made a case for phonons to be the cause of the kink—a result that would upset the conventional wisdom about unconventional superconductors.

Results of experimenters at McMaster University and Brookhaven National Laboratory seem to eliminate both the magnetic resonance and phonons as the glue. In this group's experiment, infrared light was shone on the superconductor, and the amount of light scattered at each wavelength provided a measure of the energies of the paired electrons. The physicists, led by Thomas Timusk of McMaster, found both a sharp peak in scattering at a particular frequency and a broad background of scattering across all frequencies. The sharp peak is clearly related to the kink seen in the other experiments, but it disappeared from view in so-called overdoped material, which has too many oxygen atoms for optimal superconductivity. (Overdoped materials superconduct, but at lower temperatures as the doping increases.) That rules out phonons as the cause of the peak and the kink; phonons should remain present in all materials, even the overdoped ones. Nor can phonons be responsible for the broad background: if they were, the background would cut off at high frequencies, which it does not.

The sharp peak's behavior—the conditions under which it is present—correlated well with what was expected for a magnetic resonance. But there's a gotcha: its disappearance in overdoped materials that nonetheless still superconduct. Consequently, it cannot be the cause of the superconductivity.

That leaves the broad background, which Timusk and his co-workers think is likely to be a signal of whatever process really is binding the electrons together in pairs. Michael Norman, a materials scientist at Argonne National Laboratory, argues that although this glue cannot be the much studied magnetic resonance, there are good reasons for believing it is magnetic in nature. And so the quest goes on. Two contenders are knocked out, but the puzzle remains.

ECOLOGY

The Oil and the Otter

SEA OTTERS CLEAN UP AFTER THE *EXXON VALDEZ* SPILL—AND GET SICK DOING SO BY SONYA SENKOWSKY

It has been 15 years since the *Exxon Valdez* oiled Alaska's Prince William Sound, and more than 12 since the last of the official restoration workers took off their orange slickers and headed home. But at least one cleanup crew never left the Sound: sea otters. The creatures, which were hit especially hard by the first effects of the spill, continue to feed on clams and other food in areas that still contain pockets of oil. Their diligent digging is helping release trapped petroleum—which appears to be sickening them. Ecologists are left

GREASY EATS: By digging for food, sea otters in Prince William Sound are cleaning up what remains of the mess left by the *Exxon Valdez*. The oil components are poisoning the otters.

JACK SMITH *AP Photo*

with a dilemma: remove the oil (and possibly cause more harm to the Sound) or let the animals continue to do the dirty work and pay the price.

Scientists had originally predicted that any remaining oil would have been carried by waves to shorelines by now. There exposure to air would transform the oil into a hardened asphalt residue lacking the more volatile and toxic components. "The assumption was that the oil wasn't subsurface, it wasn't low, it was up there in that 'bathtub ring,' and that's where the cleaning effort was focused," explains Stanley D. Rice, a laboratory program manager with the National Oceanic and Atmospheric Administration's Alaska Fisheries Science Center in Juneau.

But in 2001, with some animals continuing to show indications of oil exposure, NOAA researchers dug into those beaches and found far more *Exxon Valdez* oil than expected—much of it still liquid—in about 70 percent of the sites. The remaining residue "still has a pretty high complement of the toxic components of oil," remarks team leader Jeffrey W. Short.

Sea otters, which feed on clams, mussels and other invertebrates, reach their prey by diving and digging underwater pits. One otter can create thousands of pits in a year, moving five to seven cubic yards of sediment a day. These excavations release oil from surrounding sediment, helping it disperse, explains U.S. Geological Survey research wildlife biologist James L. Bodkin. He has been studying a group of about 70 sea otters from northern Knight Island, a region that lost 90 percent of its sea otter population after the spill. The otters are no longer becoming coated in oil and dying from hypothermia, but there is evidence that they are ingesting the contaminants. Researchers have recorded life spans reduced by between 10 and 40 percent compared with before the spill and noted swollen and discolored livers in some dead otters.

The sacrifices of today's sea otters, however, should have their benefits, Rice observes: "The [otters] that are new and coming along, they're going to be entering a habitat that's cleaner." Decreasing levels of an enzyme called cytochrome P450-1A in the animals' blood, produced in response to toxic chemicals, indicate that an end to the prolonged oil exposure is near, according to USGS physiologist Brenda E. Ballachey and Purdue University pathologist Paul W. Snyder. "While they're still being exposed, there is less and less oil there every year," Rice notes.

With the possibility of seeking further restoration funds from Exxon on the horizon, scientists are debating whether a cleanup makes sense. "I think that if we had asked this question and had the data we have now several years ago, we probably would be out there cleaning up," Rice states. The effort generally involves mechanical tilling—essentially, plowing the affected area with heavy machinery. The method turns the ground and releases trapped oil, which is then broken down by microorganisms.

But the time may be fast approaching, Rice adds, when such intervention may not be wise. Although human cleanup efforts would more quickly make feeding safer for sea otters and other foragers, such as harlequin ducks, they would physically disrupt the environment and would not be beneficial to all organisms. "Maybe on some marginal beaches, you would do more harm than good," Rice surmises. "What might be a good idea for otters may not be a good idea for a clam or a mussel. There is no obvious choice."

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OCEANS

Splash of Cold Water

NEWFOUND EDDY EXPLAINS MYSTERIOUS FLOWS BY CHRISTINA REED

Neighbors often trim only the part of a tree that is growing over their own property lines. For decades, Japan and South Korea acted similarly, staying within their exclusive economic zones when studying the Sea of Japan, or the East Sea, as the Koreans refer to it. Then, in 1999, oceanographers from the two nations teamed up with the U.S. Navy to explore the Japan/East Sea in the first long-term underwater study of its circulation.

Now the team is showing abundant fruit from its labor. What the researchers uncovered changes the perspective of the ocean basin between the two Asian countries: a cold-water eddy swirling in and out where no one had noticed it before. Named after one of the islands in the Ulleung Basin, the Dok Cold Eddy explains previously misunderstood flows in the Sea of Japan that may help naval operations, commercial shipping and fishing.

"We found that this eddy has an extreme impact on the circulation of the entire Japan/East Sea," says Douglas A. Mitchell of the Naval Research Laboratory (NRL) at Stennis Space Center in Mississippi. Mitchell, who identified the Dok Cold Eddy earlier this year at the oceans meeting of the American Geophysical Union, notes that it had been overlooked even in the satellite data because of the political boundaries.

The investigators discovered the Dok Cold Eddy using instruments called inverted echo sounders stationed on the seafloor from June 1999 to July 2001. The devices measured the time it took for signals to bounce off the sea surface and return. The time interval depends on the density of water, which in turn depends on temperature. Mitchell converted the acoustic measurements into temperature and velocity profiles of the currents in the Sea of Japan. During the two-year period, an eddy 60 kilometers in diameter propagated in and out of the basin beginning in the north near Dok Island. A