Still, the idea that the stratosphere may influence the troposphere is "picking up momentum," says meteorologist Marvin Geller of the State University of New York, Stony Brook. If the history of sun-climate relations is any guide, it's got a long way to go.

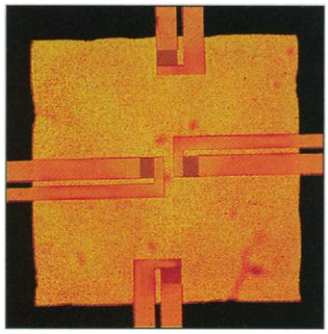
–RICHARD A. KERR

ACOUSTICS

Miniaturizing the Mike, In Silicon

The microphone is being reincarnated in silicon. At a recent meeting* in Berlin, several groups reported progress in converting the standard elements of a microphone—a vibrating membrane that picks up the sound and circuits that convert the vibration into an electrical signal—into structures on a silicon chip. Silicon microphones may not yet be as sensitive as conventional microphones, but they will be robust and cheap. "You can make thousands of them on a wafer," says physicist Gerhard Sessler of the Technical University of Darmstadt in Germany. "It is the coming thing," adds acoustic engineer Allan Pierce of Boston University in Massachusetts.

Most silicon microphones still rely on vibrating membranes to capture sound, but these membranes are micromachined from silicon and measure just 1 millimeter or so on a side and a micrometer thick. In the type of silicon mike that is closest to commercial production, known as a condenser microphone, the membrane is positioned next to a charged electrode. Together, the electrode and membrane form a capacitor, a structure that can store charge. Its capacitance, or ability to hold charge, depends on the distance between electrode and membrane. As the membrane vibrates in response to sound, the distance changes and so does the capacitance, creating an electrical signal in a circuit connected to the device.



Talk to me. Vibrations of a millimeter-square silicon membrane (orange) stimulate an electrical signal via four piezoresistors (dark orange).

CREDITS: (TOP TO BOTTOM) SAM KITTNER; GERHARD SESSLER/TECHNICAL UNIVERSITY OF DARMSTADT

In a variation on this theme, the field-effect microphone, the membrane is given an electric charge and positioned near a semiconductor channel that separates two contacts. The channel's ability to carry current varies in an electric field; as the membrane vibrates, it subjects the channel to a varying electric field, modulating the amount of current flowing through it.

In early prototypes of condenser and field-effect microphones, the membrane was etched out of one chip and the other part of the device was built on another, and the two were pressed together. At the meeting, Sessler reported a new technique for creating the whole device on a single chip. "On the chip you deposit a so-called 'sacrificial layer' ... and on top of that layer you deposit the membrane," he says. Chemically etching away the sacrificial layer leaves a free-floating membrane anchored to the chip at its edges.

Other presentations described microphones in which piezoelectric and piezoresistive materials are deposited on top of the silicon membrane. These materials generate a current or a change in resistance, respectively, in response to changes in pressure. The result is a varying electrical signal as the membrane flexes in response to sound waves.

A few microphone designs presented at the meeting translate the vibration into an optical signal rather than an electronic one. The advantage of these designs, explains Sessler, is that optical signals don't interfere with each other via magnetic fields, so large numbers of optical mikes can be packed close together. The optical output can also travel long distances through optical fibers without degrading. "You don't have to preamplify directly at the microphone," says Sessler.

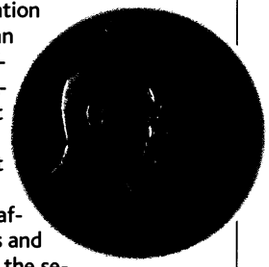
In one such device, developed by Sessler's group, the vibration of the membrane deforms an optical waveguide, altering its ability to transmit light. Two other designs pick up vibrations by bouncing a laser off a silicon membrane and recording variations in the reflected signal—a scaled-down version of a Cold War eavesdropping technique that picks up conversations that are taking place inside a room by playing a laser beam off a window. Pierce and his team at Boston have created small portable arrays of over 10,000 tiny microphones of this design connected to a small display device. The result is an acoustic imaging system, which can reconstruct the shape of objects by detecting differences in the arrival time of reflected sound pulses. The team is now developing an "artificial eye" for use underwater that would send out ultrasound pulses and detect reflected waves to distinguish objects as small as 1 millimeter.

