fered a word of caution: Increasing economic competition, he said, may pose challenges to international scientific collaboration. He argues that Britain must strengthen its ability to convert research into applications that can fuel the economy. Although Britain accounts for about 7% of all academic citations, it holds only 3% of the world's patents, he says. Japan, by contrast, has only 4% of citations but about 14% of all patents.

–Andrew Lawler

Scientists Describe Deep-Sea Rebirth

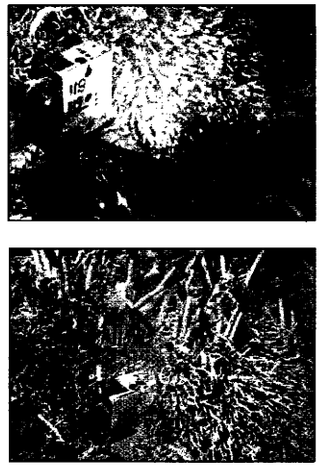
It has been 20 years since scientists discovered the strange communities of giant tubeworms, thick bacterial mats, crabs, and other species that flourish at the edges of boiling-hot deep-sea vents. Yet, these exotic communities continue to generate questions—how do organisms cope with such harsh living conditions, deriving energy not from photosynthesis but from hydrogen sulfide, and how do life-forms find and colonize these widely scattered vents? At the Seattle meeting, marine ecologist Richard Lutz of Rutgers University in New Brunswick, New Jersey, described the latest in a remarkable series of observations that are providing valuable clues to one of these puzzles: how a new vent is populated. The study, which recorded how a vent community that had been wiped out by an undersea lava flow rebounded over the course of 5 years, also may set the stage for experiments to help answer some of the other puzzles.

Lutz and his colleagues chanced upon the rare opportunity to witness this rebirth in April 1991 while surveying the East Pacific Rise—a submarine ridge where two tectonic plates pull apart—about 500 miles southwest of Acapulco. They discovered the devastated vents from the deep-diving submersible *Alvin*, at a depth of about 2500 meters. Fresh ash and lava were everywhere; the rocks were littered with dead tubeworms. They filmed the site, and a few months later, to help them relocate the vents on subsequent visits, laid down a trail of markers along the ridge crest.

Over the next 4 years, the researchers returned seven times. The changes were "absolutely spectacular," reports Lutz. Where at first, the only life was clouds of bacteria gushing out of fresh fissures, just 11 months later, the vents teemed with small tubeworms, crabs, fish, and other species. One year after that, giant tubeworms dominated the rocks, and Lutz's group reported that, at nearly 1 meter per year, the creatures are the fastest growing of known marine invertebrates. The team also chronicled what happens at those vents where, as Lutz puts it, "the hot water is turned off." When temperature and hydrogen sulfide levels fall, the tubeworms die, says Lutz. But even these failing vents sustain some life, including crabs and jellyfishlike siphonophores.

The researchers also made a startling geological discovery. Over just a few months, they observed metal-rich sulfide deposits created by the vents grow into towering chimneys, one over 10 meters tall. Lutz says geologists had once thought such formations rose up over thousands of years.

At the meeting, Lutz focused on new, unpublished findings from the last 2 years of the study. During that time, the overall number of colonizing species jumped from 12 to 29. Among the new arrivals were mussels and groves of small worms called serpulids. Lutz and his colleagues also have observed unusually dense clouds of amphipods, tiny crustaceans related to sand fleas. One surprise is that giant, footlong clams, which are common at east Pacific vents, haven't yet taken up residence. "We assumed these were a major, early colonizer, and even dated some vents based on that assumption," says Lutz.



On the rebound. Giant tubeworms recolonizing a vent.

Lutz's group plans to spend 3 more years studying the site. The real value of the research, Lutz says, is as a baseline for future ecology experiments. One possible study might investigate how excluding a predator species affects the community. The 1.4-kilometer-long ridge section would be ideal for such experiments because it contains 17 separate but similar vents that could be manipulated individually.

By helping "to figure out how a system that we never even knew existed works," those studies may complement other goals of vent research, such as finding out whether life began in a submarine volcano, says Phil Taylor of the U.S. National Science Foundation, which supports Lutz's work. Oceanographer John Delaney of the University of Washington, Seattle, who co-organized the session, adds that vent ecosystems may also yield clues as to how life could arise on other planets.

