LOW-DOSE RADIATION

U.N. Faces Tough Sell On Chornobyl Research

MOSCOW—The United Nations is mounting a last-ditch effort to reinvigorate flagging interest in the long-term health consequences of the Chornobyl disaster. At a meeting of U.N. agencies in New York City earlier this week, the U.N.'s Office for the Coordination of Humanitarian Affairs (OCHA) established a new organization, the International Chernobyl Research Network, to mount a coordinated research program on the lingering impacts of the world's most serious nuclear reactor accident. A concerted scientific effort is necessary, it argues, "if the evidence is not to be lost forever." Prospects for the new initiative are unclear, however. OCHA itself has no money to launch new research projects, and expert opinion is split on the network's scientific potential.

The Chornobyl network is the brainchild of Keith Baverstock, the European radiation health adviser to the World Health Organization (WHO). A lack of coordination among international agencies, he says, has hampered research on the health impacts of the April 1986 explosion at the Chornobyl Nuclear Power Plant, which spewed roughly 200 Hiroshima bombs' worth of radiation across a region of Eastern Europe inhabited by 2 million people. As a result, he contends, much Chornobyl research has been unsound.

Baverstock is hoping that governments and international organizations will commit new funds for the initiative. The network could be modeled after WHO's effort to coordinate research on the health effects of electromagnetic fields, a program supported by $150 million in research commitments from governmental and nongovernmental research programs worldwide, says Mike Repacholi, coordinator of WHO's Radiation and Environmental Health Unit.

Partly to help guide the new network, WHO plans a systematic review of the literature on low-level radiation. WHO has a head start on this assessment thanks to the U.N. Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), which 2 years ago issued a comprehensive survey of Chornobyl health research. UNSCEAR charged that many studies suffer from "methodological weaknesses," including spotty diagnoses and disease classification, poor selection of control groups, and inadequate radiation-dose estimates. Apart from an increase in mostly treatable thyroid cancer in children, UNSCEAR concluded, "there is no evidence of a major public health impact."

Scientific paradise lost? The U.N. hopes to rally interest in one last push for a major research effort on Chornobyl.

The biggest challenge, UNSCEAR warned, is to estimate radiation doses reliably. Recent studies suggest that doses might have been lower than originally thought. "A lot of people thought the Soviets were underestimating the dose," says UNSCEAR scientific secretary Norman Gentner. "It's turning out the opposite was the case."

The lowered dose estimates suggest that any lingering health effects apart from thyroid cancer, if they exist, will be hard to detect. But that doesn't mean researchers shouldn't try, says Dillwyn Williams, a thyroid cancer expert at the University of Cambridge, U.K. "I do believe that there are large uncovered areas of research," he says. Priority areas, he adds, should be new case-control studies on breast and lung cancer and genetic effects, under the umbrella of a comprehensive long-term population study.

Few Chornobyl researchers anticipate undiscovered health effects. "It appears unlikely that excess for solid cancers can be seen and can be related to radiation exposure," says Albrecht Kellerer, director of the University of Munich's Radiobiology Institute, who has been involved in a decade-long German-French project on Chornobyl. But he's keeping an open mind on blood cancers. "Even if there is little expectation to find a radiation effect," Kellerer says, it would be worthwhile to monitor childhood leukemia—and to continue surveillance on thyroid cancer—among the roughly 200,000 people living in Chornobyl-contaminated areas.

Kellerer believes, however, that the hunt for knowledge about the health risks from long-term exposure to low-dose radiation could be pursued more fruitfully elsewhere. His group has won support from the European Commission to move its focus from Chornobyl to the region around the Mayak nuclear facility in the southern Urals of Russia, where extensive radioactive contamination in the surrounding watershed came to light after the Cold War. Mayak, he says, has opened "a vast new chapter of radiation epidemiology."

Such views don't augur well for the U.N.'s fundraising effort, which began this week with discussions aimed at generating research commitments within U.N. agencies and will continue at a follow-up meeting next month. As well as generating funding commitments from outside the U.N., the aim of the entire effort is to arrive at a consensus on "what research exists and what's needed," says David Chikvaidze, Chornobyl coordinator for OCHA in New York City. Judging by researchers' increasing ambivalence about their chances to make breakthroughs with Chornobyl data, the U.N. might need to set modest expectations. —**PAUL WEBSTER**

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PUBLIC HEALTH

Creeping Consensus on SV40 and Polio Vaccine

At first it seemed impossible: The widely celebrated polio vaccine that was given to millions of people in the 1950s was contaminated with a monkey virus—a virus that causes cancer in animals.

