

Cousin of El Niño Haunts Indian Ocean

For decades, climate researchers have regarded the Indian Ocean as a boring basin, lacking the commotion that El Niño and La Niña stir up in the Pacific. Now, two teams of scientists have independently identified the climatic kin of El Niño in the Indian Ocean, where it caused widespread weather problems in 1997.

The finding raises the hope that forecasters will soon learn to predict abnormal torrents and droughts in East Africa, India, and Indonesia.

"It's like we've found a raw gem. Now, we have to polish it and see how good it is," says Peter J. Webster of the University of Colorado at Boulder, the leader of one team. His group published its results in the Sept. 23 NATURE, as did a trio of Japanese and Indian researchers.

The two sets of scientists noticed that water temperatures along the equatorial Indian Ocean have a habit of flip-flopping. Usually, warm water accumulates in the eastern part of the ocean near Indonesia, while the western section near Africa remains relatively cool. This pattern can occasionally reverse, however, when winds and ocean currents conspire to chill the eastern Indian Ocean, contend the scientists.

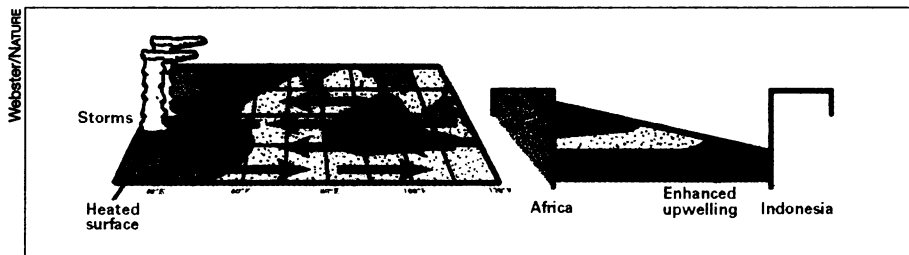
Historical data show this kind of extreme turnabout has happened six times in the past 40 years, reports Toshio Yamagata at the University of Tokyo and his colleagues. When the western Indian Ocean warms dramatically, it can bring devastating rains to Kenya and neighboring countries, which in turn spawn epidemics there (SN: 7/17/99, p. 36).

Scientists had previously detected hints of this temperature reversal while studying the climate of 1961, a catastrophically wet year in East Africa. They had, however, thought that the 1961 episode was unique, says Webster. The pattern sprang to life again in 1997 but got overshadowed by the century's biggest El Niño.

"All of the commentaries in 1997 and 1998 were referring to the great El Niño, and here we had this enormous temperature variation in the Indian Ocean, and nobody had noticed it," says Webster.

The Colorado scientists used measurements of sea level, thunderstorm activity, and ocean temperatures to reconstruct the events in the Indian Ocean. The unusual ocean pattern started to develop in early 1997, when a broad swelling in the sea surface rippled westward, piling up warm water near the African coast. In June, winds along the coast of Sumatra in Indonesia pulled up cool ocean water.

As East Africa warmed and the Sumatran region cooled, the winds that normally blow eastward along the equator



Indian Ocean map shows equatorial winds blowing westward in autumn of 1997, piling up warm water along the East African coastline, as depicted in the ocean-height diagram on right.

reversed direction. The shift enhanced the temperature disparity, feeding the growth of storms over East Africa and fostering record drought and fires in Indonesia. In mid-1998, monsoonal winds sweeping across the Indian Ocean wiped out the unusual pattern, says Webster.

The Indian Ocean reversal is an independent beast that has no clear link to El Niño, contend the two teams. Although the two events coincided in 1997, the Indian pattern occurred on its own in 1961 and at other times in recent decades.

If researchers can discern how the temperature shift in the Indian Ocean affects weather around the basin, forecasters might better predict conditions months in advance, in much the same way that El Niño gives a forewarning of unusual climatic events.

"That is the hope, but it remains to be demonstrated," says David Anderson of the European Centre for Medium-Range Weather Forecasts in Reading, England.

At present, most computer climate-forecasting models ignore the Indian Ocean, but the two reports and other new studies will likely redirect researchers' attention. For example, Lisa Goddard and Nicholas E. Graham of the Scripps Institution of Oceanography in La Jolla, Calif., used a model to show that Indian Ocean temperature plays a much bigger role than Pacific temperatures in influencing African rains, they report in an upcoming issue of the JOURNAL OF GEOPHYSICAL RESEARCH.

