JOHN BEDDINGTON INTERVIEW

U.K. Science Adviser Makes His U.S. Debut

WASHINGTON, D.C.—Last week, during his first visit to the United States as the U.K. government's chief scientific adviser, John Beddington sat down with *Science*'s news editors to discuss topics as varied as food, fuel, and physics. Nine months into his job, Beddington has adopted a lower profile than his headline-grabbing predecessor, David King. A population biologist at Imperial College London, Beddington has specialized in applying biological and economic tools to questions of natural resource management, particularly fisheries (*Science*, 22 June 2007, p. 1713). He's no stranger to politics, having advised the British government, the European Commission, the United Nations Environment Programme, and its Food and Agriculture Organization. Now Beddington must answer questions from the prime minister and Cabinet, as well as coordinating the science advice in all government departments and chairing a number of committees. The following excerpts from his interview were edited for brevity and clarity.

–DANIEL CLERY

Online
sciencemag.org
Read an extended interview on *Science*NOW.

Q: If you could put one file in the new U.S. president's in-tray, what would it be?

J.B.: The message I would probably want to give is the intimate connection between the issues of climate change, food security, energy security, and water security. These issues need mixed approaches; they need a mix of both science and engineering. These issues are tremendously important because they are going to come quite quickly. The sort of demand increases that are to be expected from urbanization, movement out of poverty, and population growth are quite dramatic, on a time scale of only a couple of decades.

Q: One of David King's goals was to increase the use of science advice across all government departments. Is that job done?

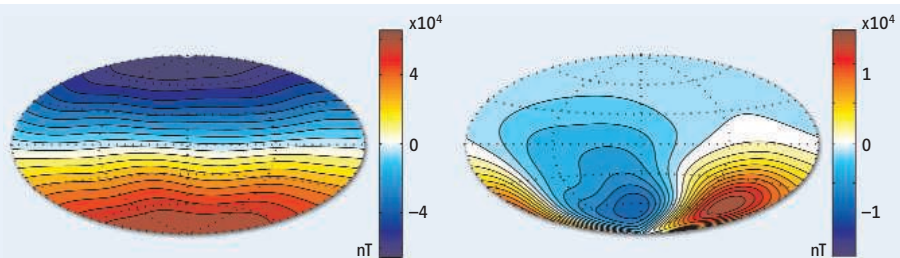
J.B.: I've done a number of things that are slightly different from David. Every 6 weeks, all of the Chief Scientific Advisors of the major departments dealing with science meet with me and with each other. We form subgroups: One is dealing with climate change and food security issues and another is going to be dealing with infectious diseases. That's a good bit of networking. In addition, this group is now meeting with the chief executives of the research councils every 3 months. You now have a network of essentially everybody who's funding government science meeting on at least a 3-monthly interval. A real community is now starting.

Q: David King took a very public stance, putting advice into the public domain even when he disagreed with the government. What approach do you favor?

J.B.: The key thing is that if there's an issue, it needs to be raised. The one that I raised very early on in my tenure was the issue of food security, which I felt had been quite seriously neglected, and the related issue of biofuels. In my first speech [as chief scientific adviser], I raised these issues. Very substantial increases in food prices shortly followed and [there was] a very quick reaction by the prime minister, who raised the issue of food security at the G8 Summit the following summer. Some issues are better raised involving the media and the public at large; others are better talking behind the scenes.

Q: On biofuels, your concern was the competition for arable lands?

J.B.: When I first raised [the issue], I made the point that some biofuels were being produced by cutting down rainforests or using permanent grassland, which has a negative effect on greenhouse gas emissions. So you



Skewed. Uneven heating of a core producing a normal magnetic field (*left*) concentrates the field (*right*).

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GEOPHYSICS

Solid Rock Imposes Its Will on a Core's Magnetic Dynamo

Mariners have been navigating by Earth's magnetic field for centuries. Seismologists detected the fluid-iron core that generates the magnetic field a century ago. But geodynamicists still struggle to understand exactly how the churning of the core's fluid iron generates the field inside Earth. One secret, according to two papers in this issue of *Science*, may lie in the far slower roiling of the solid rock overlying a planet's core. The authors draw on magnetic fields long frozen into the rocks of Earth and Mars to understand how motions in the solid rock can shape a planet's magnetic field.

Here on Earth, the frozen fields link the deep-seated magnetic field to plate tectonics at Earth's surface. On page 1800, paleomagnetist Kenneth Hoffman of California Polytechnic State University in San Luis Obispo and geochronologist Brad Singer of the University of Wisconsin, Madison, draw on magnetic fields locked into lavas as they solidified in Germany and on Tahiti since 780,000 years ago. Five times during a 200,000-year interval, Earth's magnetic field weakened for thousands of years as if it were about to switch its north and south poles, only to return to full strength without reversing. During each such excursion, magnetic field lines that had been pointing in the usual direction—roughly toward the geographic poles—swung around as if one pole were someplace in Eurasia and the other around western Australia.