–Jocelyn Kaiser

HEALTH RESEARCH

U.S., Russia to Study Radiation Effects

One of the hottest of Earth's radioactive hot spots is a Russian town east of the Urals known formerly by its Soviet label, Chelyabinsk-65. It is the site of a once-secret nuclear production facility called Mayak. During the late 1940s and early 1950s, when Mayak was running flat-out, safety was not a big concern. Workers were contaminated with huge amounts of plutonium, and the factory itself leaked cesium and strontium into the environment. The nearby Techa River carried so much waste, according to one U.S. scientist, that "you could get a lethal dose" of radiation by standing on its banks long enough. (The radiation level was 5 rems per hour; 500 rems is considered lethal.) Tens of thousands of people—including local villagers who ate fish from the river and families of Mayak workers living in a town now called Ozyorsk—were exposed to dangerous levels of radiation and are prone to above-average cancer risks today.

For decades, Russian researchers have been collecting medical records on this evolving tragedy (*Science*, 24 February 1995, p. 1084). And for the past 2 years, they have been joined by U.S. researchers, who worked with the Russians to examine the feasibility of conducting a major research effort to probe the health effects of long-term exposure to radiation. On 11 February, officials from the two countries met at the National Academy of Sciences in Washington, D.C., to announce that they have concluded that the available records would support such an effort, and that they were signing a memorandum to launch half a dozen new, in-depth studies. But there's a catch: Both partners are short of cash.

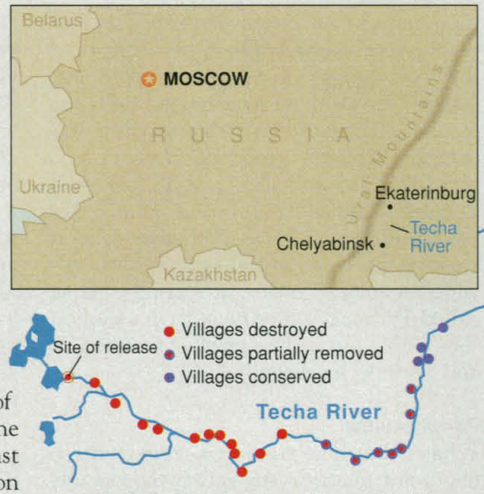
Tara O'Toole, the Department of Energy's (DOE's) assistant secretary for environment, safety, and health, says DOE will provide analytical expertise and some funding for the project, which is to be run by the U.S.–Russian Joint Coordinating Committee on Radiation Effects Research. DOE is kicking in about $1 million this year out of a total U.S. contribution of $2 million. But because DOE's budget is tight, it may have trouble increasing its support in 1998. O'Toole says, however, that DOE's goal is to invest $20 million over the next 5 years. DOE is also hoping to get help from other agencies, including the Environmental Protection Agency, the Nuclear Regulatory Commission, the Defense Department, and NASA. The agreement was endorsed for the Russians by Sergei Khetagurov, vice minister of the disaster response agency. Russia will contribute raw data, facilities, analytical staff, and experienced clinicians—but not much money.

O'Toole and Khetagurov agreed that their scientific teams will carry out a long-

term analysis of the effects of radiation on Mayak's workers and on the general population around Ozyorsk. The opportunity is "too valuable" to pass up, O'Toole told *Science*. The immediate goal, she says, is to explore what has been a closed chapter in the history of the 20th century and provide "a conclusive, open record" of the events. Already, to protect the raw data, DOE has agreed to pay for the microfilming of medical records, now stored on paper in tinder-dry wooden buildings. For the Russians, one immediate objective, according to Lubov Annissimova, an adviser to the Russian emergency relief ministry, will be to reconstruct radiation exposures of citizens around Ozyorsk and at other locations. The Russian government may compensate citizens for injuries, and it will need good dose estimates, she said.

Many scientists associated with the project hope this research will yield data that could never be obtained any other way. Nuclear safety expert Oleg Pavlovski of the Russian Academy of Sciences said the project's planning committee agreed last week that the top priority will be to focus on people who lived along the Techa River. The situation there almost resembles a planned experiment. People at the upstream end of the river received intense external radiation doses, while those downstream received prolonged, low-level, internal doses. Because the population is homogeneous, epidemiologists are confident that they can obtain good comparative exposure data. In addition, the U.S. and Russian scientists want to learn more about the effects of plutonium exposure, common among Mayak's workers but extremely rare in the West.

