Radiation standards come under review

Study ordered by Finch rekindles controversy over adequacy of standards and the nature of tolerance to radiation exposure

Although Federal radiation safety standards have been steadily dropping —the present exposure standard is 0.17 rad per person per year—they are still coming under attack. At the forefront are Lawrence Radiation Laboratory's Arthur R. Tamplin and John W. Gofman of the University of California at Berkeley (SN: 2/21, p. 194). They originally sought a further 10-fold reduction; they now say no level is safe. Toward the end of last year, they made a widely publicized allegation at a Senate hearing that with the present nuclear radiation standard, 16,000 additional deaths from cancer could be expected. A few weeks ago they upped the figure to 32,000.

Disturbed, Robert H. Finch, Secretary of Health, Education and Welfare and chairman of the Federal Radiation Council that sets all radiation standards, has called for a general review of the present standard.

Last week the gears began to grind, but it will take several months before the council hands down a decision.

Opinions vary as to whether there will be a reduction. "In my opinion, nothing will change," says Dr. Robley D. Evans of the Massachusetts Institute of Technology, "because all the relevant data have already been studied by competent people."

Dr. Ralph Lapp, nuclear consultant, sees history supporting a change: "If one extrapolates the course of events, it is not imprudent to envision a downward revision," he says.

Dr. Lapp sees the determining factor as the same one that has been in operation in the past: the nuclear industry's ability to get down to a lower level. "We have seen a steady downward revision based not on prudence but on accommodation to the radiation industry," he claims.

Dr. Paul C. Tompkins, executive director of the Federal Radiation Council, admits to the possibility—if not the likelihood—of a downward revision, which could take the form of percentage reductions for specific isotopes or an over-all reduction though he believes the present standard is safe.

"Since that number (0.17 rad) was first picked in 1960, the investigation of genetic effects would indicate that the actual effects that would be predicted today would be smaller than in 1960," he says. "The biological risk appears less today because of identification of the biological repair mechanism even in genes," (SN: 10/18, p. 348).

And that statement ushers in one of the hottest ongoing controversies in science today, and one central to the establishment of exposure standards: the threshold theory versus the linear hypothesis.

The threshold theory states that there is a limit, or threshold, below which there are no significant biological effects. The situation is analogous to taking aspirin. Swallowing a bottle of aspirin could be fatal, but taking the same amount over a long-time period is harmless because there is a threshold limit below which cells are able to repair themselves.

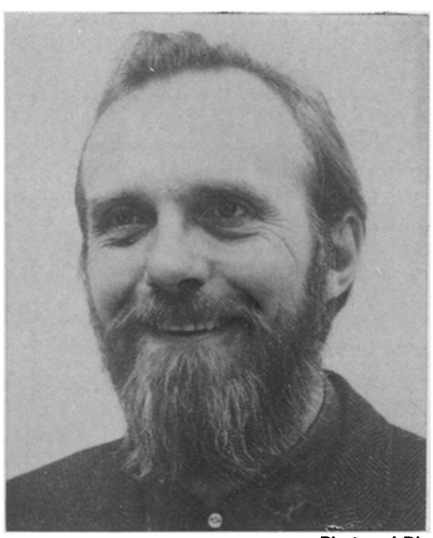
"This is one of the commonest things," says Dr. Evans, chief advocate of the threshold hypothesis. "The fact of repair is there."

The linear hypothesis, on the other hand, denies a threshold. It says that biological effects are seen all the way down until zero is reached and when plotted on a graph they come out to a straight line.

On one side, Dr. William Russell of Oak Ridge National Laboratory has found that the death rate of mice exposed to radiation doses that individually were sublethal but cumulatively were lethal was lower than that of unirradiated mice exposed to the same lethal dose all at once. This indicates, he says, that biological repair is taking place.

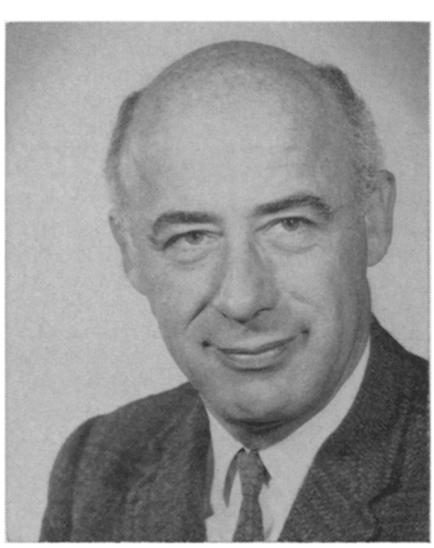
On the other hand, there is the work of the British scientist Dr. Alice Stewart, who found an increase in childhood cancers for those children who were irradiated in utero with X-rays at the one- to three-rad level. The group that had one rad has less cancer than the three-rad group. The threshold range for humans is put at about 100 to 1,000 rads.

There are other similar types of evidence for both sides. Out of the mass of statistical evidence has come a spin-off called the doubling dose concept, which, like the linear hypothesis, shows a straight line effect and is also highly controversial.



Photos: LRL

Tamplin: No safe level of exposure.



Gofman: Doubling the casualties.

