PCP block the NMDA receptor and therefore the special mode of signal transmission. Some of the behavioral effects of these hallucinogenic drugs may be due to the blocking of this second information-processing mode in neurons, Stevens suggests.

In related research, Roger Nicoll of the University of California at San Francisco has shown that although NMDA receptors play an important part in the process of memory formation, they don't do it all by themselves. In order to determine this, Nicoll tried to see if he could give nerve synapses a long-lasting sensitivity to stimulation, a state generally agreed to be the basis of memory formation, by flooding the receptors with NMDA. The NMDA by itself couldn't produce this state, and Nicoll and his colleagues are now looking for other factors, such as other neurotransmitters, that may act with NMDA receptors to form memories.

Molecular odor-eaters

Any biologist with a nose for good mysteries can't help but wonder what kind of nasal receptors allow us to distinguish so many smells, and why animals can smell scents that are 1,000 times weaker than should be required to trigger a chemical response at a receptor. While searching for an answer to the first question, scientists at Johns Hopkins University think they may have stumbled onto the trail of the second. Solomon H. Snyder and colleagues were trying to isolate the smell receptor when they discovered a protein that seems to concentrate odor molecules by latching onto them as they enter the nose.

The odorant-binding proteins are manufactured in Steno's duct, which sprays a fine mist into the entranceway of the nose. For more than three centuries, physicians and others assumed this mist served only to humidify and warm the incoming air. But Snyder suggests that odorant-binding proteins dispersed in the mist may grab onto odor molecules and present them in concentrated form to the odor receptors in the nose. Those receptors then signal the brain that the odor molecules are present.

It is possible that an understanding of the mechanisms of smell would have direct applications to human health issues. Snyder points out that although no one has died directly from an inability to smell, people are endangered when they can't smell gas leaks in the house, and sufferers of chronic diseases or cancer often waste away because of a reduced appetite, partly due to a diminished sense of smell. Understanding how to bring back or enhance the sense of smell may alleviate such problems, Snyder says.

Biology

Animals inoculated with baited breath

Scientists this month requested U.S. Department of Agriculture approval to conduct field trials of a genetically engineered vaccine designed to immunize wildlife against rabies. The new vaccine, developed jointly by the Philadelphia-based Wistar Institute and Transgene, S.A., a French biotechnology company, uses a genetically engineered portion of the rabies virus encapsulated and hidden in flavored bait. When consumed by raccoons, skunks, bats or other rabies "reservoir" animals, the vaccine stimulates immunity to the rabies virus, preventing the animals from becoming carriers of the disease. The technique has proved effective in U.S., Canadian and European indoor trials and is being field tested in Europe.

The prevalence of rabies in domestic animals has declined sharply since widespread vaccination of pets began in the 1960s. Now more than 90 percent of human rabies cases reported in the U.S. result from wild animal bites.

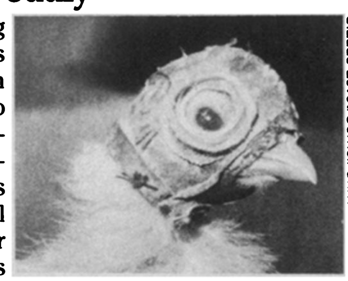
New plants resist herbivores, herbicides

Biologists and agronomists increasingly express optimism that genetically engineered crops may help reduce reliance on synthetic pesticides. Two weeks ago, Agrigenetics Advanced Science, a Madison, Wis.-based biotechnology company, announced it soon will begin field trials of two engineered, pest-resistant plants that have shown promise in the greenhouse against plant-eating caterpillars and viruses.

Biotechnology will serve more than the organic farmer, however, as evidenced by field trials begun May 11 by the St. Louis-based Monsanto Co. Its scientists are field testing in Canada a genetically engineered strain of canola — a type of rapeseed — resistant to Roundup, Monsanto's own broad-spectrum herbicide. The chemical tends to kill crops as effectively as it does weeds, and a new breed of Roundup-resistant crops could open the door to more widespread use of the herbicide.

Although Roundup is considered relatively safe to people and animals, environmentalists worry about the growing trend to develop herbicide-resistant crops, saying the research may encourage increased use of more dangerous chemicals.

Through an eyeglass oddly



Claude Levet/Cornell Univ.

Vision researchers working with bespectacled chickens find the birds' eyeballs can shrink or grow as needed to compensate for eyeglass-induced near- or far-sightedness. The research suggests eyeglasses can cause, as well as correct, changes in ocular acuity. Indeed, the researchers say, doctors someday may correct some visual problems with drugs rather than corrective contact lenses or glasses.

"These experiments are the first direct demonstration of a feedback loop controlling growth of the eye," says one of the researchers, Howard C. Howland, at Cornell University in Ithaca, N.Y. "If the same feedback loops operate in humans, it would mean that placement of lenses on the eyes of young children could conceivably affect the growth of the eyes."

Howland and his colleagues report in the May VISION RESEARCH that chickens fitted with prescription glasses experience permanent changes in eyeball size and concomitant changes in image focusing. The scientists used a technique called infrared photoretinoscopy to detect where in the chickens' eyes images were focused. They say insight into bioregulation of eye size may lead to the use of growth inhibitors or enhancers to resolve certain vision defects.