Biology

Elizabeth Pennisi reports from San Francisco at the 1994 annual meeting of the Society for Cell Biology

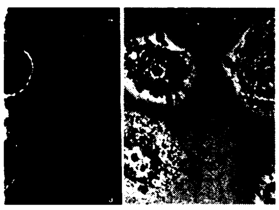
Helping transplants get organized

For the first time, researchers can make large quantities of a protein that helps cells attain their proper shapes and organize into distinctive tissues. This protein, one of about a half dozen laminins, normally exists as part of the basement membrane that underlies layers of cells making up epithelial tissue. Jonathan C.R. Jones, a cell biologist at Northwestern University Medical School in Chicago, plans to produce this laminin to help preserve and encourage the growth of transplant tissue.

Jones had wanted to study a particular type of connection that helps hold cells to basement membranes. These connections, called hemidesmosomes, help cells stay put. Thus, healthy gum cells adhere to teeth, creating a tight seal that keeps bacteria away from underlying bone, he explains.

But then he discovered that mutant cells that make lots of hemidesmosomes also make and release large quantities of laminin. Adding that laminin to solutions containing damaged human corneas enhances their recovery, he reports. The corneas take up the dissolved laminin and put it to good use as they regenerate.

He expects that laminin may also speed the growth of sheets of skin used to treat burn patients and may one day prove useful in the regeneration of other tissue. It may even help slow the retraction of the gums that makes people more susceptible to gum disease as they age. He is working with a biotechnology company to start animal tests of laminin's safety and utility for corneal and gum repair.



Jones

Two views of the same cells show their circles of laminin (left) and their outlines and nuclei (right).

Human homologues in the humble hydra

People may crown the evolutionary tree, but we may not be as far removed from our roots as we'd like to think. Humans share key genes not only with mice, fruit flies, and nematodes (SN: 10/15/94, p.244), but also with simple creatures such as the hydra.

The centimeter-long hydra basically consists of two layers of epithelial cells and a few other cells tucked in between that form nerves, stingers, and glands. The nerve cells connect loosely as a "nerve net," but the animal can survive without this primitive nervous system.

Of multicellular organisms with differentiated cells (metazoa), only sponges are simpler, says Ann Grens, a developmental biologist at the University of California, Irvine. Geneticists had shown that several vertebrates and insects have a group of genes that codes for gene-regulating proteins. At least some of the amino acids in these proteins curl to form what's called a basic helix-loop-helix motif.

Now, Grens has found that the hydra has the gene for one of these proteins.

This discovery shows that the gene "did show up early in evolution," Grens says. She doesn't know what this gene, called achaete-scute, does in hydra. But its counterpart in fruit flies leads to the development of touch-sensitive bristles and surface pits for detecting airborne chemicals. When she adds this hydra gene to fruit flies lacking their own version of it, the flies develop the missing pits and bristles, Grens reports.

Researchers have now found genes from about a half dozen vertebrate gene families in hydra, but the hydra tends to have just one family member, whereas higher organisms possess several. "It's looking like a general rule that most of the genes that are fairly widely distributed in metazoa do exist in *Cnidaria* [hydralike organisms]," Grens concludes.

Technology

Getting a grip on things

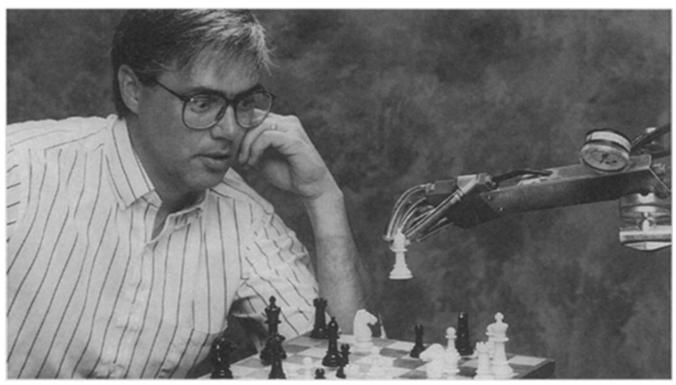
Flexible, nimble, and strong, the human hand can grasp a bowling ball or slip a thread through the eye of a needle with equal ease. Re-creating the dexterity of the tender grippers at the end of each human arm presents a formidable engineering challenge, albeit one appreciated by the more than 50,000 Americans who use artificial hands and arms.

Christopher M. Smith, a mechanical engineer at the Department of Energy's Pacific Northwest Laboratory, has invented a robotic hand noteworthy for its simplicity and versatility. While strong enough to operate power tools and even turn a wrench, it can also gently manipulate an egg.

"The hand can grasp and move irregularly shaped objects," Smith says. What's more, "its grip is only as strong as the pressure applied to it, meaning that it holds something firmly or gently, depending on what the user wants to do."

Each finger has a bellows — a corrugated metal tube similar to a flexible drinking straw — and a tendon, says Smith. Pumping air into the bellows causes it to expand against the tendon, making the finger curl.

Originally developed to handle radioactive materials at nuclear power plants, Smith later adapted the hand for general civilian use. Designed to mimic the shape and grasp of a human hand, with four fingers and an opposable thumb, the prosthetic works reliably even in moist, oily, and dirty environments.



Smith/Pacific Northwest Laboratories

A new robotic hand goes for a checkmate.

Ultrasound destroys toxic liquid waste

The image of a soprano shattering a crystal goblet with a prolonged high note sets the scene for Michael R. Hoffman, a chemist at the California Institute of Technology in Pasadena.

Hoffman uses ultrasound to break down hazardous wastes in liquids. By subjecting toxic molecules in solution to the intense energies of ultrasonic vibrations, he finds that the toxins will separate into their nontoxic components.

Human beings can hear sounds up to 16 kilohertz (kHz), or 16 thousand cycles per second. Above that threshold, ultrasound ranges from 16 kHz to several million hertz.

When focused into a liquid, ultrasonic vibrations generate tiny bubbles that superheat, expand, and collapse in only a few microseconds. Temperatures inside the bubbles can reach 5,500°C, causing complex molecules inside the fluid to break apart. Hoffman likens the process to liquid "incineration."

In one test, Hoffman's group exposed the pesticide parathion to ultrasound at 20 kHz, delivering 75 watts of energy per square centimeter. The entire sample broke down in 2 hours, quickening degradation from a half-life of 108 days to 30 minutes. A new apparatus delivers up to 3 million watts.

Hoffman also reports using this method to break down several nasty pollutants in the laboratory — which suggests that PCBs, widely used in batteries, and solvents such as TCE and PCE should succumb as well.