RADIATION: CAN A LITTLE

Concern is growing over the extent to which current radiation-exposure limits protect workers, and results of a new analysis just fuel the fire

BY JANET RALOFF

Doubts over the adequacy of current radiation-protection standards are proliferating — from the staff of the Nuclear Regulatory Commission and the Congress on down to the general public. Already this year, a new challenge to what constitutes "acceptable" exposures has been aired, and more are expected to follow close on its heels.

During congressional hearings last year, several studies on worker populations raised suspicions that even low-level exposures to ionizing radiation might be harmful. And the list of witnesses suggesting that a 10-fold reduction in worker-exposure limits might be justified included the likes of Edward Radford, chairman of the National Academy of Sciences' BEIR (Biological Effects of Ionizing Radiation) Committee, and Karl Z. Morgan, a nuclear-engineering professor who for years headed the health physics (study of health effects from radiation) program at Oak Ridge National Laboratory.

This month, Alice Stewart and George Kneale of the University of Birmingham, England, scientists who gained notoriety over the past 18 months for their analyses of employees of the Energy Department and its contractors in Richland, Wash. (SN: 2/25/78, p. 117), announced a surprising update in their study at the American Association for the Advancement of Science meeting in Houston.

Early next month an interagency review group, coordinated by the Department of Health, Education and Welfare, is expected to recommend to President Jimmy Carter that more research on the possible health effects from low-level radiation is necessary and to recommend that action be taken to limit exposures until more conclusive results are forthcoming. A third report by the BEIR committee — whose members are reportedly far from unanimous on the critical issue of dose-response relationships in the low-dose range — is expected out in six weeks. And the Nuclear Regulatory Commission will conduct hearings later this spring on the adequacy of current exposure limits.

Analyses by Stewart and Kneale, of data originally collected under DOE contract by the University of Pittsburgh's Thomas F. Mancuso, have been a catalyst for some of the action.

Pioneering a new approach for analyzing the cancer risk from low-dose exposures (generally 15 rads or less), Stewart and Kneale claim that their latest work shows the traditional — and supposedly conservative — no-threshold, radiation dose-response model underestimates cancer risks in the low-dose range. They contend that not only do the new results confirm a finding that they presented last year — that current worker-exposure standards are a factor of 10 too high — but also show the latency period for onset of radiation-related cancers in this population to be about 25 years. And cancer risk increases with the age of the individual at the time of exposure, they say.

In this fourth analysis of Hanford data, live workers have been added to the study population, increasing its size from about 3,500 individuals to 35,000, "an important difference," Stewart says. The presentation at the AAAS by the Birmingham pair consisted of a new statistical analysis by Kneale, a biostatistician, and a description by Stewart, an epidemiologist, of her new "cracked plate" theory.

Described by more than one critic as a "brilliant mathematician," Kneale offered his findings as a complex battery of statistical equations and tables. He used a new technique, called regression modeling of life tables, which Kneale said was developed independently by himself and by D. R. Cox of London University.

Kneale's explanation of the technique and its relevance to determining a dose-response estimate from the data was questioned by Charles Land, a biostatistician for the National Cancer Institute. He shared the AAAS panel with Kneale and others. Land said that even at 35,000, the sample population was too small to estimate the real cancer incidence in populations receiving only low-dose exposures. He said a population of perhaps 200 million might be necessary to confidently fix a risk estimate.

For instance, Land said, the 80,000 atomic-bomb survivors (alive in 1950) were studied for 25 years and showed only about 180 radiation-related cancers, "not very much." The small increase of multiple myelomas and pancreatic cancers that Stewart and Kneale found are "what you would expect" — random aberrations — in a study of small groups. In fact, Land said, if you eliminated all Hanford workers who received more than 10 rads, you would see no cancer effects at all. Kneale seemed to agree but countered with an analogy.

