ing individual vibrations, called phonons. They also provide a warning for scientists and engineers hoping to create wires or machines only a few molecules thick: Such devices may overheat in a hurry.

In 1988, physicists discovered that when electrons flow through a wire only a few nanometers, or billionths of a meter, thick, they move in a handful of quantum channels. So when researchers increase the voltage between the two ends of a tiny wire, the current passing through it climbs in a series of even steps as the channels open one by one. Now Michael Roukes, Keith Schwab, and their colleagues at the California Institute of Technology in Pasadena have overcome daunting technical challenges to catch heat behaving in a similar manner. "It's beautiful work," says Alex Zettl, a physicist at the University of California, Berkeley. "I have nothing but praise for it."

Roukes and colleagues set out to measure the flow of heat in beams of silicon nitride a mere 60 nanometers thick and 200 nanometers wide. They heated each beam at one end with a minuscule electric heater and tracked the temperature difference between the two ends by measuring the temperature-dependent jostling of electrons in gold patches painted on either end. They then monitored the thermal conductance, the ratio of the heat applied divided by the temperature difference, as they cooled the beam toward absolute zero. To keep from melting the delicate device, the researchers kept the heat down to about a femtowatt, or a millionth of a billionth of a watt—roughly the power that would reach your eye from a lightbulb 60 miles away. "You have to control everything well below the femtowatt level," says Schwab. "That's what's terrifying about this experiment."

As the researchers cooled the beam, the thermal conductance fell in proportion to the temperature cubed as the higher frequency vibrations, the flutes and violins of the thermal symphony, faded out. Then, below 1 kelvin, the researchers found that the thermal conductance began to decrease in direct proportion to the temperature. That meant they had winnowed out all but the bass fiddle, the four simplest vibrations, analogous to the lowest energy channel in quantum electrical conductance. The rate of decrease revealed a limit on how much heat these vibrations could carry. Two years earlier, physicists George Kirceznow and Luis Rego of Simon Fraser University in Burnaby, Canada, had predicted just this fundamental limit. "I was obviously hoping that they would see what we predicted," Kirceznow says, "but I'm stunned that the agreement was so good."

The observation may mean extra work for researchers striving to manufacture machines only a few molecules or atoms across, especially if they must run at low temperatures. Such tiny devices may have to get rid of their heat only through the limited channels, so they may tend to overheat. "When things get very small, these sorts of limits will come in," Roukes says. "So you have to consider how you'll deal with them."

Now that they've struck a quantum chord, researchers would like to observe the individual phonons that are doing the vibrating. Roukes envisions an experiment in which an exquisitely sensitive detector registers a click for each phonon. And Zettl thinks that may be just the beginning: "There are going to be many, many experiments coming out of these results."

–ADRIAN CHO

ENDANGERED SPECIES

CITES Puts Off Plan to Hasten Shipments

NAIROBI, KENYA—In a setback for scientists, an international trade body has shelved a proposal to simplify research on endangered species. The proposal would have waived an often-cumbersome permitting process for handling samples of everything from hair and DNA to cell lines derived from endangered species. The rules are mandated under the 25-year-old Convention on International Trade in Endangered Species (CITES), which three European countries lobbied to change. But unexpected opposition from the United States and several developing countries at a meeting here last week torpedoed the proposal until at least 2002.

The restrictions are meant to squelch international trafficking in wildlife while granting exemptions for research samples. They prevent smugglers of animal parts—say, bear gall bladders used in traditional medicine—from masquerading as scientists by requiring a permit from the originating and destination countries. Many countries are slow to issue permits, which in some countries is predicated on paying a bribe. Fed up with the status quo, Germany, Switzerland, and the United Kingdom proposed an amendment that would eliminate the need for permits for biomedical research, diagnosing animal diseases, and DNA testing.

Scientists at the meeting shared a few bureaucratic nightmares in hopes of bolstering their argument. For example, it took 7 months for a German group to get a permit from the U.S. Fish and Wildlife Service (FWS) to send blood from a St. Vincent's Amazon parrot to New York City for DNA analysis, says ornithologist Donald Bruning of the Wildlife Conservation Society in New York City. Such delays can be fatal for a sick animal needing a proper diagnosis, says Samuel Wasser of the University of Washington, Seattle, who studies stress hormones in scat in several African countries. By the time the blood sample comes back, Wasser says, "all we know is what the animal died from."

Although sympathetic to the plight of scientists, FWS's Donald Barry says that the European proposal would lead to "a serious erosion of domestic controls." Customs agents can't judge whether someone with wildlife parts is a bona fide scientist, he adds. Instead, Barry suggests that countries issue blanket permits to certain institutions and scientists—a plan that Wasser fears would "create a scientific and institutional elite."

Delegates from several developing nations also went on the attack. "How can we ensure that these samples are not used for bioprospecting?" says Hesiquio Benitez Diaz, a biologist with Mexico's National Commission for the Knowledge and Use of Biodiversity. Permits help to keep track of biological resources that leave the country. If a drug is developed from an endangered plant, for instance, a country may be able to seek royalties by proving the plant's origin. But right now, says Diaz, "we just don't have a framework yet for controlling access to our own genetic resources on a global level."

In closing the biennial treaty meeting on 20 April, CITES officials instructed several working committees to resolve their differences before the next treaty meeting in October 2002.

–WENDY WILLIAMS

Wendy Williams is a freelance writer in Mashpee, Massachusetts.

Feathers ruffled. Treaty negotiators have two more years to hammer out a deal to speed shipments of DNA and other samples from endangered species, such as this St. Vincent's Amazon parrot.

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