"It's important," says Graham. "You can't leave out the Indian Ocean, as some people do."
—R. Monastersky

By a nose, worms reveal new Prozac targets

The scrunched-up noses of worms swimming in a solution of Prozac could help explain the popular antidepressant's side effects, such as insomnia, sexual dysfunction, and nausea. They may even challenge the current theory of how the drug lifts spirits.

Although millions of people each year receive prescriptions for Prozac, a debate continues about how it and related antidepressants work. The prevailing hypothesis holds that these drugs correct a deficiency of the brain chemical serotonin by binding to and interfering with cell-surface proteins, the serotonin reuptake transporters, that mop up the neurotransmitter.

Some investigators, however, contend that Prozac doesn't battle depression much better than placebo pills or talk therapy. Others accept the drug's value but dispute the evidence that serotonin deficiency causes depression.

"It's not that the drugs don't help some people—I think they do—but I don't think we know why," says Elliot S. Valenstein of the University of Michigan in Ann Arbor, a critic of the serotonin hypothe-

sis. "There's so much that contradicts this simple theory, but we don't know what to turn to."

To explore the workings of Prozac, Robert K.M. Choy and James H. Thomas of the University of Washington and the Fred Hutchinson Cancer Center, both in Seattle, chose the humble nematode *Caenorhabditis elegans*. While its nervous system is extremely simple, the worm's nerve cells employ many of the same molecules, such as serotonin and its transporters, that the human brain does.

When bathed in Prozac, *C. elegans* responds in two obvious ways. First, the drug triggers the female worms to lay eggs. Second, it induces muscle contractions, most dramatically in the muscles around the olfactory cells at the worm's tip.

Investigators had previously shown that the egg-laying response stems from Prozac's interactions with the serotonin system. Choy and Thomas, however, found that the nose-muscle contractions occur independently of the drug's inhibition of serotonin transporters. This suggests that Prozac has other molecular

targets in the worm, and possibly in people as well, says Choy.

By exposing *C. elegans* to a mutation-causing chemical, the scientists created several strains of worms that in response to Prozac, lay eggs but don't wrinkle their noses. The researchers have now identified two genes—and continue to search for more—that when mutated confer resistance to Prozac's effect on the nematode nose. The genes encode novel cell-membrane proteins and are part of a larger family of genes, the scientists report in the current (August) **MOLECULAR CELL**.

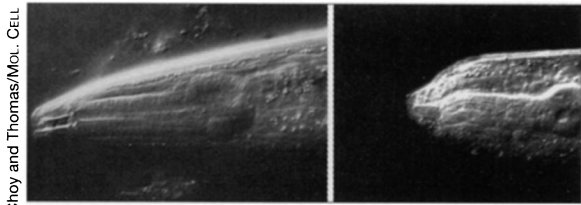
Choy and Thomas haven't yet found comparable genes in people or shown that Prozac and similar antidepressants interact directly with the worm cell-mem-

brane proteins. Only then, says Choy, can scientists address whether these proteins play any role in Prozac's antidepressant actions.

While he favors the prevailing serotonin hypothesis, neuroscientist Randy D. Blakey of the Vanderbilt University Medical Center in Nashville suspects that Choy and Thomas have uncovered interesting new targets of Prozac and related antidepressants. "They do make a very strong case that some side effects of these agents may be mediated through interactions with these proteins," he says.

In the future, scientists may bathe worms in drugs other than Prozac. Blakey, for example, plans to expose *C. elegans* to antipsychotic drugs that affect transporters for the brain chemical dopamine.

"Drugs have historically been effective tools for investigating how worm neurons work; worm neurons may prove equally effective for investigating how drugs work," notes William R. Schafer of the University of California, San Diego in a commentary in the Sept. 3 **CELL**. —J. Travis



Choy and Thomas/Mol. CELL

A normal worm (left) and one wrinkling its nose in response to Prozac (right).

