rently healthy and likely to remain so, provided fishing levels do not increase. In general, the young cod grow up along the northern and eastern shores of the island; when they reach spawning age at 7 years they move around Iceland to a portion of the shelf off the southwestern corner; there, they spawn. British and other foreign vessels, says David J. Garrod of the Agriculture Fisheries Laboratory at Lowestoft, fish principally the immature cod off the northern and eastern coasts; the Icelanders fish principally the spawning populations off the south and west.

To Jónsson's statement that too many young fish are taken by foreigners, Garrod says that Icelanders take an almost equal number of young fish; last year Icelandic trawlers caught 80,000 metric tons of young fish off the northern and eastern coasts.

As for the decline in spawning rates, Garrod contends that at present the Icelanders are the principal fishers of the mature cod found at the southwestern corner of the island. However, he also points out that other factors, such as the gradual cooling of the Atlantic waters around the island, could be affecting the entire codfish population in yet unknown ways.

A public relations firm retained in London by the Icelandic government has stated in a recent pamphlet: "There is irrefutable evidence that cod mortality during the spawning season is now more than 70 percent and overfishing is responsible for four-fifths of this mortality." Garrod seeks to demonstrate, with data on the volumes and locations of Iceland's catch of spawning fish, that she could be responsible for perhaps 50 percent of the mortality rate.

There are other charges and countercharges. The British point to Iceland's ordering 31 new fishing vessels as evidence that Iceland plans to intensify her own fishing effort, despite her avowed commitment to the cause of conservation. Icelandic government literature, for its part, often alleges that more and more fishing vessels from other nations are about to descend upon her waters. There is also disagreement about the best method of regulating the cod catch; the British favor an international quota system; Jónsson argues that international controls have conspicuously failed in the past and points to Iceland's successful maintenance of her own whale stock as evidence that she can regulate her fishing industries.

However, the crucial issue of whether the cod population is in danger is in fact a scientific unknown, as Garrod admits. "There isn't a technical way of figuring out when a stock will reach the point of a serious decline. The question is how small the breeding stock can be," and no one, he says, really knows the answer.

Thus, the marine scientists cannot offer irrefutable proof or disproof of the scientific claims on which the Icelander's have based the extension of their fishing limits. As in other national and international issues, scientists, in lieu of giving the politicians definitive answers, are presenting arguments which favor their own sides.

—DEBORAH SHAPLEY

Radiation Standards: The Last Word or at Least a Definitive One

Two and a half years ago, when the national furor over radiation standards was at its height, the old Federal Radiation Council (FRC) commissioned a panel of the National Academy of Sciences to reexamine the scientific basis for the standards then in force and to suggest any changes that might seem appropriate. In the intervening months, the issue has grown quiescent, the FRC has been abolished—its functions having been absorbed by the Environmental Protection Agency (EPA)—and the two scientists who started the debate, John Gofman and Arthur Tamplin, of the Atomic Energy Commission's (AEC) Lawrence Laboratory at Livermore, have largely faded from public view.

Nevertheless, the academy's Committee on the Biological Effects of Ionizing Radiation plugged quietly away at its task. It has now produced a weighty report that, if not the last word on radiation standards, will probably be the definitive one for some time to come.

In an unusual departure from the reassuring tone common to official pronouncements on such matters, the 470-page report concedes the critics' central point—that the maximum exposure currently permitted for the general population is far higher than it needs to be, and, by implication, should be lowered. In addition, the panel asserts that exposure from medical procedures—by far the major source of radiation to the public, now and for the foreseeable future—could be reduced substantially at little cost and with no sacrifice of medical benefits.

Underlying these conclusions is the philosophy that any increase in radiation exposure to the populace at large will result in proportionate increases in the number of excess deaths and illnesses. The panel says that such effects can be estimated, and it strongly urges that the government use these estimates, uncertain as they are, to form numerical cost-benefit judgments in setting future radiation standards.

The mission of the academy committee did not include suggesting what these standards should be, however, and, accordingly, the panel was silent on this subject except to propose some general rules. For one, the panel said, no radiation exposure should be permitted without the expectation of a "commensurate" benefit. And it cautioned that efforts to protect the public from radiation should not result in substituting a worse hazard than the radiation avoided—a reference, perhaps, to the comparative risks and benefits of fossil-fueled and nuclear power plants.

The federal standard in question states that the general population should not receive more than 170 millirems of man-made radiation each year, exclusive of medical sources. (This compares to about 100 millirems received from natural background sources in the United States. All told, the average American is subjected to about 200

millirems a year, including medical radiation, according to the EPA.)

Since the existing standard does not apply to medical sources, about all it does apply to in practice is nuclear power generation—uranium mines and mills, fuel-processing plants, the power reactors themselves, and waste depositories. At present, nuclear power contributes less than 1 millirem a year to the public dose, and the committee said it expects this amount will not be exceeded, provided that sabotage and theft of fissionable materials are controlled, that wastes are properly managed, that the performance of nuclear plants does not deteriorate and allow higher levels of emissions, and that catastrophic accidents are avoided.

