NAS Study on Radiation Takes the Middle Road

Even so, six members consider the report alarmist; the chairman challenges them to a debate

A divided and still quarrelling panel of radiological experts presented its final report on the dangers of low-level radiation in a press conference at the National Academy of Sciences (NAS) on 2 May. The Committee on the Biological Effects of Ionizing Radiation (BEIR) has been struggling for nearly 2 years to come up with some simple risk estimates for the Environmental Protection Agency (EPA) for use in setting public safety standards. The findings could have an impact on the nuclear power industry and other businesses in which workers are exposed to higher-than-average levels of radiation. The report found that, in general, the risks of low-level radiation are very small, but potentially greater than has been stated before.

When it came out, the report was more than 4 months overdue, a delay caused by strife in the committee. The quarrel, it turns out, was between a majority led by the chairman, Edward P. Radford, an epidemiologist at the University of Pittsburgh School of Public Health, and a minority led by Harald H. Rossi of Columbia University's College of Physicians and Surgeons. Radford has testified in Congress that he thinks the public standards for allowable radiation doses should be cut back to a tenth of their present level. In committee debates he held firm against an effort to lower the BEIR risk estimates.

In brief, the majority's report says that weak radiation, in the most pessimistic estimate, is unlikely to produce effects any worse than what one would expect if one simply extrapolated downward from the known effects of severe radiation. The effects decrease in proportion as dose decreases, right down to the smallest measurable level of exposure. This means that even a miniscule release of radioactivity in a populated area has a negative effect on public health.

There are some exceptions to this general rule, the NAS committee found, but none of any significance insofar as safety standards are concerned. "There is no truly adequate or generally acceptable scientific basis for such estimation [of the effects of low-level radiation] but . . . regulatory decisions require a position on the estimation of risk," the report says. Therefore, a majority found it "least objectionable in the absence of clear evidence as to the shape of the dose-effect curve" to stick with the linear (directly proportional) model. It has the beauty of simplicity, no small virtue when one is trying to write regulations.

Contrary to some of the more alarming recent studies, the NAS group found "no substance" in the theory that this proportional relationship breaks down at low dose levels. All members of the committee rejected the argument that the hazard *increases* at low levels; most members also rejected the theory that the hazard *decreases* very rapidly at low levels. Thus, the majority stuck to the straight middle line, concluding that injury and exposure decrease at the same rate.

Six members* led by Rossi and Edward W. Webster of the Massachusetts General Hospital filed a dissenting opinion, claiming that the majority report was alarmist. This group believes that as exposure decreases, injuries taper off more rapidly. They also claimed to find errors in some of the majority's data. In a statement read aloud at the NAS news conference, they said: "We believe that, because of these failings, the BEIR-III report will contribute to excessive and potentially detrimental apprehension over radiation hazards."

Chairman Radford thereupon challenged Rossi to join him in a public debate, which he hoped could be sponsored by the EPA or the American Association for the Advancement of Science. Radford said later that he considered many of the minority's charges to be "nonsense." He also pointed out that five of the six in the dissenting group were members of the National Commission on Radiological Protection and Measurement, a group that has criticized earlier NAS studies for being alarmist. Rossi and company did not answer the chairman's invitation to debate.

*In addition to Rossi and Webster, the minority included Charles W. Mays of the University of Utah Medical Center, Henry N. Wellman of the Indiana University School of Medicine, Marylou Ingram of the University of Miami School of Medicine, and A. Bertrand Brill of the Vanderbilt University School of Medicine.

The report, with its dissenting addendum, was published as an update of earlier studies known as BEIR-I (1972) and BEIR-II (1977). Radford said at the press conference that the new paper "essentially confirms and in many instances extends" the conclusions of the 1972 report. Using alternate methods of calculating risk and incorporating the results of many new animal studies of radiation, the committee reaffirmed its earlier work, adding only a few refinements. "The numbers are not substantially different" than those cited in BEIR-I, said Dean Parker, chairman of the genetics effects subcommittee and professor emeritus in genetics at the University of California, Riverside. "We have greater confidence in them now," Parker said. If anything, BEIR-III presents the risks in stronger terms than did BEIR-I, which itself was attacked for being alarmist. The report expresses the same findings in slightly larger figures.

