Putting a New Spin on Earth's Core

By eavesdropping on earthquake vibrations passing through the globe's innards, seismologists have discovered that Earth's solid core is a solo dancer, spinning separately from the rest of the planet.

Earth's metallic core consists of a solid iron sphere, about three-quarters of the size of the moon, sitting within an outer shell of roiling liquid iron. Hidden beneath 2,600 kilometers of rock, the core has remained the most cryptic realm of our planet. Some theorists have argued that electromagnetic forces inside Earth should cause the core to spin separately from the planet's outer layers. Others have hypothesized that the core should spin in synchrony with the mantle and the crust.

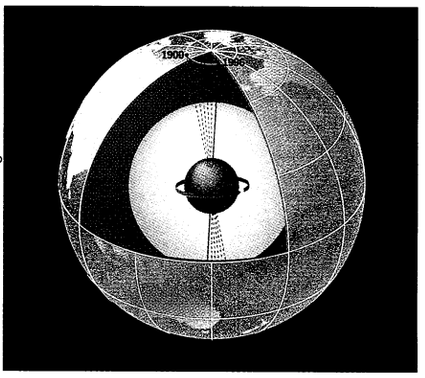
Xiaodong Song and Paul G. Richards of the Lamont-Doherty Earth Observatory in Palisades, N.Y., have found that the inner core rotates in the same direction as the rest of the planet but about 1° per year faster. They report their observation in the July 18 NATURE.

The surface of the core, at its equator, is moving about 20 km per year relative to the liquid outer core. "That's 100,000 times faster than the types of motion we normally associate with properties of the solid Earth," says Richards. In contrast, the continents creep across Earth's surface at only a few centimeters per year.

Song and Richards embarked on their research after a computer simulation at Los Alamos (N.M.) National Laboratory predicted that Earth's core should spin 1° to 2° faster per year than other parts of the planet.

Gary A. Glatzmaier of Los Alamos says he was surprised that Song and Richards could actually observe the core's rotation. "We were really excited to hear that they had found this," says Glatzmaier.

The Lamont-Doherty scientists could not have detected the core's movement without the help of recent discoveries about inner Earth. Ten years ago, seismologists found that earthquake vibrations passing through the solid core travel at different speeds, depending on their direction—a property called anisotropy. Waves go most slowly in the plane of the equator and most quickly when heading poleward.



Song and Richards/NATURE

The solid inner core (red) rotates within the liquid outer core (orange). Lines through the core show how the path of the fastest seismic waves has moved from 1900 to 1996.

To explain the differences in speed, researchers proposed that the iron crystals in the inner core have a distinct orientation, like the grain in wood. Waves moving along this crystalline grain travel faster than those going against it.

In the last 4 years, seismologists have uncovered evidence that the grain is skewed slightly from an exact north-south alignment. The axis of anisotropy—corresponding to the fastest direction for seismic waves—tilts about 10° from Earth's axis of rotation.

Song and Richards realized that this axis of anisotropy, which currently points toward Siberia, should shift over time if the core rotates separately. To test the idea, they pulled out old recordings made in central Alaska of earthquakes that occurred in the South Atlantic. Some of the seismic waves from the southern quakes passed through the inner core on their way north.

Comparing the old records with newer earthquake recordings, the scientists determined that seismic waves now take about 0.3 second less to complete the journey than they did during the 1960s. This finding suggests that the core has rotated in a way that speeds seismic waves heading from the South Atlantic to Alaska.

The Lamont-Doherty scientists and other teams of researchers are now examining different seismic records to validate the discovery and to measure the core's rotation with more precision.

"I think this is one of the most exciting things to happen in the last several years in deep-Earth studies," says Kenneth C. Creager of the University of Washington in Seattle. — *R. Monastersky*

New tests mark big leap in HIV diagnosis

Hundreds of scientists packed the vast auditorium, and dozens more gathered in scrums around television screens in the hall outside to hear Martin Markowitz of the Aaron Diamond AIDS Research Center report that a combination of three drugs appears to have eradicated HIV infection in nine people.

"When we look for the virus, we can't find it," Markowitz told the 11th International Conference on AIDS in Vancouver. What Markowitz said next, however, was just as remarkable.

His research team had used a test that can detect just 25 copies of HIV in a milliliter of blood. That's significantly more sensitive than the prototype viral load tests, which can't spot concentrations below 500 copies per milliliter (SN: 3/23/96, p. 184).

Yet even those prototype tests predict the course of AIDS with far greater accuracy than the white blood cell counts used to monitor disease progression for the last 15 years. "The risk of progression [to AIDS] is directly related to the level of virus," says John W. Mellors of the University of Pittsburgh Medical Center.

"These studies have made it increasingly clear that the CD4 [white blood cell] count is at best a gross measure of where a patient stands in the course of HIV disease," says Scott M. Hammer of Harvard Medical School in Boston.

As the Markowitz experiment demonstrates, the tests also make it possible for physicians to gauge the effects of the new multidrug AIDS treatments with exquisite accuracy (SN: 7/13/96, p. 21) and to adjust dosages or select new drugs as soon as a course of treatment loses effectiveness.

The new tests, when coupled with CD4 counts, are expected to enable physicians to predict whether someone who is infected with HIV will live for a prolonged period or die soon.

One study of 1,604 men found that those with fewer than 500 virus particles and more than 700 CD4 cells per milliliter of blood had a 1.7 percent chance of showing AIDS symptoms within 6 years. Those with thousands of viral particles and low CD4 counts faced an 86 percent chance of developing AIDS during that period, said Mellors.

Markowitz used an experimental test by Chiron Corp. of Emeryville, Calif., which has a version awaiting Food and Drug Administration approval. Another viral load test, made by Roche Diagnostic Systems of Branchburg, N.J., was approved by FDA last month. The new tests are expected to cost upwards of $150 each when they reach the market. Patients may need to be tested as many as four times per year. — *S. Sternberg*