The doubling dose concept, to which Drs. Gofman and Tamplin adhere, says that if the amount of radioactivity is

doubled then the number of cancer cases will rise by an amount equal to the natural incidence of that cancer. Thus, if one population shows a natural cancer rate of 70 cases per million and another has 700 per million, doubling the dose would produce 70 new cases in the first instance and 700—not 70—new cases in the second.

A situation exists today that can be studied to test the concept. Americans have relatively little stomach cancer when compared to the Japanese. As a consequence of the atomic explosions at Hiroshima and Nagasaki, a large increase in the incidence of stomach cancer should be seen among the Japanese as compared to the Americans if the doubling-dose concept is valid.

"There are no extra cases from the bombings," says Dr. Evans.

"The stomach cancers are just now coming in," says Dr. Tamplin. "We haven't been able to get all the data. We'll have to wait another 10 to 15 years for the whole story to come in. I'm sure you will find some doubling dose."

It is this kind of contradictory evidence that is bound to divide the council in their efforts to come to grips with a safe level—if there is one. □

NUCLEAR ENERGY

Disposing of the waste

Ever since the beginning of the atomic age the Atomic Energy Commission has had the problem of safely disposing of its lethal nuclear garbage. And the problem will grow as more facilities are built and as more nuclear power plants go on-line. Right now, for example, 48 nuclear power plants are being built that will produce 38 million kilowatts, nine times the present nuclear capacity.

According to a report of a National Academy of Sciences Committee, the AEC is plodding along with its old waste-disposal methods. The report revealed some real shortcomings—in the handling of three basic radioactive waste classifications: high, intermediate and low levels. The survey was done four years ago. The procedures have not changed.

High radioactive liquid waste is disposed of by storage in 85-foot diameter steel tanks buried about eight feet below ground.

The concern is that the tanks will leak—as has happened several times at the Hanford, Wash., plant—and the radioactive liquid will seep into the water-table system. Newer tanks are built on concrete saucers to prevent this kind of leakage.

As for low- and intermediate-level solid wastes, the present method of disposal is burial in trenches in which,

AEC

Waste tank: Storage, not disposal.

says the NAS report, "there is always the danger of a build-up of concentrations in the soil."

Disposal of low-level liquids is done in streams—a practice the report found apparently harmless, if constantly monitored. Low- and intermediate-level liquids are disposed of by injecting them into evaporation ponds or into the ground. The NAS committee says that, in the long run, this would "lead to a serious fouling of man's environment.

". . . None of the major sites," the NAS report concludes, "at which radioactive wastes are being stored or disposed of is geologically suited for safe disposal of . . . other than very dilute, very low-level (radioactive) liquids. . . ."

The AEC maintains that it is storing, not disposing. "We do regard these sites as safe places for the processing and storage of the wastes while developing programs and facilities for final disposal," says John Erlewine, assistant AEC general manager for operations.

In anticipation of problems, the AEC is looking at such alternatives as hydraulic fracturing (SN: 2/8/69, p. 143), by which radioactive wastes are introduced into cement, which is forced into horizontal rock strata where the cement hardens in a thin layer. But this method is just for intermediate wastes and requires such special geological conditions as layered shale.

Better results are expected from calcining, in which high-level liquid wastes are converted to lower-volume solids by heating. Safer for transport and easier to dispose of, these solid wastes would be put in steel containers and stored indefinitely in abandoned salt mines. Salt mines are considered the best choice because they are isolated from water. Their capacity also appears to be no problem. "It should last for a long, long time," predicts James Pollock of the AEC's production division. □

CANCER THEORY

Charges on the cell membrane

Cancer research is, by and large, descriptive.

Research has for years focused on the nature of the cancer cell's aberrant behavior, the things in the cells or its environment that trigger that behavior and what, if anything, can be done clinically about it.

Out of this have come several general hypotheses. One is that viruses cause cancer (SN: 10/4, p. 308). There is undeniable evidence that they induce some types of animal tumors, and a growing body of circumstantial evidence exist linking them to some human cancers.

A second explanation of the cause of cancer stresses the role of chemicals in the environment. Additionally, radiation is known to induce tumors. And deficiencies in the immune system have been implicated in the occurrence of malignancies (SN: 5/10, p. 457). In all likelihood the cause of cancer is related not to one or the other of these possibilities but to each of them, alone or in combination. Further, the genetic constitution of an individual appears to play a role in his susceptibility to cancer.

Each of these probable factors linked to malignancy was discussed by scientists this week in San Antonio at a seminar sponsored by the American Cancer Society.

Each contributes pieces to the incomplete jigsaw puzzle of cancer. None of them draws a single thread of biological theory to tie the pieces together.

Cancer theorists recognize the lack of such a thread in their work, and consider studies of the cell membrane as a likely source of the answer—the defective mechanism that allows a tumor cell to proliferate and spread.

So the participants in the symposium were understandably stimulated by one such attempt, the presentation of a general hypothesis which, right or wrong, seemed to be a biophysical stab at least in a promising direction. It was the observations of Clarence Cone, a chemical engineer at the National Aeronautics and Space Administration's Langley Research Center in Hampton, Va.

Cone, who began studying the effects of radiation on human cells, ended up with the suggestion that electrical changes in the surface of cells may account for both uncontrolled proliferation and metastasis. His theory, he believes, will contribute to understanding of the fundamental changes occurring in tumor cells and fits with previously explored descriptions of cancer causation.