induced to emit light, and a resonator. In its simplest form, a resonator may consist of nothing more than a pair of mirrors at either end of the lasing medium. Light bounces back and forth between the mirrors to stimulate the emission of additional radiation, building up the emitted light into a strong beam.

Lawandy and his colleagues dispense with the mirrors. They use green laser light having a wavelength of 532 nanometers to excite molecules of a rhodamine dye dissolved in methanol. The dye in turn emits orange light with a wavelength of 617 nanometers. Adding titanium dioxide particles, averaging 250 nanometers in diameter, to the dye solution greatly amplifies the emitted light.

The surprise is that a medium containing particles that reflect light in all directions can somehow amplify the emitted radiation. Generally, fabricators of lasers go to a lot of trouble to make the lasing medium as uniform as possible, eliminating any impurities or inhomogeneities that might scatter light and degrade the laser's performance.

"As lasing and disorder appear to be incompatible, it would seem to be folly to attempt to promote lasing by deliberately introducing scatterers into a medium," Azriel Z. Genack of Queens College of the City University of New York in Flushing and J.M. Drake of Exxon Research and Engineering Co. in Annandale, N.J., comment in the same NATURE. But that's precisely what Lawandy and his colleagues accomplished.

It isn't clear yet why a suspension of titanium dioxide particles in a liquid works effectively as a resonator and amplifier. Lawandy and his collaborators are now conducting several experiments that may lead them to a theory of how this effect occurs.

Although the light that emerges from dye-laced white paint appears as a general glow rather than a definite beam, it still retains several characteristics of laser light, including intense emission over a narrow range of wavelengths. This laserlike behavior could lead to advances in such areas as laser medicine and display technology, Lawandy says.

For example, dermatologists use an array of lasers operating at different wavelengths to treat and remove various types of skin discolorations. Lawandy envisions the development of a cream or gel containing an appropriate dye that could be applied to the affected area and then excited to generate an intense burst of light of just the right wavelength to erase the mark.

It may also be possible to get similar laserlike behavior out of a porous solid lasing medium, Lawandy says. Applied as tiny dots on the inside surface of a television tube, such materials, when excited, could generate intense light of precisely defined colors to create bright, vivid displays. *— I. Peterson*

Reservoir linked to deadly quake in India

The earthquake that killed 10,000 people in India last September struck within 15 kilometers of a reservoir filled just 2 years earlier. That proximity in time and space seems more than coincidental to two U.S. seismologists who propose that filling the reservoir may have set off the quake.

Scientists had previously documented cases in which reservoirs induced sizable quakes in India, China, Africa, and the United States. Four of these matched or exceeded the strength of last year's tremor, which measured magnitude 6.1. But none of the previous shocks linked to reservoirs killed as many people as the September tremor, which leveled more than 20 villages near the city of Latur.

Leonardo Seeber and John G. Armbruster of the Lamont-Doherty Earth Observatory in Palisades, N.Y., presented their controversial theory in Pasadena, Calif., this week at a meeting of the Seismological Society of America. In support of the hypothesis, they note that Earth's crust in this part of India is extremely old and normally stable. Local records show no sign of earthquake activity until a year after the Killari reservoir was filled, when residents began noticing small tremors. The main quake followed these preshocks a year later.

"That doesn't prove [the connection]. But the timing favors this hypothesis, as does the location," says Seeber, who visited the region of the epicenter in the weeks following the quake.

Filling a reservoir can trigger a tremor in two ways. The weight of the water can stress the crust underneath, causing it to crack. Or water can seep down into old faults near the reservoir, lubricating rock on either side of the fault and enabling these crustal blocks to slip.

Seeber and Armbruster's arguments have not convinced other seismologists who have studied the Latur earthquake. Pradeep Talwani, an Indian-born seismologist at the University of South Carolina in Columbia, has investigated numerous reservoir-induced quakes. After visiting the epicentral region last year, he concluded that the Latur shock does not fit the pattern observed in other examples of reservoir triggering.

Talwani and others point out that the Killari reservoir was only 10 meters deep at the time of the quake, whereas most reservoirs that spark large quakes measure 100 meters or more in depth. "This was essentially a puddle compared with most cases of reservoir-induced seismicity," Talwani says.

