RADIATION RISKS

Study Casts Doubt on Hiroshima Data

More than 5 years ago, the experts who calculate radiation risks began to be troubled by a nagging and unwelcome discrepancy in the data from the atom bomb blast at Hiroshima. Their uneasiness has grown steadily worse, and it now appears to be threatening the credibility of the world's most important database in this field, the 40-year-old studies of bomb-induced cancer in Japan. A report published this month by Tore Straume, a biophysicist at the Lawrence Livermore National Laboratory, is bringing new attention to this issue and may goad the U.S. government to invest in research aimed at resolving the uncertainties.*

Straume has shown beyond any doubt, say his colleagues, that there is a discrepancy between the measured level of neutrons emitted by the bomb in Hiroshima on 6 August 1945 and the neutron level that weapons experts calculate should have been generated. Straume and his Japanese partners have collected samples of concrete from various points around the city and subjected them to a new analytical technique—accelerator mass spectrometry—which provides a count of chlorine-35 and chlorine-36 atoms present. The ratio yields a reliable index of the number of low-energy or "thermal" neutrons on the scene in 1945.

Straume's chlorine data show that there were between two and 10 times more thermal neutrons in Hiroshima than bomb experts had calculated. If correct, this finding has serious implications. While thermal neutrons are not considered life-threatening themselves, they can only have been produced by fast neutrons—which are very dangerous. And if the fast neutron numbers were high, the actual radiation doses received by people in the city of Hiroshima must have been higher than the experts assumed. This would mean that radiation emitted by the bomb was less effective in producing cancer than has been assumed.

Even if this is correct, the experts aren't quite ready to begin revising cancer risk estimates yet, says Charles Edington, executive officer of the Board on Radiation Effects Research at the National Research Council (NRC). The NRC only a few years ago finished a major overhaul of its risk tables, and before it attacks the problem again, some important points need to be cleared up.

The first question that needs answering, according to Straume, is whether the same excess of thermal neutrons is present in both Hiroshima and Nagasaki. Straume is now testing concrete samples from Nagasaki, and preliminary results suggest that the discrepancy is not as great there. This could be because the Hiroshima bomb, known as "Little Boy," was a unique device, and one from which physicists never obtained experimental data. Their theoretical calculations of its output may have been wrong.

This speculation is not popular with those who calculated the bomb's output, like Paul Whalen of Los Alamos. He says the error probably lies in the assumptions used to calculate what happened as the neutrons interacted with the environment. The debate between the two camps—experts on bomb output and those who study neutron "transport" through the air—rages on.

Funding for research on these questions declined in the late 1980s, but now it appears to be headed up again to a "modest" plateau, says Robert Young, an official at the Defense Nuclear Agency. Recently he approved a couple of small ($200,000) grants to investigate the discrepancies at Hiroshima. At the moment, Young says, he is focusing on the speculative theory that the bomb's radioactive output needs recalculating. One study looking into the implications of changing the bomb output assumptions, to be conducted by researchers at the Oak Ridge National Laboratory, should be completed by next May, Young says.

–Eliot Marshall

*"Neutron Discrepancies in the DS86 Hiroshima Dosimetry System," by T. Straume, S.D. Egbert, W.A. Woolson, R.C. Finkel, P.W. Kubik, H.E. Gove, P. Sharma, and M. Hoshi, *Health Physics*, October 1992, pp. 421-426.

TECHNOLOGY POLICY

NASA Urged to Pump Up Its First 'A'

With mounting anxiety, U.S. commercial aircraft builders have been looking over their shoulder as foreign competitors erode their traditional lead in the global aviation market. But the National Research Council's Aeronautics and Space Engineering Board thinks this traditional area of strength for the United States can be safeguarded—with the help of another traditional symbol of American can-do, the National Aeronautics and Space Administration. In a report* released last week, the NRC urges that NASA spend more of its overall budget and research talent to advance the sort of commercial aviation technologies long considered to be primarily the responsibility of private industry.

