Government team tracks radiation studies

White House aides and federal investigators looking into government-supported radiation experiments on humans expect to uncover studies, conducted between the mid-1940s and the early 1970s, that relied on questionable research methods.

"We are in a massive information-gathering mode," says Sam Grizzle, a Department of Energy (DOE) spokesman.

The studies under scrutiny exposed retarded children, terminally ill patients, military personnel, and prisoners to radiation in order to test its effects — including its lethal effects — according to government and media reports. Moreover, some researchers may have failed to tell subjects about possible risks involved in the experiments, according to some investigators.

DOE Secretary Hazel R. O'Leary initiated the fact-finding effort in December after reading in the Albuquerque Tribune about people injected with plutonium between 1945 and 1947 for an Army study. The White House formed a task force in early January to coordinate government investigations.

Part of DOE's effort to learn more about the experiments included setting up a telephone hotline for callers with information on any human studies supported by DOE or its predecessor agencies, such as the Atomic Energy Commission. Since the hotline (1-800-493-2998) was hooked up on Dec. 23, it has averaged about 400 calls an hour, a number that appears to have peaked, Grizzle says.

DOE originally estimated that about 800 subjects participated in 600 experiments testing radiation's effects on human health. It may revise that number after reviewing the hotline calls.

Congressional committees have already scheduled hearings on the radiation studies. Clinton aides say they plan to learn more about the experiments and to seek compensation if they find anyone was harmed.

"We intend . . . to do our very best to get to the bottom of the facts," White House Communications Director Mark Gearan said Jan. 3. He didn't know when the task force's findings would be made public.

That university and government scientists conducted these experiments is old news to some people. In fact, some of the work was described in scientific journals and government reports years ago. The research has also received strong criticism before. More than seven years ago, Rep. Edward Markey (D-Mass.) called on DOE to investigate the experiments.

In October 1986, Markey released a report describing 31 government-supported radiation studies on 695 people between the mid-1940s and early 1970s. Some of the experiments were "repugnant or bizarre," the report stated. In one, researchers X-rayed prisoners' testes to study the effects of radiation on fertility.

Other radiation experiments have surfaced since Markey's report. From 1945 to 1956, researchers at Harvard University, Massachusetts Institute of Technology (MIT), and elsewhere fed cereal laced with radioactive calcium and radioactive iron to mentally retarded residents of the Fernald State School in Waltham, Mass. The researchers sought to test the absorption of those nutrients, say a Harvard spokesman and Francis X. Masse, director of MIT's radiation protection program.

The amount of radiation remained within today's safety standards, but "it's not clear the kids or parents were told" about the radiation, Masse says. The studies' results appeared in a 1954 JOURNAL OF NUTRITION.

The Department of Veterans Affairs acknowledged on Jan. 7 that its predecessor, the Veterans Administration, conducted numerous human radiation studies in special laboratories and, according to a 1952 memo, ran a secret Atomic Medicine Division. Federal employees expect more such discoveries as they and others wade through reports, letters, notes, and more.

"We found 13 boxes that may have some supporting information" about studies conducted for DOE's Hanford Site, where DOE once made weapons-grade plutonium, says Dawn Zimmerman of the Battelle Memorial Institute in Richland, Wash. In 1984, the lab described to Congress 10 radiation studies conducted between 1951 and 1975 for Hanford. — *T. Adler*

Single-electron control on the atomic level

A microelectronic circuit typically requires a massive electrical surge involving billions of electrons to register or transfer one unit, or bit, of information. However, novel circuitry in which a single electron controls the motion of other electrons potentially provides a faster, more efficient, and more economical means of storing and processing information.

Intrigued by this possibility, researchers have over the last few years explored the feasibility of designing and fabricating such "single-electron" devices (SN: 3/21/92, p.180). Now, a group of physicists has used calculations and computer simulations to demonstrate theoretically that a single-electron device can operate reasonably reliably, even when it consists of nothing more than a string of atoms.

"We proved that if we can assemble, atom by atom, the necessary structure and have electrons hop from one atom to the next, we have the physical basis for logic operations at the atomic level," says Konstantin K. Likharev of the State University of New York at Stony Brook. But at this time, "we do not feel that either we or anyone else has the experimental techniques to [fabricate] such atomic structures."

Likharev, Stony Brook colleague Dmitri V. Averin, and Karl Hess and Leonard F. Register of the Beckman Institute at the University of Illinois at Urbana-Champaign report their findings in the Jan. 3 APPLIED PHYSICS LETTERS.

The researchers based their work on the notion of creating a line of atoms that incorporates a "well" capable of trapping an electron. Once an electron occupies the well, it blocks the motion of other electrons traveling along this atomic "wire." In effect, the trapped electron repels the mobile electrons. When no trapped electron is present, electrons travel unimpeded along the atomic wire.

However, quantum mechanical effects on an atomic scale, which make an electron behave as if it were both a particle and a wave, muddle this behavior. An empty well sometimes reflects electrons, and an occupied well sometimes allows the passage of electrons. To ensure that single-electron devices based on such a design are sufficiently reliable for practical purposes, the probabilities of these unwanted outcomes must be small.

The researchers demonstrated that quantum effects can significantly decrease the reliability of the control that one electron has over the motion of another. But for the atomic structure considered, a sufficiently high reliability can be attained by making the wire at least 50 atoms long.

"In this example, quantum mechanics is in principle incompatible with creating a zero or a one," Hess says. "If you require such precision . . . your device needs to be a certain size." This, in turn, sets limits on the number of such single-electron devices that can be packed into a given area.

Likharev looks at the results a little differently. "We have a proof of principle," he concludes. "We can do logic operations on the atomic level in a natural way, using only [electrostatic] repulsion [between electrons]."

The trouble is that no one has a clear idea of how to build the necessary atomic structures in practice. For example, no technique that involves molecules and atoms assembling themselves into units can yet achieve the appropriate geometry.

Meanwhile, Likharev and his colleagues are concentrating on elucidating the electronic characteristics of larger-scale structures that can be made using present-day technology. "We try to design these devices and understand what exactly can be done," he says. —*I. Peterson*