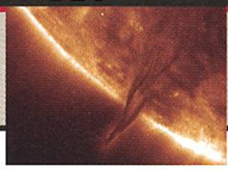
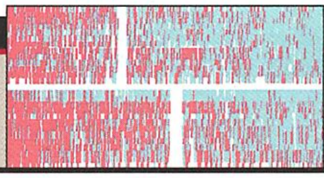




family, says John Mackenzie, a virologist at the University of Queensland in Australia. At this point, no one knows how many cause disease in humans and animals. But scientists have embarked on a broad study of many bat species. Mackenzie, for instance, has already found antibodies to the Hendra virus in bats from New Guinea, and he's now trying to obtain bat sera from Indonesia, Laos, and India, while others are planning a hunt in Cambodia. "If there are X viruses in bats, let's find them all," says Mackenzie. "If you know what's out there, it's much easier to diagnose and understand what's happening next time there is an outbreak."

The rise of such animal-borne diseases is not unusual, according to a study presented at the meeting by Mark Woolhouse of the University of Edinburgh in the United Kingdom. Woolhouse and his colleagues spent several months "trawling through the textbooks" to prove the common notion that most emerging diseases are zoonoses. They found that humanity is currently plagued by 1709 known pathogens (from viruses and bacteria to fungi, protozoa, and worms). The team concluded that 832 of those, or 49%, are zoonotic. But among the 156 diseases that are considered "emerging," 114 were zoonoses—a stunning 73%.

The bottom line? Zoonoses are three times more likely to be emerging than nonzoonotic diseases, and researchers should keep an especially wary eye on animal pathogens, says Woolhouse. Many more dangers may be lurking in the animal kingdom.

—MARTIN ENSERINK

ELECTRONIC OPTICS

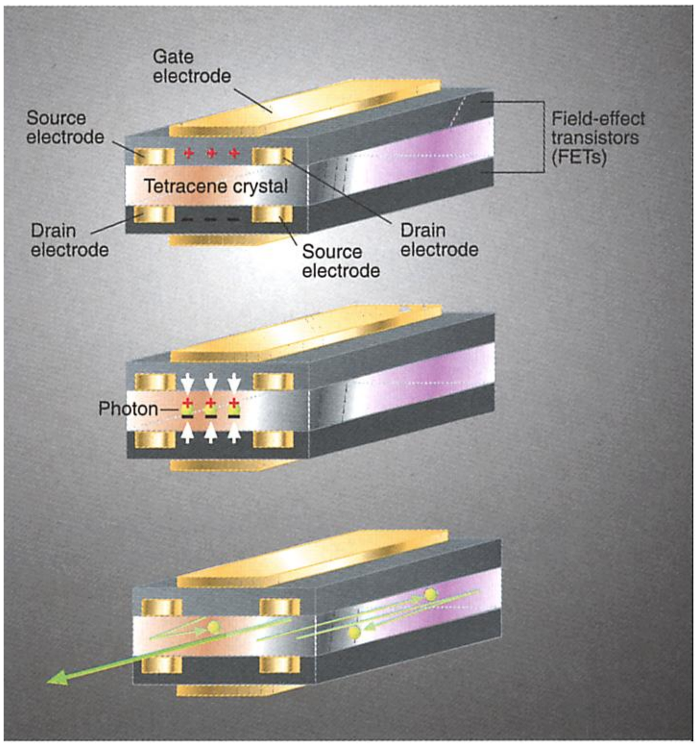
Organic Lasers Promise New Lease on Light

Tiny solid state lasers are big business: Almost $500 million worth of the devices are sold each year for uses ranging from compact disc players to telecommunications equipment. But they have big drawbacks: Many of today's lasers are made from ceramic chips—similar to those at the heart of computer processors—that require expensive clean-room facilities to manufacture, and their color palette is somewhat limited. Researchers have long pinned their hopes on organic materials, which are typically easier and cheaper to process. But to date they have managed to coax organic solids to lase only when blasted with a beam from another laser—hardly a commercial advantage. Now, however, organics have finally begun to shine on their own.

On page 599, a team at Lucent Technologies' Bell Laboratories in Murray Hill, New Jersey, reports that they've devised the first electrically powered solid state organic laser, a step that could open the floodgates for novel lasers that are cheaper and that shine in colors inorganics can't match. The feat is "big news," says Yang Yang, an optics researcher at the University of California, Los Angeles. "This is really a milestone. People have tried to make organic electrically pumped lasers for a long time."

To work as lasers, solid materials must function something like an interstate freeway: They must allow lots of traffic—photons in this case—to speed along without hitting potholes, and they must have plenty of on-ramps for electrical charges to get into the device. In conventional ceramic lasers, the on-ramps are metal electrodes placed above and below a semiconductor crystal. When a voltage is applied between the electrodes, electrons flow into one side of the crystal and out the other. The electron vacancies left behind, called "holes," act like positive charges that can move through the material as an electron on a nearby molecule jumps into the hole, leaving a vacancy where it originated. When electrons coming from one side of the device meet holes coming from the other, they annihilate one another, creating photons in the process. The photons bounce back and forth between mirrors on opposite sides of the crystal, prompting the crystal to release additional photons of the same wavelength. This creates a surge of light, some of which escapes in a beam through a predesigned leak in one of the mirrors.

Ceramics such as gallium arsenide chips make great lasers because, like a good freeway, they are clean and fast and have easy-access on-ramps. Solid organics, on the other hand, have been more like old country roads: Defects in the materials act like hazardous potholes, trapping photons and causing them to dissipate their energy as heat. And even high-quality organic materials have had big trouble with their on-ramps: Conventional metal electrodes are just too slow at injecting electrons and holes into organics.



Beaming. Transistor "gate" electrodes on top and bottom cause electrical charges to flow between the two additional pairs of electrodes (top). A voltage applied between transistors then causes these charges to enter the middle layer, where they produce photons (center) that generate a laser beam (bottom).

The Bell Labs group—physicists J. Hendrik Schön, Ananth Dodabalapur, and Bertram Batlogg, along with materials scientist Christian Kloc—tackled those two problems in turn. Initially, Kloc used a specialized gas furnace to grow high-purity crystals of tetracene, a molecule that consists of four linked rings of carbon atoms. That gave the researchers the multilane, high-speed freeway they needed for the photons. For their on-ramps, the team did away with the standard electrodes and turned to a pair of transistors, known as field-effect transistors, or FETs. FETs work by applying a voltage to one electrode, called a "gate," that triggers a flood of electrical charges to flow through a channel between two additional electrodes. Depending on the makeup

CREDIT: A. STONEBRAKER

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

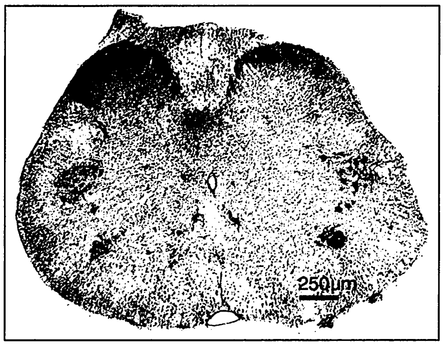
Early Insult Rewires Pain Circuits

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.