Breathing time for liquid crystal states

The light and dark areas of a laptop computer's liquid crystal display reflect the ability of liquid crystals to organize themselves into orderly arrangements. Generated in response to weak electrical forces or small temperature changes, these arrangements alter the way in which light passes through the material, making visible the letters one sees.

This kind of response also makes this state of matter — intermediate between a liquid and a crystalline solid — a useful medium for studying nonequilibrium phenomena such as phase transitions. A decrease in temperature, for example, can force the material to shift from a random to an ordered state.

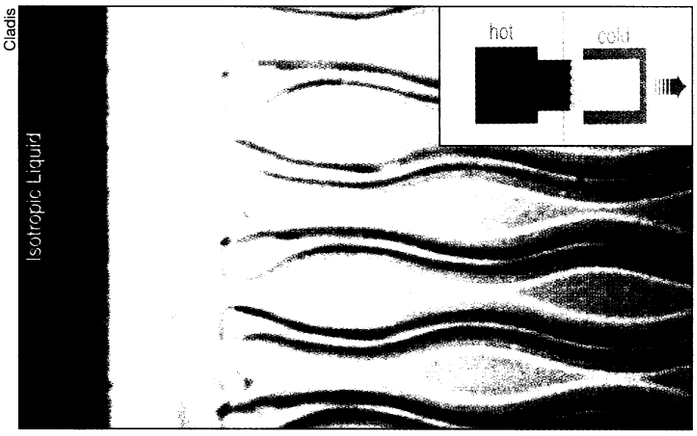
Now, researchers are using phase changes in certain types of liquid crystals to gain insights into the behavior of biological systems. They have discovered that liquid crystals that organize themselves into spiral, or helical, arrangements can develop distinctive patterns with characteristic "wavelengths" and "frequencies" when undergoing a phase transition.

Helical arrangements always have a handedness, says Patricia E. Cladis of AT&T Bell Laboratories in Murray Hill, N.J. They can spiral clockwise or counterclockwise, making it possible to tell left from right. "Our observations are the first to reveal that chirality [handedness] is sufficient to confer a frequency on a nonequilibrium system," she says.

In other words, the existence of such asymmetry in a liquid crystal automatically gives the material a rhythm — an ability to keep time. "It's sort of like the heartbeat turning on," Cladis notes. This finding is intriguing because DNA molecules and other components of life on Earth display a particular chirality.

By heating one end and cooling the other of a rectangular sample of a so-called cholesteric liquid crystal, Cladis and her coworkers create a temperature gradient. They see a sharp, straight-line boundary corresponding to the temperature and position at which the liquid crystal abruptly changes from a random to an organized state. By moving the sample toward the cold side at a well-defined speed, the researchers can shift this interface, inducing more of the sample to settle into an ordered state.

At certain pulling speeds, this boundary becomes wrinkled, displaying notches and bulges spaced at regular intervals, giving the interface a characteristic "wavelength" (see photo). Moreover, as the interface travels, adjacent notches and bulges move closer together, then farther apart, and so on in a coordinated, precisely timed fashion. Cladis and her coworkers call this oscillatory behavior the "breathing" mode.



By pulling a liquid crystal sample in a temperature gradient (inset), researchers can generate distinctive patterns at and behind the moving interface between the random (or isotropic) phase (left) and the ordered liquid crystal (right).

The occurrence of this breathing mode along the moving interface also creates in its wake a distinctive pattern of defects in the ordered material, giving the impression of banners unfurling in a stiff breeze. By doing the experiment at different pulling speeds, the researchers can obtain a variety of liquid crystal patterns.

Cladis described this work at an American Physical Society meeting held this week in San Jose, Calif. *— I. Peterson*

Slipping in new cells tricks Sly syndrome

Cerebral blood vessels have walls that prevent many drugs from entering the brain, making nervous system disorders tricky to treat. So researchers have attempted to insert healthy cells directly into the brain.

As part of this effort, Evan Y. Snyder of the Harvard Medical School in Boston and his colleagues recently implanted neural progenitor cells from the brains of healthy newborn mice into newborn mice that have Sly syndrome, a rare and fatal metabolic disorder (SN: 8/10/91, p.93). Neural progenitor cells normally become the brain's all-important neurons and glia.

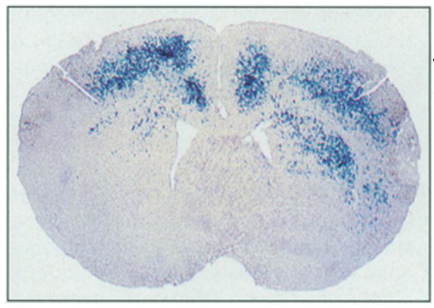
After 3 weeks, the transplanted cells had penetrated diverse regions of the brain and produced beta-glucuronidase, the enzyme that victims of Sly syndrome cannot make. Other cells then picked up and used the enzyme. The transplant thus prevented much of the brain cell damage normally caused by this inherited disease, which strikes people, dogs, and mice, the scientists report in the March 23 NATURE.

Absence of the enzyme allows a complex sugar called glycosaminoglycan to accumulate in cells in the brain and throughout the body. This buildup causes many problems, from mental retardation to liver disease.

The transplanted cells "migrate out all over the brain . . . to the extent that it's hard to say what are host cells and what are injected cells," says Fred H. Gage of the University of California, San Diego. "There is no question [the cells] worked very well."

"The apparent lack of deleterious effects . . . resulting from implantation of progenitor cells makes this a very appealing experimental approach," adds William S. Sly, the St. Louis University School of Medicine physician who identified and described the syndrome.

Before inserting the neural progenitor cells into the cerebral ventricles of newborn mice, Snyder and his coworkers added to them a so-called immortalizing gene. This gene ensures that the cells continue to reproduce in tissue cultures in the laboratory but appears to become inactive when transplanted. The scientists also inserted into some of the cells a gene to make more beta-glucuronidase, but it's unclear to what extent the gene boosted enzyme production.



J.E. Hayden, Univ. of Pa.

In this slice of a mouse cortex, the blue denotes transplanted cells.

Cell transplants into human brains remain rare. Researchers are only now beginning to put fetal cells into the brains of people with Parkinson's disease (SN: 11/28/92, p.372; 12/3/94, p.383).

This is one of the first experiments in which neural progenitor cells have been used to treat a disease, points out coauthor John H. Wolfe of the University of Pennsylvania in Philadelphia. Researchers may someday use the technique for similar diseases, such as Tay-Sachs and Gaucher's. But before any human studies begin, researchers must overcome many obstacles, Snyder and others assert. *— T. Adler*