Depression proves risky for ill hearts

Despair and sadness weigh heavy on the heart. If such feelings attain the status of clinical depression, they literally drag down one's chances of living out the year after weathering a heart attack, a new study finds.

Both women and men who exhibit mild to moderate depression while hospitalized for a heart attack are more likely to die over the subsequent year, report psychologist Nancy Frasure-Smith of the Montreal Heart Institute in Quebec and her colleagues.

Previous research on mortality among depressed heart-attack victims has focused largely on men (SN: 10/23/93, p. 263).

"With current cardiac treatment regimens, the prognosis after [a heart attack] is quite good, even for depressed patients," the researchers assert. "[B]eyond its impact on prognosis, depression results in considerable suffering for patients and families."

Frasure-Smith's group studied 283 women and 613 men who completed psychiatric interviews in the hospital while undergoing treatment for a heart attack. Most participants had not experienced more than one heart attack.

A total of 133 women and 157 men cited symptoms of at least mild depression while hospitalized. Most weren't treated for their depression.

Although women were twice as likely to report signs of depression as men, the depressed members of each sex displayed roughly equal 1-year mortality rates, the scientists note in the January/February PSYCHOSOMATIC MEDICINE. About 8 percent of depressed women and 7 percent of depressed men died of heart-related causes in that time, compared with slightly more than 2 percent of their nondepressed counterparts.

The researchers statistically controlled for many other influences on mortality, including age, cigarette smoking, social isolation, and medical problems.

Men most often reported being depressed if they lived alone and were unmarried, Frasure-Smith's group says. In contrast, women who were unmarried and lived by themselves had the lowest risk of depression.

Men may experience a unique closeness with their spouses, the researchers suggest. Women maintain a wider variety of close relationships, although from a single study it's unclear whether living alone really benefits them after a heart attack.

In prior studies, depression raised the risk of death from heart-related causes. Future work needs to pin down the size and source of this effect, add psychiatrist Lawson R. Wulsin of the University of Cincinnati and his coworkers in the same journal. *—B. Bower*

Tiny turnstile spits out solo photons

Photons are party animals, compelled by quantum mechanics to roam in crowds. The gregarious habits of these fundamental particles of light have hindered attempts to use them one at a time for tasks such as computing or sending secrets. The challenge has been to guarantee that only one photon arrives on the scene at any given moment.

A new device made from the semiconductor gallium arsenide, however, forces photons to sally forth one by one. The pillar-shaped component—an exotic light-emitting diode—acts as a turnstile with electrons as tokens, say its inventors at Stanford University, Hamamatsu (Japan) Photonics, and NTT Basic Research Laboratories in Atsugi, Japan.

Ideally, each electron that enters the component chucks out one photon from the top of the device. The turnstile, described in the Feb. 11 NATURE, approaches that goal when operated at a frigid 55 millikelvins. It ejects a photon for at least a third of the electrons, timed to a precision of tens of billionths of a second. Unfortunately, the device's builders note, the photons go off in all directions, making them difficult to capture in an optical fiber and to pipe to downstream circuits.

Each of these microscopic pillars spouts photons one by one, if electrons enter its base.

"If they're up to 33 percent, that's a significant breakthrough and improvement," comments Michael G. Raymer of the University of Oregon in Eugene. If they can further boost that percentage and steer the photons to a useful destination, "then the device would have very important applications in quantum information processing," he adds.

Quantum computing, for example, attempts to exploit the quantum mechanical nature of tiny particles, such as photons or atoms, to surpass conventional computers in certain tasks (SN: 3/1/97, p. 135). After researchers first used photons as bits four years ago, further progress using photons has stalled. One reason is the difficulty of guaranteeing that a photon would be present when needed.

Because the new device provides timed release of lone photons, it may overcome that limitation, says Oliver J. Benson, one of the Stanford researchers. Adds Jungsang Kim, also of the Stanford team, the device may also aid the use of photons in secure communications. It would help eliminate unintended, redundant photons carrying copies of a message. Those copies may allow a spy to pilfer information from extra photons without being detected.