E. P. Radford

H. H. Rossi

The reason for this, according to Radford, is that the committee believed it was important that the figures reflect the fact that for many kinds of cancer, incidence increases with the age of the exposed population. For example, a city exposed to a large dose of radiation 30 years ago does not produce a fixed number of thyroid cancers each year, but a gradually flowering crop of cancers that grows larger each year. Since the oldest human radiation studies are no more than about 30 years old, Radford thought some compensation should be made for

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The committee, which is chaired by Frank Freeman, a neurologist at the Veterans Administration Hospital in Nashville, decided not to recommend strict controls on the drug because it has only about half the abuse potential of morphine (most drugs that are more strictly controlled have the same potential); there is only weak evidence that the overall number of drug-related deaths would decline if strict controls were adopted; and its availability in treatment for heroin addiction would be drastically reduced.

These are not settled facts, and FDA Commissioner Donald Kennedy is not bound by what the advisory committee says. It is reasonably certain, however, that Lilly will soon be sponsoring an educational campaign on the hazards of the drug; it's an idea that the advisory committee endorsed by a vote of 12 to 1, and one that even Sidney Wolfe, of Ralph Nader's Health Research Group, could hardly turn down. The final verdict, which will address the question of whether an industry-sponsored campaign is sufficient, is expected from Secretary of Health, Education, and Welfare Joseph Califano by 1 June.

New OTA, NIDA, NIAAA Directors Appointed

The top posts at three troubled federal science agencies have recently been filled. The new director of the congressional Office of Technology Assessment (OTA) is John Gibbons, 50, a nuclear physicist who formerly headed the University of Tennessee's Environment Center. And the new director of the National Institute on Drug Abuse (NIDA) is William Pollin, 57, a psychiatrist who formerly directed NIDA's research division.

Also, the new head of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) is John DeLuca, 35, a public administrator who formerly directed a state alcoholism program in New York.

Gibbons, the new OTA director, is a well-placed specialist in energy conservation and research. This made him particularly attractive to Representatives Morris Udall (D-Ariz.), the current chairman of OTA's congressional board, and John Dingell (D-Mich.), who chairs the House subcommittee on energy and who placed Gibbons' name in nomination for the post. People who know him say that Gibbons is a scientist first and a policy expert second—an affable fellow who is inclined to compromise when the going gets tough.

Some worry that he will have a hard time standing up to OTA's congressional overseers. Gibbons himself indicates that he would like to focus OTA's work more narrowly, concentrating on topics that Congress really wants. He also says that some personnel changes may be necessary to reduce the tension and bickering that has plagued the agency for some time.

Prior to directing the Tennessee center, Gibbons had served as head of the office of energy conservation at the old Federal Energy Administration; presently, he is a member of the federal energy research advisory board. Although the congressional board passed him over when it selected Russell Peterson, his predecessor, a year and a half ago, Gibbons was the swift choice this time around. His salary will be $52,500.

Pollin, the new NIDA chief, is an expert in behavioral psychology and schizophrenia, with special experience in genetic factors and twin and sibling studies. He takes control after a long vacancy in NIDA's top post, following the departure of NIDA's embattled former director, Robert DuPont.

"Dr. Pollin's background and experience in brain, behavioral, and clinical research will provide a solid base for the institute's new policy directions," says Secretary of Health, Education, and Welfare Joseph Califano. Under his tutorship, the institute will attempt to move from a narrow Nixon-directed focus on heroin and address broader problems of addiction to prescription drugs, synthetic drugs, and tobacco. NIDA administrative, personnel, and press officers did not know what Pollin's salary would be.