One of the new designs even shuns the traditional membrane. Jörg Sennheiser of Sennheiser Electronic Corp. in Wedemark,

* The Joint 137th Meeting of the Acoustical Society of America and the 2nd Convention of the European Acoustics Association Integrating the 25th German Acoustics DAGA Conference, Berlin, 14–19 March.

ScienceScope

Too Hot to Handle Cowed by a heated dispute, the French Physical Society (SFP) announced last week that it will no longer sponsor an award named after the late Lebanese physicist Rammal Rammal. The medal honors talented physicists who foster scientific cooperation among Mediterranean countries. But SFP officers last month nullified a jury vote that had tapped Israeli physicist Daniel Amit for the 1998 prize. Their decision came after Lebanese officials and academics protested the selection, even though Amit is an outspoken critic of Israel's occupation of southern Lebanon (*Science*, 5 March, p. 1422).



On 31 March the SFP's executive board went further, voting to sever its ties to the medal altogether. Despite the "generous aim" of a prize it has sponsored since 1993, the SFP is "incapable of handling" the type of controversy that dogged last year's pick, the board stated. The medal's originator, French physicist Gérard Toulouse, says he's consulting with Rammal's family about how to continue the prize. Toulouse says he would have preferred a more courageous stand from SFP leaders: "Any sensible member of the scientific community would have felt that the SFP [officers] should resign and the Rammal medal should stay."

Ready to Fuse Physicists are gearing up for another attempt to tame the wild horse of the energy frontier. In February, researchers produced "first plasma" at the National Spherical Torus Experiment (NSTX), a $24 million facility at the Princeton Plasma Physics Laboratory in New Jersey that will explore how to sustain the sun-hot plasma needed to fuse hydrogen atoms. Magnetic fields in the device are supposed to shape the plasma into a spherical torus—a sphere with a hole through its center.

Princeton researchers are now analyzing results from the test run in preparation for the machine's first full-scale research campaign, due to begin in July. A team from 14 U.S. institutions and Japan, Russia, and Great Britain will focus on "discovering whether the machine works the way the theoretical calculations said it would," says NSTX project director Masayuiki Ono. It could take a year, he says, "to bring it to full capability."

Contributors: David Malakoff, Jocelyn Kaiser, Michael Balter

Germany, presented a microphone that consists simply of two tiny wires placed close together and heated electrically. The small flows of air molecules generated by sound waves cool the wires. "The temperature difference in the two wires depends directly on the velocity of the air particles," explains Hans-Elias de Bree, who developed the concept several years ago while still a student at Twente University in Enschede, the Netherlands. The microphone, which Sennheiser says could be realized in silicon, cannot respond to sound frequencies any higher than about 10 kilohertz, making it usable for telephones but not for high-fidelity recording. But it can stretch down to waves below 20 hertz, which are important in seismology. "A pressure microphone simply cannot do this," says de Bree.

Although no silicon microphones are yet produced commercially, researchers in the field are bullish about their prospects. In a few years, says Sessler, "nobody will use conventional microphones anymore, only silicon ones." **–ALEXANDER HELLEMANS**

Alexander Hellemans is a writer in Naples, Italy.