That pole pattern during ancient excursions has a familiar look, Hoffman and Singer note. Mathematically remove today's powerful, axially aligned dipole field—the sort produced by a bar magnet—from Earth's normal field, and the remaining complex but weak field would skew the pole positions in

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don't want to be doing that. I think that the [U.K. government's] Gallagher Report indicates that there's some need for caution on the development of biofuels within the U.K. and Europe. It's a complicated issue. The information that is available to make a comprehensive assessment of the implications of biofuels is quite inadequate.

Q: You have said that the world needs to dramatically increase food production, using less water than is used today. Will the world need to embrace GM technology?

J.B.: Population growth and the increase in wealth implies something like a 50% increase in food demand by 2030. At the same time, the proportion of the population that lives in an urban environment will go up from about 47% to 60%. That means there's going to be some real problems for agriculture. Essentially, about 70% of available freshwater is used by agriculture. There's going to be competition [for water] between urban communities and agriculture relatively close to urban communities. I'm worried about that.

GM is not going to be the only answer. The knowledge of the plant genome is going to be absolutely critical to improving agricultural production. GM is only one of the techniques that can be used; marker-assisted breeding could be used equally well.

British advisory. John Beddington warns that increasing energy, food, and water demands are vital security issues.

Q: The U.K. government is falling behind its own targets for reducing greenhouse gas emissions. How should it catch up?

J.B.: There's some interesting work that's being done by the government's new Climate Change Committee, which is going to be reporting in December, that is going to answer those questions very specifically. The Energy Technology Institute, funded jointly by industry and government, is looking at operational scale inputs to a whole series of green engineering technologies to address these problems. The big [initiative], which everybody really needs to be addressing, is CCS [carbon capture and storage]. And that really needs very serious investment.

Q: At U.K. universities, many physics and chemistry departments have closed because of declining student numbers [*Science*, 12 September, p. 1428]. Should the government intervene to support strategic science subjects?

J.B.: I think it's absolutely critical that we make certain the STEM agenda works—science, technology, engineering, and mathematics are the subjects that we desperately need students to take A-levels [high school finals] in and go on to do degrees. There has been a downward trend [in undergraduate STEM enrollment], but I think it is actually starting to reverse. One area that has been very successful in reversing this [overall] downward trend has been the Ambassador Scheme, in which we've got something of the order of 20,000 scientists and engineers going into schools, talking to students about their lives and the problems they're actually facing. Now our commitment is to expand that.

just that way. Hoffman and Singer infer that this field, called the nonaxial dipole (NAD) field, was there three-quarters of a million years ago. Ever since then, the pair argues, something must have kept the molten iron of the core swirling in the same pattern to generate the NAD field.

The ultimate stable driving force appears to be plate tectonics. Lots of cold oceanic plates have sunk through the mantle to the top of the core beneath Western Australia. That relatively cold material would cool the underlying core fluids, which would sink, superimposing a weaker but persistent circulation on the one generating the main dipole field. Hoffman and Singer suggest that the field-generating circulations are layered, with the main dipole field generated deep within the outer core and the NAD generated near its top.

Dynamo specialists say this paleomagnetic argument indicates that mantle rock influences the magnetic field, as modern observations had hinted. "It's very likely the mantle does have a role in the core flow," says geophysicist Peter Olson of Johns Hopkins University in Baltimore, Maryland, "but it's not that easy to say one [field] is shallow and the other is coming from deep."

On Mars, the patches of magnetic field detected from orbit froze into the crust more than 4 billion years ago, not long before the dynamo in the martian core died. Oddly, the patches of field lingering in the northern hemisphere are far weaker than those in the southern hemisphere. The planet's crust also differs between hemispheres. It's thin and low-standing in the north but high and thick in the south. Could the two asymmetries be related? On page 1822, dynamo specialist Sabine Stanley of the University of Toronto, Canada, and colleagues consider the possibility.

In a dynamo computer model, Stanley and her colleagues made the bottom of the mantle colder in the southern hemisphere than in the north. That would be the temperature pattern imposed on the core by a mantle circulating so as to create the crustal asymmetry: hotter mantle rock slowly rising throughout the northern hemisphere in one great plume—thinning the crust by eroding it—and cooler mantle sinking throughout the southern hemisphere. Researchers have suggested several ways such a mantle circulation might have been created, including a supergiant impact (*Science*, 11 April, p. 165). Once the resulting temperature pattern was imposed on the model mantle, it induced a circulation in the molten core that generated a magnetic field, but almost entirely in the south and only weakly in the north.

Creating a lopsided magnetic field is "a significant accomplishment," says planetary physicist David Stevenson of the California Institute of Technology in Pasadena. But proving that early Mars worked that way will require a better record of early magnetic field behavior, he cautions. Understanding eons-old interactions between the mantle and the magnetic field will take a lot more work.

–RICHARD A. KERR

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