Suppose, he said, that you suspect a certain trait appears one percent of the time. If to test the hypothesis you looked only at 10 people and you got no positive findings, it would appear you initially overestimated the incidence. If you get one positive sample, however, you will have underestimated the incidence by at least a factor of 10. "But suppose you got 5 of 10 showing the trait," Kneale said; "this would, on a standard statistical basis, reject the hypothesis that the true incidence was one percent. I think that is what the Hanford data does. It rejects the possibility that the true risk might be as low as it seems when extrapolating downward [from data collected on atomic-bomb survivors]."

In the end, Land concluded that it would be unfair to critique the technique without closer scrutiny, adding however, that "it looks pretty good to me." The opportunity for scrutiny should come when the technique is published, probably in HEALTH PHYSICS.

Land, together with George Hutchison and Brian MacMahon of the Harvard School of Public Health, and Seymour Jablon, an analyst of Japanese atomic-bomb survivors for the National Academy of Sciences, have co-authored a critique of the first analysis of Hanford data by Stewart, Kneale and Mancuso, which appeared in HEALTH PHYSICS. The critique, to appear soon, also in HEALTH PHYSICS, is "fairly critical" Land said, but supports the Stewart-Kneale finding of an increase in two radio-sensitive cancers. The first Stewart-Kneale analysis — and the only one evaluated statistically in a refereed journal — "was a bad paper," Land told SCIENCE NEWS, containing errors in statistical methodology. Evidently Stewart and Kneale agree, Land told a press conference at the AAAS, "because [our] suggestions are followed in [their] more recent analyses."

Stewart's presentation was really an attack on the linear, radiation dose-response curve, which she says is based on high-dose exposures (40 rads and more) from atomic-bomb survivors and radiotherapy patients that are extrapolated to low-dose ranges. "This linear hypothesis," she said, "would be perfectly plausible . . . if cancer were the only effect of radiation. But it isn't. Radiation is a nonspecific poison which tears tissues apart. It has by definition noncancer and cancer effects."

"There's a recent report on the Atomic Bomb Casualty Commission data that actually says that none of the long-term-mortality experiences of the A-bomb survivors are attributable to noncancer effects," Stewart said. But in fact, bomb survivors had a higher than usual mortality rate after their exposure and prior to any increased cancer incidence, she said.

Think of a slightly damaged cell as a

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broken plate, Stewart said. Though it can be glued back together, its integrity will never be as good as that of the original. Every time it's stressed, it will be more likely than the original to break. In the same way, a repaired cell of the body will not react to disease or trauma as well as a healthy one; the body will be more prone to assault — both from disease and physical injury — than the original. Stewart says the lack of evidence of body damage from low-dose radiation exposures may indicate some cell repair occurs. While that hypothesis has circulated for years, most have considered it a positive indication that low exposures are relatively harmless.

Stewart sees it otherwise. "It's the very slightness of the damage which is the trouble," she says. If a damaged, and subsequently repaired, cell reproduces it can pass on the damage to succeeding generations, via sexual reproduction, or just copy the damaged cell and incubate its clones until the body weakens — as happens with advancing age, disease or injury, she says.

This would explain, Stewart says, why the quadratic equation that best expresses the dose-response data in Kneale's latest analysis may be real and not a statistical artifact. Low-dose exposures lead to proportionately more damage than single, larger doses delivered all at once, she says, but some of the damage will be weakened resistance to disease and injury.

What's more, because low doses are expected, at least initially, to generate small, subtle changes, Stewart says one will not be likely to find responses visible against the background in any but very healthy populations. "Until you had a population of workers in the nuclear industry, you've never had the right one," she said, one that was essentially far more healthy than the general public to start with.

Stewart says the next step will be to update the deaths among the study population (her records only document deaths through 1976). Kneale will then try to correlate deaths with occupation. It won't be easy, she said, because job titles were drawn up for payroll purposes; there are seven or so different listings for secretaries, for example, and five for technicians, she said. If Kneale's finding of a 25-year latency period for radiation-related cancers is correct, one might expect to find a small epidemic of cancers showing up within the next five years or so, she said.

The Environmental Policy Institute, a nonprofit research arm of the lobbying Environmental Policy Center, has been supporting the Stewart-Kneale work since DOE terminated its contract with Mancuso in 1977 (SN: 2/18/78, p. 103). □