Radiation health experts hope the Russian data will provide new insights into low-dose radiation effects. Present risk estimates are based on studies of bombing survivors in Hiroshima and Nagasaki. While the Japanese data are excellent, they don't represent peacetime hazards very well. The bombing victims were exposed to short, intense bursts of radiation, while today's safety planners are more concerned about low-level exposures lasting for many years—the kind people at Ozyorsk experienced.



Hot spot. Radioactive dumping resulted in prolonged exposure to people along the Techa.

For the general population, "the primary radionuclide of concern is strontium-90," said Mira Kossenko, of the Urals Research Center for Radiation Medicine. She helped create a registry that includes 30,000 individuals, death certificates on more than 11,000, and data on 774 fatal cancers. She said that 80% of the death reports had been confirmed by autopsies, but that diagnoses of leukemia and other cancers need further confirmation. Dan Hoffman, Kossenko's co-investigator and chair of epidemiology at George Washington University in Washington, D.C., says that the registry is potentially as valuable as the Hiroshima-Nagasaki data, adding, "The key word is 'potentially.' "

DOE consultant Marvin Goldman of the University of California, Davis, says the Russian data analyzed so far suggest that a specific dose, if delivered over a long period, is less likely to induce cancer than is the same dose delivered in a burst. If the Russian data support this observation, they could translate into lower risk estimates for long-term, low-level exposure and reduced concern about environmental hazards. But, as Goldman notes, the Russian data must be validated before anyone can seriously begin to rework the radiation risks. Goldman and his colleagues are eager to start digging into this grim legacy of the Cold War.

–Eliot Marshall

FRANCE

Transgenic Corn Ban Sparks a Furor

PARIS—One of France's leading geneticists has quit as president of the nation's Biomolecular Engineering Commission (CGB), which regulates the use of genetically altered organisms, following a government decision to prohibit cultivation of transgenic corn in France. Axel Kahn, who is also director of the biomedical research agency INSERM's molecular genetics and pathology unit in Paris, stepped down on 13 February, one day after French Prime Minister Alain Juppé announced the ban.

Kahn says he had no choice but to resign in the face of the government's "incoherent" decision. Juppé's action came 1 week after the government had approved transgenic corn for consumption by humans and animals, and 2 months after the European Commission—the European Union's executive body—gave the green light to its sale in Europe, largely at the insistence of France. Now, the government is saying it is OK to eat, but not grow, the crop in France. The French government had even asked Kahn to argue for the safety of transgenic corn at the commission. "I no longer have any credibility with my colleagues in Brussels," he says.

According to Kahn, its "environmental risk is equal to zero." But during debates over European approval in Brussels last year, some scientists were not so categorical. While it was generally agreed that the corn is safe to eat, concerns were raised that during cultivation, modified genes might spread to other plants or organisms. The modified corn contains a gene from the bacterium *Bacillus thuringiensis*, which codes for a protein toxic to the European corn borer, an insect that ravages corn crops. It also includes a gene that confers resistance to certain herbicides, as well as a gene for resistance to the antibiotic ampicillin, which acts as a genetic marker. Some scientists believe that the ampicillin-resistance gene could be taken up by infectious bacteria, thus eliminating the effectiveness of the antibiotic.

Jean-Paul Aubert, former chief of the Pasteur Institute's cellular physiology unit—and also a member of the CGB—says that although the likelihood of such a gene transfer is "vanishingly small," it is now possible to create transgenic plants that do not carry the gene. "It would be better to abstain from putting this gene in the plant, because the corn is distributed en masse in humans and animals," Aubert says.

Such concerns, also expressed by ecologists and consumer groups in France and Europe, appear to be behind the French government's decision. A spokesperson for Juppé declined to comment on the controversy, but environment minister Corinne Lepage—who had earlier argued for putting transgenic corn on the market at Europe's Council of Ministers—applauded the decision last week, saying that she had asked Juppé for the ban after becoming concerned that the modified genes "are susceptible to dissemination ... in the environment."

So, for the time being at least, in France—itself a major corn producer—consumers will be eating transgenic corn imported from the United States and Canada.

–Michael Balter