He also focuses on the unusual pattern of foreshocks and aftershocks. When reservoirs set off large quakes, they usually trigger a "swarm" of many small tremors that begin before the main jolt and continue long after. Although the Latur quake did have preshocks, they did not occur as part of a swarm that rattled up until the disaster. Furthermore, the aftershocks died off extremely quickly.

"None of the features that we usually associate with reservoir-induced seismicity was present," Talwani says.

Archibald C. Johnston of Memphis State University visited the Latur area in February as part of a United Nations group studying the earthquake. "Our team favored the conclusion that it was not induced by the reservoir, although we acknowledged that it could have been triggered. The difference being that when we say triggered, we mean the earthquake would have happened anyway, but its timing might have been altered by the reservoir. Induced means that the reservoir actually created an earthquake that wouldn't have happened otherwise."

Regardless of what caused the Latur quake, Seeber notes that many earthquakes are set off by reservoirs, quarries, geothermal power stations, and other artificial structures. Because tremors often precede these quakes, Seeber and Armbruster urge colleagues to consider the seismic potential of such structures when small shocks occur in normally stable continental crust. *— R. Monastersky*

Nursing mother rats show brain changes

You might call it sleeping on the job, since a female rat naps as she nurses her young, but she's certainly paying attention. In fact, a recent study shows that nursing dramatically increases the size of the area in the brain that picks up sensations from a mother rat's nipple-bearing underbelly.

Two major changes occur as a mother nurses, report Judith M. Stern and her coauthors in the March JOURNAL OF NEUROSCIENCE. The area of the somatosensory cortex — the part of the brain that registers touch, pain, and temperature — devoted to sensations from a rat's underbelly almost doubles. And the mother's perceptions of feelings from her underbelly sharpen as the surface area of skin that excites a particular nerve cell shrinks. This sharpens the brain's perceptions, just as smaller dots, or pixels, in a television picture make it clearer.

Stern's team compared nursing mothers with virgin rats and with rats whose babies had been removed soon after birth. After anesthetizing the rats, the researchers recorded in detail the activity in nerve cells, or neurons, when they touched different areas of the animals' trunks with microelectrodes.

Normally, there isn't much direct stimulation of a rat's stomach, says Stern, a behavioral neuroscientist at Rutgers University in New Brunswick, N.J. The onset of nursing is a chance to examine the effects of increasingly strong stimuli on the brain, she adds. "It's . . . little paws treading on [the mother] and little snouts nuzzling [her]," as well as the sensation of nursing itself.

"We don't think this [increase in sensitivity] is due to an increase in the number of neurons," says Stern. "We don't know for sure, but [we think that connections] that were already there are being strengthened. . . . Think of a path in the forest that hasn't been used and has grown over. It gets cleared as it gets increasingly tromped on."

This study reinforces a relatively new appreciation of the rapid, fluctuating changes that take place in the brain, says Jon H. Kaas of Vanderbilt University in Nashville. Most earlier work involved the effects of sensory deprivation – what happens when researchers take away the ability of an animal to behave in a certain way. "It's hard to think of a way to overstimulate neurons," he says. "Their great insight is that they took a behavior that normally changes dramatically."

Stern's team noticed changes in the cortex after as little as 6 days. One rat studied after it stopped nursing seemed to have lost any increased sensitivity in its trunk, implying that these changes may be reversible. One of the most surprising results, says Stern, was that touching the nipples and the surrounding hairless skin did not trigger a response in the cortex.

"We don't know why," she adds, "[but] all we have done is look at a very small portion of the cortex. There are presumably many more changes."

"It surprises me that they didn't find [nipple stimulation affecting] the cortex," says neurophysiologist Thomas R. Insel, who works for the National Institute of Mental Health in Poolesville, Md. "It only underscores the importance of [underbelly] sensory stimulation."

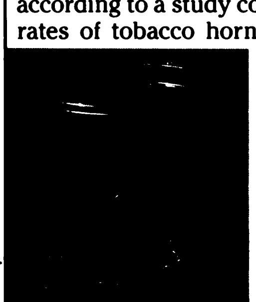
The hormonal basis for maternal behavior has been worked out in great detail, says Insel, but "this comes out of left field. It's a wonderful piece of work."

It implies that maternal behavior is more complicated than previously thought, he adds. "The cortex is a vast interconnected wiring scheme, a place that gets lots of inputs and lots of outputs and can be affected by many things." This implies both that "maternal behavior may be influenced by changes in the cortex and that behavior can change the brain." *– D. Christensen*

Climate change may make insects winners

While many people fear global warming, insects should probably celebrate it, a new study indicates.