DeLuca, of NIAAA, ascended to his former post as director of alcoholism programs in New York after a stint on Governor Hugh Carey's personal staff, and some experience with the Peace Corps and VISTA. It is not immediately clear whether his appointment will aid efforts at improving the quality of NIAAA's scientific work. De Luca's salary will be $47,500.

R. Jeffrey Smith

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the fact that the results have not yet come to full flower. He adopted a computational method called the "relative risk" approach and used it to estimate the maximum, end-of-generation number of cancers likely to result from a given exposure to radiation. The lower end of the scale was computed by the absolute risk method.

BEIR-I expressed the risk 7 years ago in terms of cancer mortality, not cancer incidence, and it did not incorporate relative risk estimates. Thus, BEIR-III makes the problem look bigger, as follows. The committee concluded that a one-time dose of radiation amounting to 1 rad given in 1 year over the whole body to 1 million people will produce 192 to 756 cases of cancer in males or 344 to 1306 cases of cancer in females. (A rem is a standard measurement of biological damage done by radiation, and a rad is a similar measurement of radiation absorbed by tissue. In most low-level radiation, they are roughly equivalent.) The same exposure would produce between 70 and 353 cancer deaths. BEIR-I predicted there would be 50 to 165 deaths. If the same exposure were spread out over a year rather than given all at once, the risk would be less, according to the new study. The probable fatalities would range from 68 to 293 in a population of 1 million. An exposure of 1 rem given to a population of parents would be expected to produce an increase of 5 to 75 serious genetic disorders per million live births in the first generation offspring. The same exposure, if given to each generation, would result, "at genetic equilibrium," in an increase of 60 to 1100 serious genetic disorders per million live births.

For perspective, it is important to point out that the naturally occurring incidence of serious genetic disorders is about 107,000 per million births, and the incidence of cancer (of whatever origin) about 250,000 per million people. Also, the rates of exposure discussed here—1 rad or 1 rem per year—are higher than most people receive. The average background radiation to which we are all exposed is thought to be about 0.1 rem per year over the whole body. A medical x-ray is likely to amount to no more than about 0.025 rem, and is concentrated in a small area. A person standing at the north gate of the Three Mile Island nuclear plant for 24 hours a day for 3 weeks following the accident might have received at the most 0.09 rem of additional whole-body radiation. That is roughly equivalent to what a person receives by living for 1 year in Colorado, where the natural background radiation is higher

Nuclear Risks: Still Uncertain

While the National Academy of Sciences (NAS) was preparing to release the BEIR study of low-level radiation at a full-scale press conference, it quietly mailed out another report with some less remarkable conclusions, filed by a separate panel of NAS radiological experts. The paper, called "Risks associated with nuclear power: A critical review of the literature," was written for the NAS Committee on Science and Public Policy (COSPUP) and was funded in part by the Department of Energy. It was designed to sort out some of the conflicting estimates of the hazards of nuclear power.

It will be of little help to executives seeking a way out of the morass, however, for one of its central findings is that the experts do not know enough about the chances for a nuclear accident to speak with confidence about the overall hazards.

The steering committee that ran the project was chaired by W. Conyers Herring of the Bell Telephone Laboratories. I. M. Singer of the University of California at Berkeley is chairman of COSPUP.

The one area in which these experts felt it was safe to make a forecast was in the routine operation of nuclear reactors and the industries that support them. Here they came up with some solid figures. They found that, on the average, the number of fatal cancers produced under normal conditions would be about 0.5 per gigawatt-year of nuclear electricity generated (equivalent to 1 million kilowatts generated steadily for a year). If one assumes that 40 gigawatts are produced a year, as was the case in 1975 when this study was begun, then the nuclear industry is causing two cancer deaths a year. (There are 360,000 cancer deaths annually in the United States.) If one assumes, as some reports have, that by the year 2000, this country will have produced 4000 gigawatt-years of nuclear electricity, then the industry will have generated 2000 related cancer deaths.

