GENETICS

DNA Mutations Linked To Soviet Bomb Tests

CAMBRIDGE, U.K.—For survivors of the atomic bombs dropped on Japan at the end of World War II, the disfiguring burns and radiation-induced illnesses were all too real and agonizing. Now researchers have strong new evidence of a more insidious effect in other people blighted by nuclear weapons: unexplained DNA mutations from atomic tests in Kazakhstan in the early days of the Cold War.

Wasteland. Researchers from the International Atomic Energy Agency visited the Semipalatinsk nuclear facility last year.

On page 1037, researchers led by geneticist Yuri Dubrova of the University of Leicester, United Kingdom, describe a compelling connection between radioactive fallout and elevated mutation rates in families living downwind of the Semipalatinsk nuclear facility, the Soviet equivalent of the Nevada Test Site. The mutation rate of minisatellite DNA—short, repeating sequences that pepper the genome—challenges the conventional view that radiation inflicts its punishment on DNA solely by directly corrupting the nucleic acids. Some other mechanism must be at work amplifying the effect of the chronic low-dose radiation, because the number of mutations is "orders of magnitude too large for such an explanation," says Dudley Goodhead, director of the U.K. Medical Research Council's Radiation and Genome Stability Unit in Harwell. At the same time it's unclear whether such mutations are—or could ever be—linked to health effects.

The findings bolster a controversial 1996 report by Dubrova and a different group of colleagues that linked germ line mutations to fallout from the 1986 Chornobyl explosion. That study, published in *Nature*, described double the usual mutation rate in the children of men living in a region of Belarus heavily contaminated with cesium-137. The study was a revelation, as the Japanese bomb survivors and their families had showed no such mutations. But the study drew skepticism because Dubrova's team could not eliminate some other environmental factors and the researchers used British families as controls, as they were unable to obtain blood from nonirradiated Belarusans.

In the findings reported this week, Dubrova's team collected blood from three generations of 40 different families in the Beskaragai district of Kazakhstan, a desert region hit particularly hard by four atomic surface tests between 1949 and 1956. In each subject they examined eight minisatellite DNA regions that are prone to mutations. The naturally high mutation rate in this DNA allows researchers to detect statistically significant increases in mutation rates in small populations.

When the data came back, "I couldn't believe my eyes," says Dubrova. Compared to control families in a nonirradiated part of Kazakhstan, individuals exposed to fallout had a roughly 80% increase in mutation rate, and their children showed an average rise of 50%. Probing further, Dubrova's group found an apparent dose-related effect in the children: evidence that the radiation, not some other environmental factor, was inducing the mutations. The correlation "was the icing on the cake," says Dubrova. His group is now following up its Chornobyl findings with an improved study under way in Ukraine.

What these germ line mutations mean for health is a mystery, says Bryn Bridges of the Medical Research Council's Cell Mutation Unit in Brighton. "Is this just a biomarker or more?" he asks. Although minisatellites were once dismissed as "junk DNA," evidence is mounting that they affect gene transcription and are linked with disease predisposition. But looking for radiation-induced health effects in Kazakhstan would be fruitless, says Dubrova, because there are not enough people affected by the fallout who are still alive.

The germ line mutations are unlikely to become merely a Cold War footnote. "They present a potential challenge to the current paradigm used for assessment of genetic risk," says Goodhead, who notes that screening for such mutations might offer a new tool for monitoring radiation exposure. Indeed, says William F. Morgan, director of the Radiation Oncology Research Laboratory at the University of Maryland School of Medicine in Baltimore, the findings are relevant to the current debate over how to protect people from chronic low-dose radiation near some of the Department of Energy sites that represent the U.S.'s nuclear legacy.

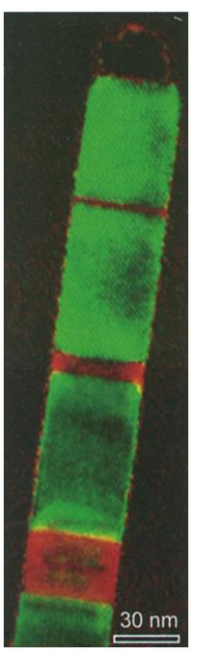
–RICHARD STONE

NANOTECHNOLOGY

Nanowire Fabricators Earn Their Stripes

Electronics makers love a good sandwich. By layering sheets of semiconductors, researchers have learned to control electrons and photons precisely enough to build everything from ultrafast transistors to ultrasmall lasers. Now three groups report that they have carried this sandwichmaking ability down to one dimension by creating tiny wires, each of which resembles a stack of pancakes composed of different semiconductors. The work could open the door to a host of new devices that would boost progress toward long-sought technological goals such as molecular-based computers, quantum computers, and chips that automatically cool themselves.

"These are very nice results," says Paul Alivisatos, a chemist and nanotech expert at the University of California, Berkeley. The ability to layer materials into two-dimensional sheets has been so important for research and applications, Alivisatos says, that "the ability to do it in one dimension has to be very important. There will undoubtedly be a lot of work in the next few years on this."



Nanowhisker. Gold-capped wire of indium arsenide and indium phosphide.

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Nanowires have already generated considerable attention. Over the past few years, numerous groups have grown a variety of different semiconducting wires and have even managed to turn them into components of electronic devices, such as transistors. These early nanowires, however, lacked a key ingredient: variety. Although researchers made wires from various materials, each single wire was chemically uniform. If researchers could change that makeup,