For the agency that brought you the glamour of moon landings and reusable spacecraft, a shift toward workhorse technologies like subsonic commercial airliners and helicopters might sound like a comedown. But the report notes that preserving "the role of the United States as a leader in aeronautics technology" is part of NASA's original charter. And NASA, which is already paying more attention to economic competitiveness under its new director, Daniel Goldin, may be happy to heed the message. The NRC is "preaching to the choir," remarks a NASA spokesman.

The sermon derives its note of urgency from the U.S. industry's nose-dive in the global aviation marketplace. Between 1980 and 1989, the U.S. share of the global transport aircraft market plunged by more than a quarter, from 87% to 64%, the report says. In 1989, that decline took a stinging turn when the European aircraft manufacturing consortium, Airbus Industrie, overtook McDonnell Douglas as the world's second largest aircraft company, behind Boeing. Moreover, because the market is booming—it is expected to double every decade—the erosion of market share means a disproportionate loss of future economic opportunity for the United States, says JoAnn C. Clayton, director of the NRC's Aeronautics and Space Engineering Board and coordinator of the report.

Other countries gained an edge, notes Eu-

*"Aeronautical Technologies for the Twenty-First Century."

Air superiority? The latest from Airbus Industrie, the European consortium.

gene E. Covert—the MIT aeronautics professor who chaired the committee of scientists, engineers, and managers that prepared the report—when they set up government-industry consortia and invested heavily in R&D. The report, like many others that have recently urged the federal government to get involved in commercial research, recommends some of the same medicine for the United States. And that's where NASA comes in. By supplying research talent and shouldering some of the financial load of developing new aeronautics technologies, NASA can help the U.S. commercial aircraft makers preserve their market lead, contends the report.

Items on the report's to-do list include: improving aerodynamic performance of aircraft; revitalizing wind tunnels and other experimental facilities; developing lighter, more fuel-efficient engines and lighter, stronger, and more capable materials for both engines and airframes; and designing more reliable and easier to use avionic and control systems for air traffic controllers and pilots. Although most of those efforts would be aimed at workhorse jet transports and smaller commuter aircraft, not everything in the report will disappoint the agency's fans of exotic technologies. The report also recommends that NASA continue long-range research aimed at developing a fleet of supersonic commercial aircraft, if designers can solve the major problems now dogging these aircraft—profligate fuel use, ozone-depleting emissions, and noise pollution.

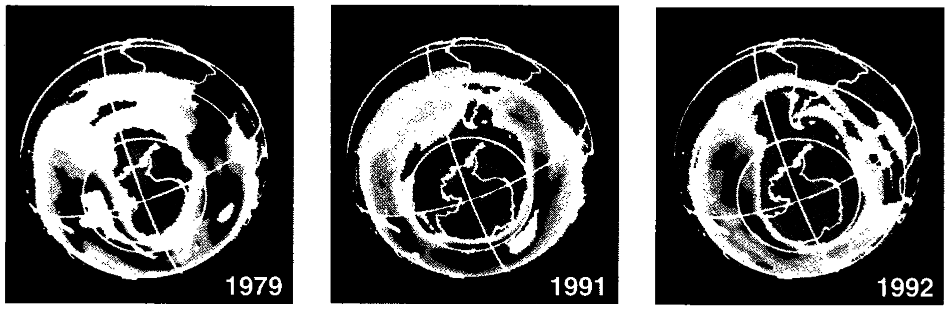
Renewing NASA's role as an R&D partner for civilian industry will cost money, and the report doesn't say where NASA would get the extra funds. But if the overall NASA budget remains tight, the report suggests that the agency reallocate money from "military or space-based resources" into civilian aircraft technology. That would represent a significant evolution in NASA's self-image. Still, Brad Bigeon, director of aeronautics policy for the American Institute of Aeronautics and Astronautics (AIAA) in Washington, D.C., thinks the report "will have a large influence" on the NASA research agenda.

John Swihart, a former AIAA president who now heads the National Center for Advanced Technology, explains why: Daniel Goldin, NASA's new administrator, "is a strong industrialist." Indeed, even before the report was issued, Goldin declared in a speech last month that NASA's aeronautics program "must be refocused to have more immediate payoff to the nation—the American taxpayer." To show he meant it, Goldin has been visiting CEOs of large U.S. airframe and engine manufacturers. NASA is also putting some money where its mouth is: Its fiscal year 1993 budget already includes a 20% increase over the current budget (from $555 million to $668 million) for aeronautics research and development.