If changes in Earth's climate continue to bring day and evening temperatures more in line with one another (SN: 1/4/92, p.4), insects may find themselves less troubled by plant toxins, according to a study comparing growth rates of tobacco hornworms living in either fluctuating or constant temperatures.



Stamp

A caterpillar's lab dining room.

Researcher Nancy E. Stamp of the State University of New York at Binghamton exposed tobacco hornworm caterpillars to either a steady 20°C environment or to a temperature that alternated between 23°C for 15 hours and 15°C for 9 hours. She fed them either a standard diet or one doctored with rutin, a plant toxin that wards off insects and other plant pests.

The different concentrations of rutin in the feed covered the range found in one of the tobacco hornworm's common meals – tomato plants – Stamp reports in an upcoming ENTOMOLOGIA EXPERIMENTALIS ET APPLICATA.

At higher concentrations, rutin hindered the eating and growth rates of caterpillars living in the variable temperature. But at a constant temperature, the rutin failed to have this effect.

"It didn't matter how much more toxin was in the diet, [the caterpillars] acted like there was no toxin," Stamp says.

Typically, plant toxin experiments are done at one temperature, says Frank Slansky at the University of Florida in Gainesville. Stamp's work indicates that "much of [this] prior work may not reflect biological reality," he adds.

This study carries "an important message about the interactive effects of [plant toxins] and temperature under field conditions," Stamp writes. Data from the last 40 years reveal that the average annual minimum temperatures have risen, while maximum temperatures have not changed. "We are not paying any attention to the fact... [that] this may interfere with plants' abilities to defend themselves," she says.

The interaction between other insects and plant toxins exposed to steady temperatures would likely be similar to that seen with hornworms, Stamp predicts.

But, warns Slansky, "We must be cautious not to overgeneralize from these results." The poison-resistance mechanisms of insects vary widely, and plant toxins have diverse modes of action, he explains. *– T. Adler*

An interstellar tale writ in space dust

Space, it turns out, is not a pristine place. When stars explode, they make an awful mess.

On an earthly scale, think of the diffusing black plumes that blot the sky when Hollywood detonates a Chevrolet. On a stellar scale, hydrogen-gas clouds speckled with dirty carbon grit drift between stars, blocking light, soaking up heat, and emitting characteristic radiation.

But what is that sticky interstellar soot really like?

To find out, Adolf N. Witt, a physicist at the University of Toledo in Ohio, and his colleagues cooked up hydrogenated amorphous carbon, or HAC, exposed it to ultraviolet light, and studied its unique glow. In essence, they find that exposing loose HAC grains to hot hydrogen gas and ultraviolet radiation – a striking parallel to known conditions near expanding and exploding stars – sharply perks up their red light radiation.

In fact, the distinctive red glow of certain carbon-rich nebulae, including one called the Red Rectangle, bears a strong resemblance to the photoluminescence of synthesized HACs, Witt says. In deep space, radiation from nearby stars causes dust clouds to give off a reddish hue. The dust grains themselves – each a mineral core with an HAC coating – soak up light of one wavelength, then emit light of another. Yet when conditions around the dust change, so does its photoluminescent efficiency, says Witt.

He reported these findings at a meeting of the Materials Research Society in San Francisco this week.

To simulate conditions near expanding and exploding stars, Witt's team formed HAC films at 300 kelvins in a vacuum, then exposed them to ultraviolet light and high-energy hydrogen atoms and measured the HAC's spectra. In a series of experiments, they found that carbon exposed separately to ultraviolet rays or hydrogen yields a paltry red glow.

However, when carbon meets up with hydrogen in the presence of ultraviolet light, the two bond. This increases the HAC's photoluminescence, brightening the distinctive red radiation.

The upshot, says Witt, is that astronomers can use naturally occurring HACs hovering among the stars as remote sensors, sending back to Earth information about the deep space environment.

"Call them sensors or probes, if you like," Witt says. "What we now have is a laboratory material whose photoluminescence varies in efficiency under measurable conditions. This is very useful. Astronomers can use telescopes to locate dust clouds in space that can tell us by the light they emit what their interstellar environments are like." *– R. Lipkin*