This ratio may be fiddled with to produce a variety of results, but it really ought not to be taken as representing a precise estimate. There are too many variables and unknowns hovering about, as this report concedes. First are the uncertainties about the lethality of low-level radiation, the kind that would be responsible for the deaths tabulated here. The BEIR (Biological Effects of Ionizing Radiation) report on this subject was so unsure of its findings that it used a very wide range of estimates. It said that 1 million person-rems of radiation would cause between 70 and 353 fatal cancers. For the sake of simplicity, the COSPUP study of nuclear risks set the figure at 200 deaths. It is a round number, but quite arbitrary.

Consider also what the forecast leaves out. The figure for cancer deaths (0.5 per gigawatt-year) does not include deaths caused by nonradiological accidents, such as everyday accidents in the uranium mines. According to this report, these deaths would amount to something less than 0.4 per gigawatt-year of nuclear generated electricity. The report says that coal mining causes about 0.8 comparable deaths. It also says that a gigawatt-year of coal-fired electricity produces one or two deaths from transportation accidents and "some premature deaths in the general population due to air pollution." Old coal boilers, if permitted to burn 3 percent sulfur coal, would cause between 3 and 170 premature deaths per gigawatt-year.

These numbers make nuclear power seem attractive, but there are reasons to be skeptical of them. The report states that little data are available on the hazards posed by terrorism; that little is known about the effects of leaks from waste storage areas; and, most timely, that no one has developed a good fix on the risks of a major nuclear plant leak. This study adopts a low risk estimate for such accidents, but notes that the number is "conceded to be quite uncertain," with expert estimates ranging from a fraction of the number to 100 times its size. "The statistical expectation of population dose from these [reactor accidents] may be significantly smaller than, or larger than, that from other quantifiable sources," the report concludes. In a word, the hazards are still unknown.

It is not surprising that, given a ringing conclusion like this, the NAS declined to call in the TV cameras.—E.M.

than anywhere else in the country. The average background level in Pennsylvania is about 0.046 rem, so that the person standing at the nuclear plant's north gate actually would have received at least 0.046 rem more than a person living in Colorado.

All these figures represent averages, because they were designed for use by a regulatory agency. As such they tend to understate the risk in some cases and overstate it in others. The BEIR committee members were aware of this and said they hoped that more specific risk estimates for vulnerable subgroups could be given in the future. "A notable development since the 1972 BEIR report," they wrote, "is the increasing recognition that there are human genotypes that confer both increased cancer risk and increased susceptibility to DNA damage after exposure to carcinogenic agents, including ionizing radiation." Few of these groups have been delineated.

The report does say, however, that women face a greater risk because they, almost exclusively, are susceptible to breast cancer and are more likely than men to develop cancer of the thyroid. Embryos may be seriously affected by radiation in development, but it is not clear yet how large this risk is. People in certain occupations face greater hazards. The 200,000 people who work with medical x-ray equipment receive an average whole-body dose of radiation each year amounting to 0.3 to 0.35 rem. An equal number of dental x-ray machine operators receive 0.05 to 0.125 rem. Those who handle medical radionuclides receive 0.26 to 0.54 rem. Workers in the civilian nuclear power industry receive 0.6 to 0.8 rem.

These disparate risks are further complicated by the differing lethalities of the types of radiation. Neutrons and alpha, beta, and gamma rays behave differently, as do the cancers they produce. It is known, for example, that leukemia and bone cancer induced by radium-224 follow an atypical epidemiological pattern. Ten to 12 years after the time of exposure, these cancers cease to appear in the population. The incidence of other cancers grows larger as time passes.

This very diversity of data led the committee to cling to what seemed a safe and workable model, the linear dose-response curve adopted by the NAS in 1972. This decision, Radford said, should set a precedent for future attempts to devise risk estimates for other carcinogens—such as asbestos and vinyl chloride—whose potency is difficult to measure in small quantities.

—ELIOT MARSHALL