In sum, said the committee:

> The present guides of 170 millirems per year grew out of an effort to balance societal needs against genetic risks. It appears that these needs can be met with far lower average exposures and lower genetic and somatic risk than permitted by the current radiation protection guide. To this extent, the current guide is unnecessarily high.

The academy committee reserved its most sharply phrased admonitions for the medical profession and its use of diagnostic x-rays, estimated to be increasing at a rate of 1 to 4 percent a year. At present, the panel noted, medical exposures are not under "control or guidance by regulation or law." It went on to say that medical radiation "can and should be reduced considerably by limiting its use to clinically indicated procedures utilizing efficient exposure techniques and optimal operation of radiation equipment."

The committee said that use of improved equipment, proper shielding of reproductive organs, and elimination of unnecessary x-rays could reduce the "genetically significant dose" currently received by the general population by 50 percent. Among procedures listed as probably unnecessary were mass screening for tuberculosis, lung cancer, and gastric cancer; routine x-rays for food handlers; and "possibly" mass screening for breast cancer in women. The committee, however, rejected the idea of a blanket limit on medical radiation for the general public, on the grounds that such a limit would be "impractical." Instead, it indicated, reduction in x-ray exposure could best be brought about voluntarily by the medical profession.

Potentially the most controversial aspect of the academy report is the panel's effort to place numbers on the risks inherent in radiation. It is no longer sufficient, the committee said, to assume that the adverse effects of man-made radiation are "insignificant, negligible, tolerable, permissible, [or] acceptable." If the nation as a whole is to be exposed to increasing amounts of radiation, and if the standard-setters are to presume that no threshold exists below which adverse effects do not occur, then "the only logical basis for decision making" is to express risks and benefits in numbers, and possibly in dollars, the panel said.

In the process of assigning numbers to risks (no attempt was made to quantify benefits), the committee provided what might be read alternatively as cold comfort for the critics of Gofman and Tamplin or as measure of vindication for the two scientists.

They had estimated that exposing the entire U.S. population to the allowed limit of 170 millirems per year would ultimately result in 32,000 extra deaths from cancer each year, an increase of roughly 10 percent in the current death rate from cancer. While the academy committee found fault with some of Gofman and Tamplin's underlying assumptions, the worst it had to say about their calculations was to call them "overestimates." A more accurate estimate, in the panel's view, would be between 3,000 and 15,000 extra deaths each year with a most probable figure of 6,000.

In general, the committee said, for each 100-millirem increment 3,500 added deaths from cancer could result each year. The panel derived these estimates, which it said were "fraught with uncertainty," from studies of survivors of the atomic bombing of Nagasaki and Hiroshima and from mortality statistics on persons treated with radiation for diseases other than cancer.

Table 1. Summary of estimates of annual whole-body dose rates in the United States (1970). [From the academy report]

Source	Average dose rate* (mrem/yr)
Environmental	
Natural	102
Global Fallout	4
Nuclear Power	0.003
Subtotal	106
Medical	
Diagnostic	72†
Radiopharmaceuticals	1
Subtotal	73
Occupational	0.8
Miscellaneous	2
Subtotal	3
Total	182

* The numbers shown are average values only. For given segments of the population, dose rates considerably greater than these may be experienced. † Based on the abdominal dose.

Beyond these figures, the committee said a population-wide exposure of 170-millirems a year for an entire generation could be expected to cause an added toll of genetic defects and diseases of between 1,100 and 27,000 per year and an overall increase in the nation's "ill-health" of 5 percent.

Several years ago, such assertions might have provoked an argument from doctors and the advocates of nuclear power, but so far the outward reaction of the radiological establishment has been only praise and agreement. The Washington *Post* quoted AEC chairman James Schlesinger, shortly after the report was released late last month, as saying that a general tightening of radiation standards may be in order when "radiation from all sources has been reviewed across the board." The panel's admonitions to radiologists are in keeping with the philosophy of the American College of Radiology. And Lauriston Taylor, the president of the National Council on Radiation Protection and Measurements (NCRP), a leading arbiter of radiation standards since the late 1920's, thinks the academy report "was a whale of a job and highly objective. . . . It contained no surprises." If it had, that would have been surprising in itself, as the panel's chairman, Cyril L. Comar of Cornell University, and about a third of the panel's 20 members are also members of the NCRP.

William D. Rowe, the head of the EPA's radiation programs, says the academy report will form the technical underpinnings for revisions in radiation standards that his agency expects to begin during the next 6 months. The form of these revisions remains to be seen, but one possibility under discussion at the EPA is the abandonment of a blanket exposure limit for the general population, in favor of strict limits for specific types of sources, such as nuclear power plants and nuclear fuel facilities. Such limits would take account of increasing numbers of these sources in near-urban areas and would be designed to discourage what one EPA official said has been a tendency under the present standard "to irradiate up to the limit" on the presumption that no other source in a given area was contributing radiation or ever would be.

As for doctors, it seems unlikely that the EPA will exercise its authority so

(Continued on page 1012)

(Continued from page 967)

far as to set population limits on exposure to medical radiation, in part because such limits are seen as impractical and in part because it would be politically difficult to impose them. Instead, the EPA expects to work with other federal agencies and with professional organizations, such as the American College of Radiology, to encourage doctors to improve x-ray equipment and procedures. A likely first target for such improvements is the Veterans Administration, long a pacesetter in the field of radiology.