Since the virus was discovered in the monkey kidney extracts used to make the Salk vaccine some 40 years ago, concern has risen that the vaccine, which wiped out polio in the United States, might have triggered an epidemic of cancer (*Science*, 10 May, p. 1012). Now, at the request of the U.S. Congress, an expert panel of the Institute of Medicine (IOM) has issued the most definitive judgment to date, allaying most—but not all—of those fears. The virus, known as SV40, has not caused a wave of cancer, the panel concluded. But it might be causing some rare cancers, and more research is needed to find out.

Since the contamination was detected,

Double shot. In the 1950s, some batches of Salk polio vaccine contained the monkey virus SV40.

CREDITS: (TOP TO BOTTOM) R. STONE; HULTON-DEUTSCH COLLECTION/CORBIS government researchers and others have published epidemiological studies that they said proved that the vaccine was safe. But questions remained, because the virus kept turning cultured cells cancerous, and it kept causing tumors in animals. That debate heated up in the past decade, after researchers began finding SV40 DNA in four types of rare human cancers—the same kinds it causes in animals—and press reports emphasized that tens of millions of people could have been exposed.

The IOM committee examined the 4 decades of epidemiology to see whether people exposed to SV40-contaminated vaccine have a higher risk of cancer. Although the studies were flawed, the panel concluded, they were good enough to show that no cancer epidemic has occurred. But millions of people might have been infected with SV40 from the contaminated vaccine, the panel wrote. And the evidence is strong enough to suggest, but not prove, that the virus can sometimes cause human cancer. "We acknowledge that SV40 at least could have a carcinogenic effect, but epidemiological evidence does not suggest that it actually did," says IOM committee member Steven Goodman, a biostatistician at Johns Hopkins School of Medicine in Baltimore. Even so, he adds, "there's a body of evidence [on SV40 carcinogenicity] that has to be taken quite seriously."

The committee stressed the need for more reliable and sensitive tests to detect SV40 in human tissue, especially tests for anti-SV40 antibodies in human blood. Once those tests are devised, researchers could test human tissue samples from before 1955 for the monkey virus to ascertain whether it really came from contaminated polio vaccine. In addition, the panel said, there's enough evidence that the virus is spreading in humans that the issue should be studied further.

But overall, the IOM report "really closes the book on the discussion" of past epidemiological work, says pediatric oncologist Robert Garcea of the University of Colorado Health Sciences Center in Denver. Although SV40 might yet turn out to cause cancer in humans, the risk, if any, is "not remotely in the ballpark" of well-known carcinogens such as tobacco smoke or asbestos, adds Goodman.

The report seems to have satisfied protagonists across the spectrum, although they're drawing different conclusions. One reason, Goodman explains, is that IOM took extraordinary precautions to prevent conflicts of interest, excluding anyone who had ever sat on a government vaccine panel or received money from government or industry for vaccine research.

Virologist Janet Butel of Baylor College of Medicine in Houston, Texas, is "gratified that they recognized the biological evidence" implicating SV40 in cancer. Keerti Shah of Johns Hopkins School of Medicine, a longtime skeptic, calls the report "a positive step," although he'll need better assays before concluding that SV40 is indeed present in humans. If the National Institutes of Health follows the panel's suggestions, more money should soon be available to probe the link.

