of the FET, the flowing charges can be either electrons or holes.

The researchers placed the FETs above and below the tetracene crystal. The bottom FET was designed to flood its channel with electrons, while the top FET sent holes. The team then applied a voltage between the two FETs, which drew the flood of positive and negative charges into the tetracene, where they produced a burst of photons that triggered the lasing process. The scheme worked to perfection, generating a yellowish-green laser pulse. This novel use of FETs "is an important concept, because it allows them to control the charge injection, which is the key to getting this to work as a laser," Yang says.

Despite the organic laser's success, it may be a while before organics take over that $500 million market. Growing high-purity organic crystals requires manufacturing processes nearly as exacting as those used to grow conventional ceramic chips. And researchers must also learn how to mass-produce lasers with transistors positioned above and below. Still, Batlogg notes that researchers should easily be able to change the tetracene to other organics to produce a whole range of different colors of laser light. That should give lasermakers something to beam about.

–ROBERT F. SERVICE

NEUROSCIENCE

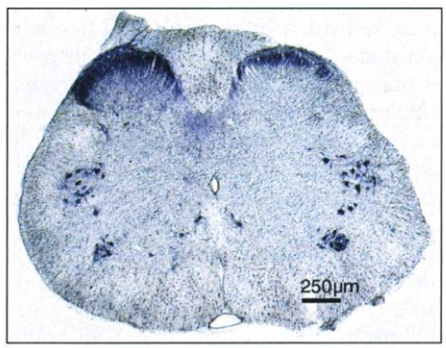
Early Insult Rewires Pain Circuits

For many years, physicians rarely anesthetized infants or gave them pain-killing medication. They worried that such treatments could interfere with breathing—and they downplayed babies' ability to perceive pain. That's changed in the past 15 years, partly thanks to studies showing that infants respond physiologically and hormonally to pain. A new animal study should amplify the call to manage pain more aggressively in newborn humans: Pain experienced by the youngest infants, the study suggests, could have the longest lasting effects.

On page 628, neuroscientist M. A. Ruda of the National Institute of Dental and Craniofacial Research (NIDCR) at the National Institutes of Health (NIH) and her colleagues report that painful stimuli delivered to rats shortly after birth permanently rewire the spinal cord circuits that respond to pain. Not only do the circuits contain more axons, but the axons extend to more areas of the spinal cord than they normally would.

Researchers knew that pain circuits are somewhat malleable in adult animals, but the Ruda team's study shows that "injury to the neonate or fetus can produce changes that are in some way different than [those] in adults," says neuroscientist Clifford Woolf of Massachusetts General Hospital and Harvard Medical School in Boston. What's more, the NIDCR workers have preliminary evidence that these wiring changes make the animals more sensitive to pain later in life.

Pain pathways start with sensory neurons in the skin, link to the dorsal horn of the spinal cord, and from there climb to the thalamus and cortex in the brain. To see how painful stimuli affect the spinal portion of these pathways, Ruda and her colleagues injected one hind paw of newborn rat pups with an inflammatory agent that causes the paw to swell and turn red for several days—"kind of like gout" in humans, Ruda explains.



Hardwired. Early pain fosters the development of pain-sensitive axons, as indicated by the darker stain at the top left of this spinal cord.

Some 8 to 12 weeks later, the researchers sacrificed the adult rats and stained their spinal cords with a dye that seeks out pain-sensitive axons. They found about 25% more stained axons in the side of the spinal cord corresponding to the paw that had been inflamed weeks earlier. In addition, the sciatic nerve, which delivers input from the hind limb, projected to six segments of the spinal cord on the treated side, compared to just four on the other side. "You can really see spreading and invasion of these fibers into new areas of the cord," says molecular neurobiologist David Julius of the University of California, San Francisco.

Pain changed neuroanatomy only when induced during a distinct developmental window. If the pups were given the noxious injection just after birth or on day 1 or day 3, more neurons became devoted to processing pain. If the researchers waited until day 14, however, they found no neuroanatomical changes. In terms of neurological milestones, day 0 in a rat pup corresponds to about 24 weeks of gestation in a human infant, says Ruda. This suggests that at a very early age, particularly in premature infants, "what's happening could impact the ultimate wiring of the brain."

