Members in the Media

"This is a Nobel Prize-winning result if it is proved. But it needs to be confirmed, and the experiment really has to demonstrate a total mastery of the data. Neither of those criteria have been achieved, and therefore you have to bring a healthy skepticism to the result as it stands."

***Richard Gaitskell**, Brown University, on the DAMA collaboration announcement that they have observed evidence for dark matter,* Los Angeles Times*, April 19, 2008*

"I have all the lifetime miles I need. I don't need any more."

***Kevin Lesko**, Lawrence Berkeley National Laboratory, on having to travel to Canada or Japan to conduct research that he will soon be able to do at DUSEL,* Associated Press*, April 27, 2008*

"I don't see anything to suggest this is propaganda. They seem to be working on an advanced machine."

***Houston G. Wood**, University of Virginia, on new photos of Iran's nuclear reactor,* The New York Times*, April 29, 2008*

"Maybe there is a compass in the eye of birds, and a map in their beaks."

***Thorsten Ritz**, University of California, Irvine, on how birds use magnetic fields to navigate,* Washington Post*, May 5, 2008*

"There are at least 15 theoretical models out there, and most of them are pure guesses,"

***Warren Pickett**, University of California, Davis, on a new class of superconductors,* Christian Science Monitor*, May 7, 2008*

"You could drop it."

***Zeina Jean Jabbour**, NIST, on reasons for trying to redefine the standard kilogram, which is still based on a physical object,* Los Angeles Times*, April 17, 2008*

"This is a real geek fest."

***Terry Schalk**, University of California, Santa Cruz, on the Maker Faire in San Mateo, CA,* The New York Times*, May 13, 2008*

"If most of your world is water, you'd better know something about water. If nearly all of the universe is something we know nothing about, we'd better learn everything we can about it."

***Daniel McKinsey**, Yale University,* Argus Leader*, May 1, 2008*

"If you cared about money you wouldn't be a scientist at all, would you."

***John Womersley**, Science and Technology Facilities Council, answering a student concerned about pursuing a career in science, given the funding situation for science in the UK,* BBC News online*, April 9, 2008*

"We'll compare the images we get tonight with all the accumulated images of the same part of the sky on other nights and look for what's there now that wasn't there before. This is how we are going to find killer asteroids and a few million other solar system objects. It will be the greatest movie ever made."

***Zeljko Ivezic**, University of Washington, on the Large Synoptic Survey Telescope,* Discover Magazine*, May 13, 2008*

"I'm typically using several hundred processors. For the biggest projects, the calculations take months."

***Jacques G. Amar**, University of Toledo, on his research on far from equilibrium processes that uses the Ohio Supercomputer Center,* The Columbus Dispatch*, April 29, 2008*

"There are not that many alternatives."

***Klaus Lackner**, Columbia University, on his idea for vacuuming carbon dioxide out of the atmosphere,* Los Angeles Times*, April 29, 2008*

"Our universe will not be affected by what you do in the past."

***Ronald Mallett**, University of Connecticut, on time travel,* The Boston Globe*, May 12, 2008*

"I'm trying to do this without money because I think money corrupts the whole thing,"

***David Maker**, running for Congress,* The Huntsville Times*, May 13, 2008*

This Month in Physics History

June 1798: Cavendish weighs the world

In June 1798 Henry Cavendish reported his famous measurement of Earth's density. A great chemist and physicist, Henry Cavendish (1731-1810) was obsessive, extremely shy, and eccentric. He was known for wearing clothes that were 50 years out of style. He avoided company, especially fearing women. He took walks at night to avoid beings seen by neighbors, and even had an extra staircase installed in his house to avoid meeting his servants on the stairs.

Elements of this odd personality undoubtedly made him a great scientist, capable of dedicating himself to making extremely precise measurements where others would lose patience. He liked to build and rebuild scientific instruments, always trying to improve them. He was extremely methodical, systematically ruling out various sources of error, never satisfied that the work was complete.

Henry Cavendish

Like many scientists at the time, Henry Cavendish was an aristocrat, and had inherited enough money to finance his chemistry and physics experiments. He turned much of his house into a laboratory, dedicating only a small portion of the house to living space.

Among his many experiments, he is most famous for what is now called the Cavendish experiment, which he used to determine the density of Earth.

Newton had published his law of gravitation in 1687, but he hadn't made any attempt to determine the constant G or the mass of Earth. By the 1700s, astronomers wanted to know the density of Earth, as it would make it possible to determine density of the other planets. In addition, as the New World was being explored and territory being claimed, surveyors needed to know the density of Earth. In 1763 Mason and Dixon set out to settle a boundary dispute between Maryland and Pennsylvania. Cavendish wondered how precise their measurements could be. He realized that the Allegheny Mountains would exert a slight pull on their surveying equipment, possibly affecting their measurement, but he didn't know how large the effect would be. This led him and others to wonder about the averaged density of Earth itself.

In 1772 the Royal Society set up a "Committee of Attraction" to determine the density of Earth. Some people had proposed measuring this by finding a very uniformly shaped mountain and measuring how much it deflected a plumb bob. Since gravity is so weak, this would be a tiny effect, but the committee, including Cavendish, nonetheless tried it, using a large mountain in Scotland. They came up with a value for the density of Earth of about 4.5 times the density of water. But they had made assumptions that Cavendish thought unfounded.

He considered the problem for years, until in 1797, at age 67, he began his own experiments. He started with a torsion balance apparatus given to him by his friend, the geologist Reverend John Michell, who had been interested in doing the experiment himself but wasn't able to carry it out before he died. Realizing that Michell's equipment was inadequate to measure the tiny gravitational force between two small metal spheres, Cavendish set about tinkering until he had a more precise setup.

He built a large dumbbell, with two-inch lead spheres stuck to the ends of a six-foot long wooden rod. The rod was suspended from a wire held at the center, and was free to rotate. A second dumbbell with two twelve-inch lead spheres weighing 350 pounds each was then brought near the first so that the large spheres would attract the smaller ones, exerting a slight torque on the suspended rod. Cavendish would then painstakingly watch for hours to observe the rod's oscillations.

This would provide a measure of the gravitational force of the larger spheres on the smaller ones. And since the density of the spheres was known and the gravitational attraction between Earth and the spheres could be measured by weighing the spheres, the ratio the two forces could be used to determine Earth's density.

Since the gravitational force between the spheres is so weak, the tiniest air current could ruin the delicate experiment. Cavendish placed the apparatus in a closed room to keep out extraneous air currents. He used a telescope to observe the experiments through a window, and set up a pulley system that made it possible to move the weights from outside. The room was kept dark to avoid temperature differences in different parts of the room affecting the experiment.

Cavendish relentlessly tracked down potential sources of error. He rotated the spheres in case they had picked up some magnetization. He observed the attraction of the rods without the spheres on the ends. He tried different types of wire to support the apparatus.

After agonizing over every possible complicating factor, Cavendish finally reported his results in June 1798 in a 57-page paper in the Transactions of the Royal Society entitled *"Experiments to Determine the Density of the Earth."* He reported that the density of Earth was 5.48 times the density of water. (The currently accepted value is 5.52).

Others later repeated the experiment, using similar apparatus, and for almost a century no one achieved any improvement over Cavendish's original measurement.

Today Cavendish's experiment is viewed as a way to measure the universal gravitational constant G, rather than as a measurement of the density of Earth. Using updated measuring apparatus but the same basic setup, physics students and scientists today often perform Cavendish's experiment, which is still recognized as one of the most elegant physics experiments of all time.

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