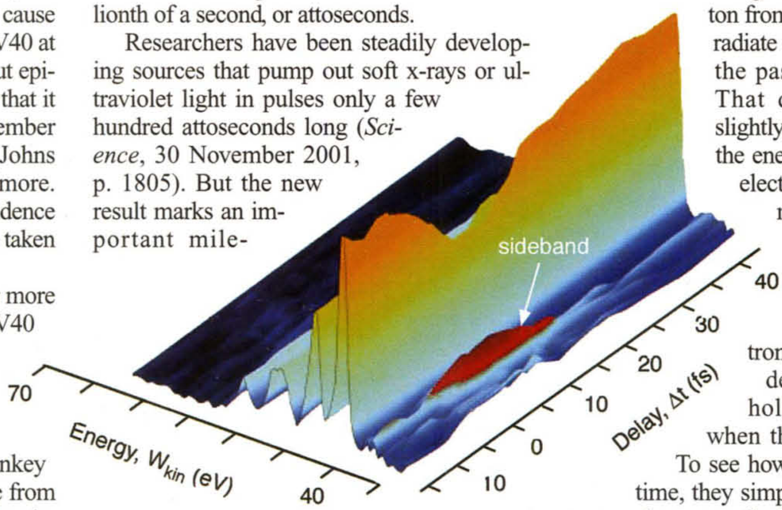
–DAN FERBER

ATTOPHYSICS

X-ray Flashes Provide Peek Into Atom Core

Using ultrashort pulses of x-rays, physicists have taken a "movie" of electrons frenetically rearranging themselves deep inside an atom. The technique opens the way for a new class of experiments in which researchers should be able to trace and control changes within atoms that take place in billionths of a billionth of a second, or attoseconds.

Researchers have been steadily developing sources that pump out soft x-rays or ultraviolet light in pulses only a few hundred attoseconds long (*Science*, 30 November 2001, p. 1805). But the new result marks an important milestone in the emerging field of attophysics, says Philip Bucksbaum, a physicist at the University of Michigan, Ann Arbor: "This is the first demonstration of a real experiment. It's not just measuring the pulse itself."



Sign of the times. In the electron spectrum, an extra peak (red) next to the main one lets physicists time changes in the atom.

CREDIT: ADAPTED FROM M. DRESCHER *ET AL., NATURE* **419**, 803 (2002)

Electrons stacked deep in an atom behave a bit like gumballs piled into a vending machine: Pop one out from the bottom of the heap, and the others move to fill the void left behind. But whereas anyone with a keen eye can see the gumballs shift, the electrons rearrange themselves far too quickly to be directly observed with even the fastest particle or radiation detectors. The shuffling reveals itself, however, when the atoms are prodded with equally speedy bursts of electromagnetic radiation, Markus Drescher of the University of Bielefeld in Germany, Ferenc Krausz of the Vienna University of Technology in Austria, and colleagues report in this week's issue of *Nature*.

The researchers hit krypton atoms with a one-two punch: a blast of soft x-rays only 900 attoseconds long, followed by a flash of laser light roughly seven times longer. The x-rays stripped electrons from the krypton atoms in a process called photoionization, and some of the atoms lost an electron from a particular inner shell, creating a core hole. An electron from an outer shell then fell into the vacancy. In the process, it gave up some of its energy to yet another electron, which then flew out of the atom with a specific energy. The core holes decayed through this complicated Auger process within a few femtoseconds, and the researchers hoped to track precisely how their numbers dropped.

Through a trick of quantum mechanics, the researchers reduced the problem of clocking the decay of holes to one of counting electrons. As the Auger electron emerged, it could absorb a photon from the laser pulse or even radiate a matching photon into the passing stream of light. That quantum interaction slightly increased or decreased the energy of a fraction of the electrons—a fraction determined by the shape of the laser pulse.

By counting those energy-shifted sideband electrons, the physicists could deduce how many core holes remained unfilled when the laser pulse arrived. To see how that number fell with time, they simply varied the delay between the x-ray flash and the laser pulse. "We basically record a series of snapshots," Krausz says. "We reconstruct the motion from them" in the same way a movie recreates a moving image from still ones.

The researchers found that the krypton core holes decayed with a lifetime of about 8000 attoseconds, or 8 femtoseconds. That relatively long lifetime matches what other researchers had inferred by indirect methods. However, the new measurement marks the first time anyone has used attosecond x-ray sources and lasers to time the flickering changes within an atom directly.

"I imagine that everybody is going to adopt this technique," says John Hepburn, a chemist at the University of British Columbia in Vancouver, Canada. In the meantime, Drescher and Krausz say that their first priority is to apply the method to a shorter lived core hole, to confirm that they really can trace attosecond changes.

–ADRIAN CHO

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