FISHERY MANAGEMENT

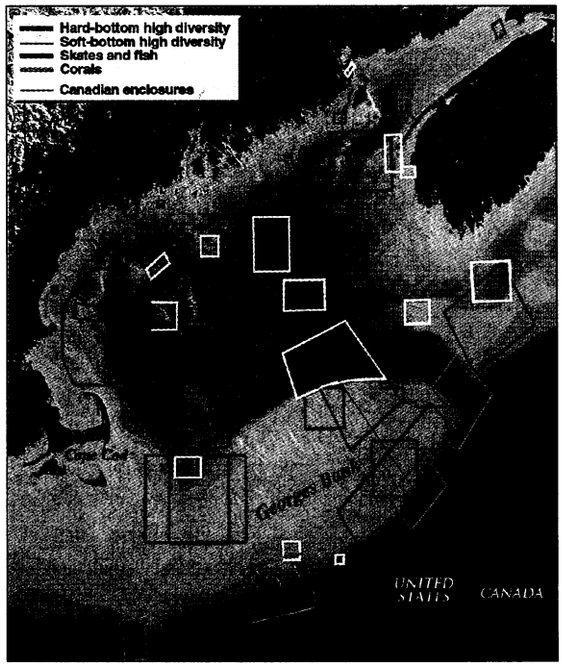
Plan Would Protect New England Coast

BOSTON—For centuries, the gravel and sand of Georges Bank and the great canyons, muddy basins, and shallow ledges of the Gulf of Maine have supported one of the world's most productive fishing regions. But big boulders have historically protected a 1050-square-kilometer region at the bank's northeastern tip from dredging boats in search of scallops and trawlers hunting down groundfish. However, those boulders are becoming less of a deterrent against improved and sturdier gear. So when geologist Page Valentine of the U.S. Geological Survey in Woods Hole, Massachusetts, stood before his colleagues last month and defended his proposal to safeguard this rare, undisturbed gravel bed, he knew that he was also standing at the crossroads of science and politics.

Valentine's presentation was part of a 2-day workshop held at the New England Aquarium here to build support for Marine Protected Areas (MPAs), a controversial concept aimed at preserving biodiversity in coastal waters. The meeting, organized by Elliott Norse, founder of the Marine Conservation Biology Institute in Redmond, Washington, featured talks by 21 experts across a range of marine habitats and species and represented the marine community's biggest push for MPAs.

The discussion generated a map (see above) that nominated 29% of the ocean floor off the coast of New England and Canada's Maritime Provinces for protection, as well as 25% of pelagic (open-ocean) waters. The next step will come in the fall, when the scientists discuss the plan with government officials, commercial stakeholders, and environmental activists—meetings that are likely to be contentious. "The conservation groups will want to see if various species are covered. And various fishermen will be convinced that their livelihood is threatened," says Mike Pentony, an analyst for the New England Fishery Management Council, who was an observer at last month's workshop. The areas could be established by the National Marine Fisheries Service or under existing U.S. and Canadian laws to protect endangered species and habitats.

Existing MPAs in the United States cover only small regions in the Florida Keys and off the coast of Seattle, and there is no consensus among scientists on what they should protect or how. An MPA could merely be spared from oil drilling and sand mining, or it could restrict any activity with the potential to harm marine life, including whale watching and research. There are even protected areas in Georges Bank—about 14% of U.S. waters near New England are closed to groundfishing—but the lines have been drawn by regulators focused more on the welfare of economically important fish than on science. "Fisheries closures are for the simple purpose of rebuilding overused fish stocks," says Peter Auster, an ecologist at the University of Connecticut, Avery Point, "and they will be repealed when the target populations rebound." Norse and others say that the extensive research already done on the Gulf of Maine and Georges Bank makes them prime targets for MPAs.



Bottoms up. Researchers have pegged some three dozen pieces of the ocean floor off New England as priority areas for the protection of one or more types of benthic ecosystems.

CREDIT: KEVIN JOY/NATIONAL UNDERSEA RESEARCH CENTER

As a first step toward that goal, the scientists at the workshop chose 36 areas that warrant closer attention. Some are particularly rich in biodiversity; others support fish nurseries or contain rare or fragile species like barndoor skates and corals. Any discussion of exactly how to protect them was postponed until the fall, and although the researchers all said they wanted to remain above the political fray, they agreed to adjust many of the boxes to make them more acceptable to competing interests, such as fishers. For example, Ransom Myers, a fish biologist at Dalhousie University in Nova Scotia, had proposed a protected area for the barndoor skate that included areas in the gulf where the skate has not been observed for many years. Although he argued that the larger regions might restore the skate to levels not seen in decades, the committee decided that a more reasonable goal might be preservation of existing habitats.

John Williamson, a former commercial fisher who serves on the New England Fishery Management Council, thinks that fisheries management "has embraced" habitat protection as a way to restore marine ecosystems crucial to many species, including commercially important ones. But he calls it "a delicate situation" and compares working with the fishing community to herding cats. In addition, he chides scientists for "talking in isolation."

To help break down those barriers, scientists hope to repeat the New England workshop in other regions, notably the Pacific Northwest. Ideally, workshop members say, scientific participation in future debates over ocean zoning also will help officials avoid the mistake made a century ago when beauty rather than ecological importance was the driving force behind the creation of national parks.

Norse admits that the process is far from perfect. "We're working with the best people and the best data," he says, "but there's still a lot that's arbitrary" about the recommendations. "It's art based on science." Still, he says, "it's good that we're doing this now and not in 10 years." **–KARIN JEGALIAN**

Karin Jegalian is a science writer in Cambridge, Massachusetts.