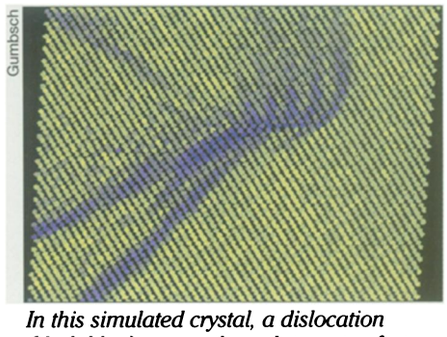
The researchers are making a new version of the turnstile in a tiny cluster of semiconductor atoms, or quantum dot, hoping to boost photon output and operating temperature. *—P. Weiss*

Supersonic defects have the right stuff

You don't need to be in a jet or rocket to break the sound barrier. Striking a hard blow on a piece of metal can do the same thing.

Using computer simulations, researchers have found that a structural defect can spread through a material faster than the speed of sound, which is several thousand meters per second in a typical metal. These defects, known as dislocations, arise when deformation of a material forces perfectly aligned planes of atoms to slip past each other. Hitting the family car with a shopping cart, for example, sends dislocations running through the fender, forming a broad dent.

Previously, theorists thought that these dislocations couldn't break the sound barrier, says Huajian Gao of Stanford University. However, he and Peter Gumbsch of the Max Planck Institute for Metallurgy in Stuttgart, Germany, found that under certain conditions, materials can violate this rule.



In this simulated crystal, a dislocation (dark blue) moves through tungsten faster than the speed of sound. It creates the equivalent of a sonic boom, indicated by the feathery trails left in its wake.

The researchers simulated the behavior of atoms in a thin strip of tungsten at temperatures between 10 and 70 kelvins. A sharp blow to the virtual metal initiates a supersonic dislocation, indicated by telltale shock waves left behind. The waves are produced when atoms trailing the dislocation get squeezed togeth-

er, much as air gets compressed when a jet produces a sonic boom. Gumbsch and Gao report their findings in the Feb. 12 SCIENCE.

"People have done simulations before to see if dislocations can propagate supersonically, but they failed," says Gao. The reason the new one succeeds is that the blow was hard enough to set up a fast initial dislocation. "If you start with a very slow dislocation, you cannot accelerate to a supersonic speed," he explains.

Supersonic movement of dislocations may play an important role in distortions of steel at low temperatures, Gumbsch says. It may also explain seismic shocks that have been observed to travel faster than the speed of sound.

"I believe all of the work, and I like it," says Michael Marder, a physicist at the University of Texas at Austin who models cracking in materials. Other computer simulations "assume that dislocations basically creep along and diffuse. It's significant to show that they can move at speeds comparable to the speed of sound."

Atomic-scale simulations give researchers an invaluable tool with which to study these phenomena, Marder says. It's difficult to image micrometer-size defects zipping along in a real crystal, he points out. "Small things that move fast are really a problem." —*C. Wu*

Feds plan battle against aliens

Creeping, crawling, tendril-snaking alien species have been invading the United States. Zebra mussels, transplants from Eurasia, thrive so well in the Great Lakes that they shut down power plants by clogging their water-intake valves. In New York and Chicago, Asian long-horned beetles topple shade trees. European leafy spurge is smothering western U.S. farm and grazing land, and Australian pines and Brazilian pepper trees are slurping up Florida's fresh water.

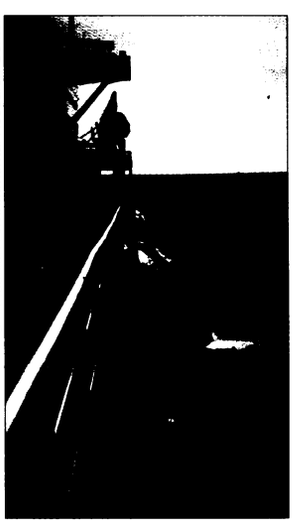
On Feb. 3, President Bill Clinton signed an executive order to coordinate the federal fight against such exotic invaders. The action establishes no new regulations or policies but creates an Invasive Species Council led by the secretaries of commerce, agriculture, and the interior. The council has 18 months to formulate a comprehensive plan.