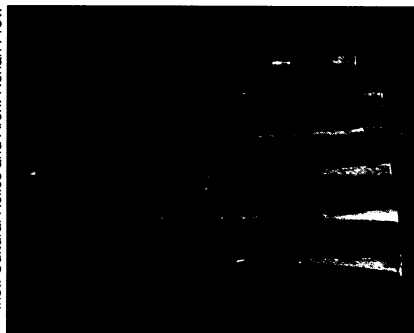
Chinese dig sound from ancient flute

In one of the most unusual recording sessions ever held, a musician recently entered a sound studio and successfully played a Chinese folk song on a nearly 9,000-year-old bone flute. The flute, one of six unearthed in a prehistoric Chinese village, is the earliest known complete, playable musical instrument, a research group reports.

Analysis of the sounds from the seven-holed instrument indicates that a tiny opening drilled next to one of the holes corrected a slightly off-pitch tone, holds a team headed by archaeologist Juzhong Zhang of the Institute of Cultural Relics and Archaeology of Henan Province in Zhengzhou, China.

The researchers didn't analyze the other flutes' sounds because preliminary tests indicated that they would crack if played. Construction of replicas of each bird-bone flute will allow for a detailed comparison of the specimens' musical scales to two current Chinese musical scales. An account of the ancient flutes appears in the Sept. 23 **NATURE**, and the flute recording can be heard at <http://www.nature.com>.

"Aside from finding what we see as the earliest complete, playable musical instrument, what's surprising is the appearance of sharp social divisions in this very early agricultural village," says Garman Harbottle, a nuclear chemist at Brookhaven National Laboratory in Upton, N.Y., and a coauthor of the new report. Some graves at the ancient settlement,



Inst. Cultural Relics and Arch. Henan Prov.

Jiahu bone flutes include a playable specimen (second from bottom).

Jiahu, contain opulent offerings, while others are, literally, bare-bones affairs.

Jiahu excavations began in 1962. The ancient flutes were uncovered in burials in 1987 and then radiocarbon dated. Harbottle helped the Chinese scientists interpret their data.

"This new find is exciting but not surprising, since complex societies certainly existed by 9,000 years ago," remarks archaeologist April Nowell of the University of Victoria in British Columbia. About 30 partial bone flutes ranging in age from 12,000 to 36,000 years have been found in Europe, as well as a disputed Neandertal flute (SN: 4/4/98, p. 215). Nowell says that German researchers have recorded a tune with the piece that remains of a 30,000-year-old flute, making it the oldest playable musical instrument. —B. Bower

Smart robot orbs to aid space crews

In one of the *Star Wars* movies, hero Luke Skywalker trains for his eventual clash with Darth Vader by wielding his light saber against a hovering robot orb. Soon, NASA will send similar-looking robots aboard spacecraft, the agency says.

Tests of the softball-size, red spheres, which will be packed with microelectronics and sensors, could start on the International Space Station in 2002. The spheres eventually would float around as mobile assistants to the crew.

This summer, NASA engineers demonstrated prototype navigation and control systems for the devices. They are now adding object-tracking and imaging capabilities to the machines.

Instead of martial training, the tag-along globes will offer information services, such as roving teleconferencing to Earth and optional reminding about scheduled tasks. The devices will be able to synthesize speech onboard and recognize language with the assistance of an external computer, says project engineer Hans Thomas of NASA's Ames Research Center in Mountain View, Calif.

The propeller-driven robots will also patrol the spacecraft interior, alert for gas leaks or other problems. They'll move approximately as fast as a person walks.

Howie Choset of Carnegie Mellon University in Pittsburgh has helped NASA develop this robot, as well as another to inspect spacecraft exteriors. He predicts spin-offs, including underwater versions to inspect seafloor drilling platforms.

Recalling the 1960s film *2001: A Space Odyssey*, Thomas predicts that the robots will nudge NASA "toward a 2001-ish vision where the spacecraft takes care of itself, and the astronauts worry about the high-level goals."

However, that vision has a dark side: The film's spaceship-controlling computer, named Hal 9000, went berserk. Hal's degree of autonomy remains far off, Thomas says. "Hopefully, we'll be able to figure out how to keep the programs from getting paranoid," he chuckles. —P. Weiss



Tom Trower/NASA Ames Home Page

This posed scene depicts a "personal satellite assistant" robot hovering over an astronaut at work.