–Ivan Amato

ATMOSPHERIC CHEMISTRY

Pinatubo Fails to Deepen the Ozone Hole



A bigger beast. The Antarctic ozone hole *(pink and dark blue)* had grown to record size by 23 September of this year—15% larger than ever before, but ozone concentration was above last year's record low.

When the Philippine volcano Pinatubo exploded last year, pumping the upper atmosphere full of fine debris, researchers foresaw yet another assault on the stratosphere's beleaguered ozone layer. Some calculations of the effects of volcanic debris implied that as much as 25% to 30% of the ozone shield over temperate latitudes might be eaten away by the volcanic haze—five times the observed loss over the past decade. Early measurements didn't bear out that concern, but researchers weren't prepared to call off the alarm until the verdict came in from the most vulnerable part of the planet's ozone layer, the frigid stratosphere over Antarctica.

Last week, the annual Antarctic ozone hole "hit bottom." Its rating of Pinatubo's ozone-depleting power: modest at best. Says Arlin Krueger of NASA's Goddard Space Flight Center in Greenbelt, Maryland, where stratospheric ozone is monitored by satellite: "We had a pool going here on how deep the hole would go. Most people were betting on the low side because of the volcano, as I did. But the hole has not satisfied most of us." Although the hole was more extensive than ever before, probably because of unusual weather patterns, total ozone bottomed out well above the record set last year—even a tad above the low levels seen in 1987, 1989, and 1990.

Researchers had worried about Pinatubo because it filled the stratosphere with submicron-sized sulfuric acid droplets. These tiny haze particles, scientists feared, would provide surfaces where, at low enough temperatures, chlorine from manmade chemicals could be freed from its harmless forms to produce chlorine monoxide, its ozone-destroying form. Ice crystals in polar stratospheric clouds already perform that pernicious role at higher altitudes (above 14 or 15 kilometers) over Antarctica in the wintertime. If the Pinatubo debris was going to have an effect anywhere in the world, it was expected to do it at lower altitudes over the Antarctic, says David Hofmann of the National Oceanic and Atmospheric Administration (NOAA) in Boulder.

Indeed, Hofmann and his NOAA colleague Samuel Oltmans believe the debris was behind the loss of 10% of the ozone present before the hole formed. Pinatubo's mark, says Hofmann, was evident in the pattern of ozone depletion. Between altitudes of 13 to 16 kilometers, "we're seeing substantially lower ozone than we ever have; it's at least 50% below normal," says Hofmann, who follows ozone observations made by balloon-borne instruments. "The surprising thing was that ozone was totally destroyed between 14 and 18 kilometers. We've seen total destruction before, but it's always been limited" to a layer 1 or 2 kilometers thick, mostly above 16 kilometers.

Whether Pinatubo can be credited with other distinctive aspects of the 1992 hole is less certain. This year's hole deepened in September with unprecedented speed, even faster than 1991's record pace. And it expanded to a record-breaking size. "It's been 20 million square kilometers year after year," says atmospheric physicist Mark Schoeberl of Goddard. "Now its 23 million square kilometers. Why? I don't know." Schoeberl does have evidence that the pool of air cold enough to trigger polar stratospheric cloud formation expanded this year. But that could be either a natural meteorological variation or, conceivably, a stratospheric cooling somehow caused by the Pinatubo debris.

The hole will break up in the next month or two, spewing its slightly larger than normal load of ozone-poor air around the Southern Hemisphere and ending this test of Pinatubo's impact. After that, researchers will return to poring over past observations from around the globe in search of volcanic effects. That effort is now suggesting that volcano-related losses outside the hole will turn out to have been at most 5% or 10% at the peak of the debris' abundance, which is well past. And with half of Pinatubo's cloud sifting earthward every year, one ozone threat, at least, will soon have abated.

–Richard A. Kerr