It won't be easy to control invasive species or stem their influx. Introduced species with short reproductive cycles, voracious appetites, or no local enemies can quickly dominate an eco-system. The Nature Conservancy estimates that, next to habitat loss, invasive species pose the direst threat to native populations. Damage and losses due to these aliens add up to about $123 billion a year (SN: 2/6/99, p. 91).

Many alien species hitchhike in cargo and stow away in ships' ballast water. "Thousands of species are in motion every day in ballast water," says marine biologist James T. Carlton of Williams College's maritime program in Mystic, Conn. Currently, ships are asked to voluntarily exchange their ballast water far out to sea—a stop-gap measure, he says. Research into filtration, ultraviolet radiation, and thermal treatments may reveal a better method to "bake, remove, fry, or otherwise render ballast water as abiotic as possible," says Carlton.

International trade treaties, such as the North American Free Trade Agreement, increase the volume of shipments and so add to the risk of introducing pests. It's important that the Invasive Species Council address trade issues as it coordinates the dozens of federal agencies with a stake in the battle against exotic species, says biologist Daniel Simberloff of the University of Tennessee in Knoxville.

"We need an early-warning system to pick up species when they first become invasive," says biologist E.O. Wilson of Harvard University.



Smithsonian Environmental Research Center

Zebra mussels, voracious Japanese shore crabs, and cholera bacteria have traveled to U.S. harbors in ballast water.

Even brigades of biologists can't catch every alien invasion as it happens. "We want to alert fishermen, boaters, highway workers, people who have developed a familiarity with a community of organisms," says Bob Peoples of the U.S. Fish and Wildlife Service in Arlington, Va. "When something new shows up, we want them to talk to their state fish and game department." —*L. Helmuth*

No beginning in sight for star formation

It kept going and going and going ....

As far back in time as astronomers can observe, the cosmos was churning out stars at a prodigious rate, a new study reveals.

Scientists believe that as they peer ever deeper into space and farther back in time, they will eventually come upon the epoch when star formation was not yet in full bloom. However, "we haven't found that place yet," says Charles C. Steidel of the California Institute of Technology in Pasadena. "The universe was remarkably consistent [in making stars] for a fairly large amount of cosmic time."

As far back as 12 billion years ago, when the universe was perhaps 16 percent of its current age, the cosmos was producing stars at a rate about 10 times higher than it does today, Steidel says. The prolific star formation lasted until about 7 billion years ago. Steidel presented his team's findings Jan. 30 at a cosmology workshop in Chicago.

Moreover, an analysis by another team suggests that the cosmos was making stars just as rapidly when it was even younger, about 9 percent of its current age. Piero Madau of the Space Telescope Science Institute (STScI) in Baltimore and his colleagues report their results on the Internet (http://xxx.lanl.gov/abs/astro-ph/9809058).

The findings contradict a previous report from a team led by Madau and including Steidel. It counted faint, faraway galaxies in the tiny patch of sky called the Hubble Deep Field, which was scrutinized by the Hubble Space Telescope. The team compared this number with a tally of closer galaxies observed by ground-based telescopes. The scientists calculated that star formation reached its zenith when the cosmos was roughly half its current age and was considerably less at earlier times.

Steidel's team has now used ground-based telescopes to search a region 200 times the area of the patch of sky viewed by Hubble. The researchers were surprised to find that star formation remained constant throughout the observable early cosmic history. The findings may only apply to relatively bright galaxies since the telescopes Steidel used could not observe galaxies as faint as those as seen by Hubble.

The researchers now assert that the Hubble Deep Field is simply too small a sample of sky to provide an accurate assessment of star formation. Previous observations by Steidel's team have revealed that massive galaxies in the early universe bunched together tightly (SN: 2/7/98, p. 92). The Hubble field happens to be a region where few galaxies cluster, Steidel suggests.

In a study supporting that assertion, Stefano Casertano and Henry C. Ferguson of STScI and their collaborators counted the number of faraway galaxies in another patch of sky viewed by Hubble. They reported last month in Austin, Texas, at a meeting of the American Astronomical Society that they had found a star-formation rate comparable to Steidel's and about double that found in the original Hubble Deep Field. —*R. Cowen*