other institutions to study trace elements in meteorites, cosmic dust, and moon rocks, but the earthquake threw the 2-ton instruments against an interior wall, knocking the optics out of alignment and wrecking electrical circuits. Replacement parts for the 20-year-old instruments are unavailable, Nakamura says, and the company that made them doesn't even want to send a technician to assess the damage. What's worse, Nakamura worries that Monbusho won't authorize the $30,000 to $40,000 needed to buy a replacement because the damaged ones weren't new when he acquired them.

If the earthquake has set back some areas of research, it has also created new opportunities. Monbusho has just approved a 3-year, $2.8 million research project involving about 100 researchers from practically every department. Earth scientists will study the region's faults; engineers, the performance of local structures. There will be studies of the social and economic effects of the earthquake, and the Department of Computer and Systems Engineering is planning a digital archive of earthquake data.

The medical school has its own programs. An epidemiological study is focusing on the psychological and mental stress suffered by quake survivors, while another group is trying to understand high rates of renal failure among certain patients injured in building collapses. Kosaku Mizuno, chair of the department of orthopedic surgery, says they have been puzzled by what he calls crush syndrome, in which a person is trapped in wreckage for some length of time but whose vital organs appear undamaged. "It is very difficult to differentiate the patients that succumbed to crush syndrome from patients that recovered," he says.

Regardless of their field, many of the researchers at Kobe feel they now have a proprietary interest in earthquake research. "We're living in Kobe," says Kunio Kataoka, dean of engineering, "so we should be doing this research."

–Dennis Normile

AUSTRALIA

Ocean Anomaly Triggers Record Fish Kill

MELBOURNE—Hundreds of millions of pilchards, small relatives of herrings, have washed ashore during the austral autumn along the entire 5000-kilometer length of Australia's southern coast, leaving scientists scrambling to explain the biggest fish kill in the country's history.

Neither the pilchards' natural predators nor seabirds gorging on the dead fish seem to have been affected, suggesting that the culprit is not an algal toxin. The leading suspects are currently a diatom bloom or a virus, but there are hints that the cause may lie deeper, in unusual changes in the temperature profile of the Southern Ocean. However, scientists are puzzled by the fact that juvenile pilchards and other species have not been affected, as well as by the absence of a diatom bloom or temperature change in the waters of Western Australia.

The mysterious killer's handiwork was first spotted in late March. South Australian fishermen reported unusual "black water" ahead of the kill in Spencer Gulf, in the eastern half of the Great Australian Bight; a month later, fishermen in eastern Victoria were complaining of a sticky slime on their nets and lines. The kill spread eastwards at some 60 km a day from Spencer Gulf and then swung north around the coastline, eventually halting at Newcastle, north of Sydney; it also spread south into Tasmanian coastal waters and west across the Bight into Western Australia.

Surface water samples were found to be teeming with cells of the diatom *Thalassiosira*, a specialized marine alga with a lacy silica skeleton. Researchers suspect that the pilchards were suffocated or otherwise incapacitated by floating slime secreted by the algae. Marine biologist David Smith, research director at the Victorian Marine Research Laboratories at Geelong, found that almost all the lamellae on the pilchards' gills had eroded away, destroying their capacity to absorb oxygen.

The killer's modus operandi in the west was more puzzling, however. For one thing, there are no signs of a diatom bloom, and the destruction followed a strange path, spreading westward from the Bight at around 25 km per day. "It's the weirdest thing, because it is spreading against the direction of the Leeuwin Current, which flows eastward into the Bight at around 2 km per hour," says biologist Rick Fletcher of the Western Australian Fisheries Research Laboratories in Perth.

Oceanographers initially thought the culprit was a Kelvin wave, a deep, eastward-propagating pulse of water of varying temperature that breaks through the thermocline, the boundary between warmer water on the surface and a colder, deeper layer. These planetary-scale waves carry a mound of warm, low-density water from the western Pacific to the South American coast during an El Niño, blanketing the nutrient-rich cold waters of the northern Humboldt Current and starving anchovies and other fish.

Gary Meyers of the Commonwealth Scientific and Industrial Research Organization's (CSIRO's) division of oceanography in Hobart says temperature soundings in the eastern Indian Ocean indicate the thermocline had been thinned by a bulge of cold, deep water, and that the collapse of such a mound could have spawned such a wave. In theory, it could have initiated an ecological chain reaction whose fallout proved fatal for pilchards. But the killing front appears to have moved too rapidly to have been caused by a Kelvin wave, Meyers now believes.

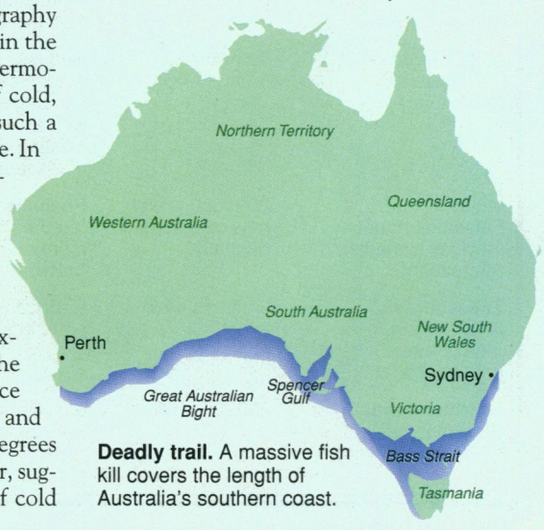
Kelvin wave or not, something extraordinary seems to have stirred the Southern Ocean recently. Sea-surface temperatures between Spencer Gulf and eastern Victoria have been 2 to 4 degrees lower than normal since late December, suggesting a series of major upwellings of cold water. Competitors in the Sydney-Hobart yacht race in late December also reported unusual algal bloom in Bass Strait.

One theory being pursued by fish virologist Mark Crane, of the CSIRO's Australian Animal Health Laboratory at Geelong, is the possibility of a herpesvirus epidemic. Crane has found aggregations of herpeslike virus particles in the pilchards' gill tissues, although he has not yet been able to isolate or culture the virus. He speculates that the virus could have been a harmless passenger that emerged once the pilchards' immune system was weakened by some form of environmental stress—for instance, oxygen deprivation from slime coating the gills.

For Fletcher, the kill is something more than a scientific conundrum. Perth is "the largest pilchard fishery in Australia," he says, with most of its annual catch of 10,000 tons used as bait. Although the kill has ebbed, Smith fears its effects will be felt on other commercial species—including mackerel, Australian salmon, and barracuda—that prey on pilchards.

–Graeme O'Neill

Graeme O'Neill writes about science from Melbourne.



Deadly trail. A massive fish kill covers the length of Australia's southern coast.

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