Hofmann and other atmospheric researchers blame the extraordinary 1993 ozone hole on the eruption of Mount Pinatubo 2 years earlier. The Philippine volcano spewed out sulfur-rich particles that exacerbated ozone loss for several years until the atmosphere finally cleansed itself of the debris.

Because chlorine and bromine pollution continues to accumulate in the atmosphere, the ozone hole should worsen slightly in the next few years. Ozone concentrations over populated areas of the globe are also expected to continue their decline, allowing increased doses of harmful ultraviolet radiation to reach Earth's surface.

But thanks to international bans on the production of ozone-depleting chemicals, the ozone layer should begin a slow recuperation after the year 2000. The Antarctic ozone hole may disappear for good sometime around the middle of the next century. "What we'll be looking for is the healing of the ozone layer," says Hofmann.

Congress, however, is now considering whether to delay or repeal the ban on production of chlorofluorocarbons and other ozone-harming chemicals (SN: 10/7/95, p.238). Hofmann warns that putting off the ban, even by only 4 years, would significantly delay ozone recovery because these chemicals survive for decades in the atmosphere.

The ozone hole captured headlines last month when the World Meteorological Organization announced that ozone values had fallen much faster than normal in early September. Hofmann discounts the organization's measurements because they came from stations on the periphery of Antarctica that do not always sit beneath the ever-shifting hole.

In contrast, measurements taken at the South Pole, in the heart of the continent, and at McMurdo Station, on the Antarctic coastline, show a more normal rate of ozone loss this year, according to Hofmann and Terry Deshler of the University of Wyoming in Laramie.

— R. Monastersky

Optical refrigeration proves really cool

Laser light, most often used to heat objects, can now cool them as well.

Richard I. Epstein, an astrophysicist at Los Alamos (N.M.) National Laboratory, and his colleagues have developed an "optical refrigerator." The new system, described in the Oct. 12 NATURE, may someday offer computer makers a simple way to cool their machines' hardware, making possible faster and more powerful circuitry for computing and communicating.

Speaking metaphorically, Epstein likens the process to bathing a warm object in "cool light." Since heat arises from atomic motion, a carefully tuned laser can chill an object by dampening its molecular vibrations, causing the object to shed energy as fluorescent light.

To get a feel for the process, he says, think of "pouring light into an object, soaking up some of the vibrational energy," and then letting the fluorescence "carry the energy away."

"The fact that they can extract heat from something with light is interesting," says Clifford R. Pollock, an electrical engineer at Cornell University. "People usually use light to create heat rather than to remove it."

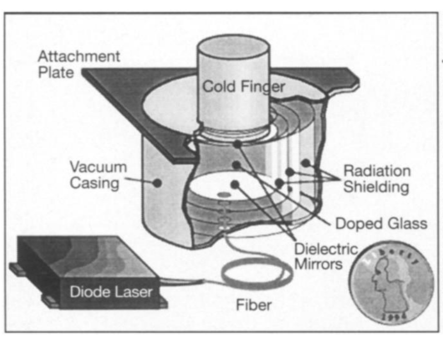
Pollock sees optical cooling as especially handy for applications in which vibrations cause problems, such as in cooling satellite circuitry.

In the Los Alamos Solid-State Optical Refrigerator—or LASSOR—a diode laser shines infrared light into fluoride glass impregnated with ytterbium ions. When "pumped" with photons, the glass glows, cooled with 2 percent efficiency. Though well below the cooling efficiencies of a kitchen refrigerator, the 2 percent energy conversion rate ranks well against other methods for freezing items to 77 kelvins, the temperature at which nitrogen liquefies.

The basic principle is "fairly simple," Epstein says. Though the idea for laser cooling dates back to 1929, scientists couldn't quite get the process to work until recently. The chief difference today, he says, has come from the recent development of compact, solid-state lasers and carefully crafted fiber optic materials, he says.

The LASSOR represents a spin-off of astrophysical research: The group had worked earlier on cooling space-based photon detectors, Epstein says. Now they will try to chill objects to various temperatures. "We want to make a rugged cooler with no moving parts," he says, "just a laser, a piece of glass, and a shell to absorb the fluorescence and shed the extra heat.

"We think the potential for this is phenomenal." *— R. Lipkin*



Bradley C. Edwards/Los Alamos Natl. Lab.

In the new optical refrigerator, or LASSOR, a laser pumps light through optical fibers into a chamber, causing an object to cool down.

Nobel prize for genes that shape embryos

Three biologists this week won the 1995 Nobel Prize in Physiology or Medicine for unearthing the assorted genes that govern the development of fruit fly embryos.

Their work has led other investigators to find similar genes that shape the embryos of higher organisms, including humans. As a result, "these three scientists have achieved a breakthrough that will help explain congenital malformations in man," stated the Nobel Assembly at Sweden's Karolinska Institute in Stockholm.

The Nobel prize will be shared by Edward B. Lewis of the California Institute of Technology in Pasadena, Christiane Nüsslein-Volhard of the Max Planck Institute for Developmental Biology in Tübingen, Germany, and Eric F. Wieschaus of Princeton University in Princeton, N.J.

"It's a wonderful prize. A great deal of what's known about vertebrate development really comes from the pioneering genetic work of these people," says developmental biologist Philip A. Beachey of Johns Hopkins University School of Medicine in Baltimore.

In the late 1970s, Nüsslein-Volhard and Wieschaus joined forces to pursue a systematic strategy for isolating all the genes crucial to the early stages of embryonic development. They laced the sugar water fed to adult male fruit flies with chemicals that damage DNA.

When these males mated with female fruit flies, the females often produced dead embryos that Nüsslein-Volhard and Wieschaus then painstakingly studied under a microscope. The two ultimately identified more than a dozen genes that guide the formation of the early embryo's body plan, including genes that, when mutated, eliminate specific body segments.

Lewis' research, begun in the 1940s, focused on developmental events that occur a bit later in embryogenesis than those studied by Nüsslein-Volhard and Wieschaus. Once fruit fly embryos divide into segments that will become the head, the abdomen, and the tail, a flurry of genetic activity directs the development of those segments into specialized organs such as wings and legs.

By examining mutant flies—say, those with an extra set of wings—Lewis discovered a novel family of genes that controls the development of organs in the fly from head to tail.

Lewis' insect genes have counterparts in vertebrates, namely, many of the so-called *HOX* genes. Some human *HOX* genes can even substitute for the corresponding insect gene during fruit fly embryogenesis. *— J. Travis*

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