Ruda doesn't know precisely how the stimuli strengthen pain circuits. The extra neural activity could save neurons that

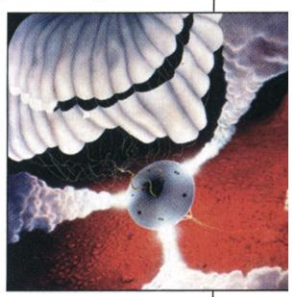
CREDITS: (LEFT TO RIGHT) M. A. RUDA *ET AL.*; NASA

ScienceScope

Martian Gamble NASA and the White House are locked in a quiet but intense struggle over the future scale of Mars exploration. NASA space science chief Ed Weiler this week intended to announce plans to send a single lander to Mars in 2003, rather than a single orbiter, in the wake of two mission failures in the past year (*Science*, 10 March, p. 1722). But NASA abruptly canceled the 24 July press conference after senior officials insisted on considering sending two landers, according to Administration officials. Agency managers and Mars researchers argue that sending two spacecraft will reduce risk. "There were two Viking landers and orbiters," says one scientist. "When it really matters, double up."

But doubling up means a heftier price tag, and the White House is loath to ask Congress for more Mars money in 2001 and future years. "It's big bucks," says one Administration manager. The White House may still approve two landers—but on the condition that NASA cut current programs to pay for an expanded Mars effort. That would be bitter medicine for an overall space science effort already strapped for cash.

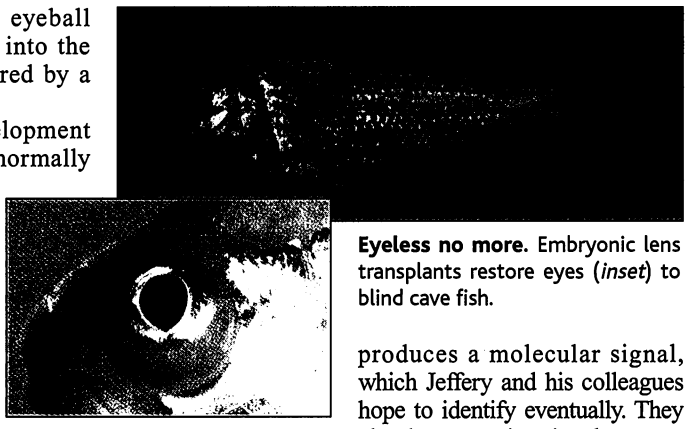
NASA chiefs must move quickly. The larger program would require more planning, and NASA had already set a 1 August decision deadline to ensure that it could meet the 2003 launch date. Yet NASA won't know its 2001 budget—which is still stalled in Congress—until fall, while the 2002 budget request won't be released until next year. So if the agency wants two landers, it may have to gamble that there will be money to do it. Says one Administration manager: "We're playing a high-stakes game."



Into the Finals California Governor Gray Davis last week named the six academic teams that are still in the running for $300 million in state funds to set up new research institutes, along with a five-member panel that will pick the three winners this fall (*Science*, 26 May, p. 1311). The judges, led by Scripps Research Institute president Richard Lerner, will choose among multi-institution teams proposing new centers focusing on systems biology, agricultural genomics, information technology, nanosystems, biomedicine, and the social impacts of information systems. Eleven teams had entered the competition.

in normal eyes. The eyeball gradually sank back into the socket and was covered by a flap of skin.

Because eye development seemed to progress normally until the lens degenerated, Jeffery and Yamamoto wondered whether this disintegration was triggered by a signal from the embryo or from the lens itself. To find out, Yamamoto removed the embryonic lens from one eye of a blind cave fish embryo and replaced it with a lens from a surface fish embryo. He also did the opposite experiment, replacing the lens of an embryonic surface fish with one from a cave fish embryo. In all cases, he labeled the transplanted tissue with dye so he could track what happened to it. "It's not a complicated experiment, but it really [was] very elucidative," says Mathers.



Eyeless no more. Embryonic lens transplants restore eyes (*inset*) to blind cave fish.

In both types of transplants, the lens behaved as if it were still in its original embryo. The one from the cave fish degenerated, even though it was in an environment conducive to further development, whereas the lens from the surface fish thrived in the cave fish embryo and the eye differentiated, forming a cornea, anterior chamber, and iris. These results show that "the lens plays a central role" in determining whether the eye develops, comments David Beebe, a developmental biologist at Washington University School of Medicine in St. Louis. Jeffery doesn't know, however, whether the fish can actually see, as a vision test is quite difficult to devise.

