New Hope for People with Hearing Loss

Scientists have long held that people who've lost specialized "hair cells" in the inner ear cannot make up for their loss and must suffer permanent hearing impairment or balance disorders. Neurobiologists may have to rethink that dogma. Dramatic new findings suggest that mammals, including humans, have the ability to repair inner-ear damage.

Those results hold out the tantalizing promise of treatment for millions of hard-of-hearing people, says cell biologist Andrew Forge, a coauthor of two new reports that appear in the March 12 SCIENCE. Scientists may one day use this information to design drugs that would spur the inner ear to fix itself after an injury, Forge believes.

"I think the two reports are a great contribution," comments Edwin W. Rubel, a developmental neurobiologist at the University of Washington in Seattle. Rubel and other researchers had previously shown that birds with inner-ear damage can regenerate hair cells. But many researchers believed this process occurred in mammals only during fetal development. Thus, the two reports represent the first time researchers have shown regeneration of hair cells in adult mammals, Rubel says.

Forge, a researcher at University College London, and his colleagues at the University of Virginia School of Medicine in Charlottesville collaborated on two studies. In the first, they looked at live guinea pigs given a drug that kills the microscopic hair cells in the inner ear. These cells are called "hair cells" because they have bundles of hair-like projections growing from their surface. Hair cells detect vibrations caused by sound waves or movements of the head and transmit that information along nerve fibers to the brain.

The drug caused a progressive loss of hair cells in the utricle, an organ in the inner ear that is involved in regulating balance, says Jeffrey T. Corwin, one of the Virginia researchers.

Four weeks after administration of the drug, however, tissue specimens taken from the guinea pigs showed signs of recovery. The researchers used electron microscopy to look at thin tissue sections taken from the animals' utricles. There, they discovered evidence of what appeared to be immature hair cells in areas where hair cells had been decimated by the drug. In some cases, the immature cells had actually forged a tie with the nerve, a required step if hair cells are to begin functioning, the researchers say.

Unpublished data from Forge's laboratory demonstrate that, given enough time, those baby hair cells seem to mature. The team has yet to prove the cells begin to function properly, Forge says.

The first study could not tell the researchers how the new cells were created. Therefore, Forge and his Virginia co-workers conducted a laboratory study to look for the genesis of those cells.

Forge, Mark E. Warchol, also at the University of Virginia, and their co-workers began the second study with utricle tissue removed from humans and guinea pigs. (Surgeons obtained the human tissue during operations to excise a dangerous tumor that can spread to the brain.)

The researchers grew the animal and human ear tissue in culture dishes and then doused the cells in each with a drug that selectively kills hair cells. After 24 hours, the researchers rinsed any remaining cells to remove the drug. Next, the team flooded the cells with a radioactive tracer that marks dividing cells.

After the first week, the team found evidence of proliferating cells in both the human and guinea pig cultures. Forge believes that nonhair cells in the tissue sample began dividing after the drug destroyed nearby hair cells. Eventually, these new cells take on the characteristics of hair cells, he says.

In both studies, researchers examined tissue taken from the part of the ear that regulates balance. Thus, the research may lead directly to treatment of certain kinds of dizziness caused by a balance disorder, Corwin notes. The finding also implies that scientists may someday restore hearing loss caused by old age, toxic drugs, or chronic exposure to loud noises.

In order to help the hard-of-hearing, scientists must prove that hair cell regeneration also occurs in the cochlea, the spiral-shaped part of the inner ear involved in processing sound, Forge adds.

Furthermore, researchers must find the signal that tells ear cells to begin dividing in order to repair an injury, adds Douglas A. Cotanche, a researcher at Boston University. If researchers find such a signal, they might be able to design a drug that spurs ear cells to divide in a controlled fashion, he adds. Such a drug might provide people with a cure for hearing loss.

"That's miles away," Cotanche says. "But that's the dream." – *K.A. Fackelmann*

Fungus fools flies with fake flowers

Roy/NATURE

Normally a tall, slender stem with delicate, pale blue flowers that droop off the top, this transformed rock cress sent up a yellow "floral" shoot because of a fungal infection. When a rust fungus invades this plant, called Arabis holboellii, *the plant doubles the number of leaves produced and adds extra swirls to the rosette at its base. Its stem then develops a dense cluster of yellow leaves that in one species of* Arabis *makes the plant look like a buttercup, both to insects and to botanists, says Barbara A. Roy, a plant ecologist at the University of California, Davis. The yellow color develops because male and female fungal sex organs cover the leaf surface.*

At the Rocky Mountain Biological Laboratory at Gothic, Colo., she observed that these fake flowers attract flies, bees, and butterflies. These creatures tend to hang out at the yellow "pseudoflowers" up to five times as long as they spend at real flowers, Roy says. That's because the fungus exudes a sugary fluid that makes the pseudoflowers smell sweet and can provide the insect visitor with 10 to 100 times the sugar of neighboring real flowers, she reports in the March 4 NATURE.

That sweet stuff rewards the insect for its unknowing role in the life cycle of the fungus. As they visit the yellow "petals," these insects pick up and distribute sex cells and make possible sexual reproduction, Roy says. Then the yellow fades, and no more sweet fluid is produced. Other types of rust fungi make sweet fluids, but no other has been discovered that causes its host plant to make fake flowers.