Other recent work by Jeffery and his colleagues may explain why the lens undergoes programmed cell death in the cave fish. The researchers looked at early embryos for changes in the expression of a variety of proteins that help specify how cells differentiate into specific organs and tissues. As they reported last month in Boulder, Colorado, at the annual meeting of the Society for Developmental Biology, cave fish embryos seem to make more of a protein called Sonic hedgehog in the area destined to be the head. As a result, fewer cells are set aside to form the eyes (*Science*, 23 June, p. 2119). Jeffery suspects that with fewer cells to start with, the precursor lens may wind up smaller than usual, perhaps too small to survive, and therefore decays. "It's possible you are looking at a single gene defect that has caused a drastic developmental change," Mathers notes.

Still unclear, however, is how the embryonic lens of the sighted surface fish triggers further eye development. Presumably the lens produces a molecular signal, which Jeffery and his colleagues hope to identify eventually. They also hope to pinpoint the genes involved in eye development in *A. mexicanus*. Studying different populations of the fish may provide clues to these genes, notes Beebe: Because populations became isolated when the fish could see and became blind independently, different mutations may be involved in each population.

–ELIZABETH PENNISI

CREDITS: YAMAMOTO *ET AL*

EUROPEAN SCIENCE

Urgent Call for Research Overhaul

BERN—The European Union is in danger of losing ground in the global research competition unless its member nations devote more resources to science, restructure the E.U.'s flagship research program, and develop a Europe-wide science strategy, an expert panel says. The recommendations are music to the ears of E.U. Research Commissioner Philippe Busquin, who has been arguing for major changes along those lines.

In a report issued on 20 July, the 11-member panel calls for "an urgent reengineering of the overall management and administration" of the E.U.'s Framework Program. Framework 5—which provides $17 billion over 5 years for multinational research efforts and scientific networking—should be made more flexible to respond to hot new research fields, the report suggests, and its complex grant-application procedures should be made "much simpler and easier to understand."

Taking a broader perspective, the panel—scientists, academics, and business leaders from 11 E.U. states—contends that the Framework Program (which accounts for only 5% of Europe's total spending on research) by itself cannot chart a course for European research. They recommend that member nations find better ways to coordinate national research efforts. The panel, appointed by the European Commission, also calls on E.U. member nations, which now spend an average of about 2% of their gross domestic product on R&D, to step up public

ScienceScope

Rephrase the Question The overhead that the federal government pays for universities to subsidize research done on campus is an incendiary topic, capable of infuriating Congress and deposing college presidents. So perhaps it's not surprising that two reports issued this week generate more heat than light.

The first, by RAND's Science and Technology Policy Institute (www.rand.org), estimates that universities are shortchanged from $700 million to $1.5 billion a year in a $15 billion portfolio of federally funded academic research. It also argues that any government attempt to force universities to pick up even more of their so-called indirect costs could shrink research efforts.

Unfortunately for presidential science adviser Neal Lane, who assigned RAND the study, Congress in 1998 had asked the White House for a report on ways to *reduce* indirect costs, including a comparison of university rates with those charged by industrial labs. So after Lane saw a draft version this winter of the RAND report, he quickly ordered up a study by his own Office of Science and Technology Policy. That brief report takes a more neutral tone by, for example, laying out the pros and cons of four options to further cut overhead costs.

Legislators are especially interested in whether the system favors wealthier universities, says a Senate aide. "But we need to read the reports before we decide whether to propose any changes," he says. Both reports, however, complain that there are insufficient data for a meaningful analysis and urge the government to make more information available.

Staying or Going? France's giant basic research agency, the CNRS, may soon have a new leader. The 3-year term of its current director-general, physicist Catherine Bréchignac, expired 18 July. But as *Science* went to press, the government had yet to decide whether to renew her mandate. The holdup is due to a disagreement between French President Jacques Chirac, who wants to keep Bréchignac, and Prime Minister Lionel Jospin, who wants to dump her, according to the daily *Le Figaro*. If Bréchignac goes, potential replacements include the directors of two research centers in the Paris suburbs: biologist Pierre Tambourin, head of the GENOPOLE research complex in Evry, and mathematician Jean-Pierre Bourguignon, chief of the Institute of Advanced Scientific Studies in Bures-sur-Yvette. A decision is expected by early August.

Contributors: Andrew Lawler, David Malakoff, Jeffrey Mervis, Michael Balter