—ROBERT GILLETTE

APPOINTMENTS

William C. McInnes, president, Fairfield University, to president, University of San Francisco. . . . **Carl M. York, Jr.**, former assistant chancellor, University of California, Los Angeles, to vice chancellor for academic affairs, University of Denver. . . . **Elwyn A. Smith**, vice president for student affairs, Temple University, to vice president for academic affairs, Eckerd College. . . . **Dale W. Lick**, chairman, mathematics department, Drexel University, to vice president for academic affairs, Russell Sage College. . . . At the University of Louisville: **John A. Dillon, Jr.**, dean, Graduate School, also to vice president for academic affairs and **Harold E. Boyer**, dean, School of Dentistry, to vice president for health affairs. . . . **Bert W. O'Malley**, professor of reproductive biology, Vanderbilt University School of Medicine, to chairman, anatomy department, Baylor College of Medicine. . . . **Leonard B. Glick**, associate professor of anthropology, University of Wisconsin, Madison, to dean, School of Social Science, Hampshire College. . . . **Robert H. Koff**, director of teacher education, Stanford University, to dean, College of Education, Roosevelt University. . . . **Franklin C. Fitchen**, chairman, electrical engineering department, South Dakota State University, to dean, College of Engineering, University of Bridgeport. . . . **A. Richard Kassander, Jr.**, head of atmospheric sciences, University of Arizona, to vice president for research at the university. . . . **Warren Winkelstein, Jr.**, acting dean, School of Public Health, University of California, Berkeley, elevated to dean. . . . **James T. Doluisio**, chairman, pharmacy department, University of Kentucky, to dean, College of Pharmacy, University of Texas, Austin. . . . **Harry J. Sievers**, chairman, history department, Fordham University, to dean, Graduate School of Arts and Sciences at the university. . . . **John V. Byrne**, chairman, oceanography department, Oregon State University, to dean, new School of Oceanography at the university. . . . **Kenneth Stocking**, professor of biology, Sonoma State College, to provost, new School of Environmental Studies at the college. . . . **Lloyd E. Berry**, assistant chancellor, University of Illinois, to dean, Graduate School, and director of research, University of Missouri. . . . **Robert W. Krauss**, chairman, botany department, University of Maryland, to dean, School of Science, Oregon State University. . . . **James H. Reeves**, executive assistant to the president, Tennessee State University, to dean, Graduate School at the university. . . . **Ralph L. Carnes**, associate dean, College of Arts and Sciences, Roosevelt University, elevated to dean. . . . **Bernard Kutner**, professor of social science, Albert Einstein College of Medicine, Yeshiva University, to dean, Sargent College of Allied Health Professions, Boston University. . . . **Robert P. Barnes**, professor of history, Central Washington State College, to dean of arts and sciences, Northwest Missouri State University. . . . **Charley Scott**, associate dean, Graduate School, University of Alabama, elevated to dean. . . . **Ray M. Iverson**, professor of biology, University of Miami, to dean, College of Science, Florida Atlantic University. . . . **Michael R. Ronayne, Jr.**, professor of chemistry, Suffolk University, to dean, College of Arts and Sciences at the university. . . . **Lawrence W. Kuhl**, associate dean, College of Arts and Sciences, University of Rochester, to dean, Graduate College, University of Nevada, Las Vegas. . . . **Nancy E. Warner**, director, pathology laboratory, Women's Hospital, University of Southern California Medical Center, to chairman, pathology department, University of Southern California School of Medicine. . . . **Samuel L. Kountz**, associate professor of surgery, University of California School of Medicine, San Francisco, to chairman, surgery department, Downstate Medical Center, State University of New York, Brooklyn.

Addendum: The photograph of Charles Darwin on page 725, *Science*, 17 November, was by courtesy of the Smithsonian Institution.

Personnel Placement

POSITIONS WANTED

Biologist returning to the United States. NIH postdoctorate and private research experience. Diverse interests and broad training in ecology. Box 460, SCIENCE. X

Cancer Research, M.D., Ph.D. Aim: experimental approaches to cancer directed toward clinical applications. Long-time cancer research, teaching and administrative experience. Numerous publications. References. Box 409, SCIENCE. 12/1

General Manager, V.P., director, Ph.D. microbiologist: diversified experience—production quality control, R & D sales in health fields—diagnostics, biologicals, pharmaceuticals, chemicals. Desires management, applied research, Q.C., or academic administration position. Box 449, SCIENCE.

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Science and Society: Lecturer-Writer-Researcher desires position teaching course in dynamics of social change resulting from scientific/technologic change, energy/resources development. . . . analytic interdisciplinary overviews of socioeconomic-cultural-political effects and implications of science and engineering; North America and world, historic to future. Both basic and advanced classes; syllabi courses and seminars, and so forth. Specializing in subject since 1950 researching, writing (including nine pages in *Encyclopedia Americana*), and lecturing (United States, Canada, England), for which biography now in one *Who's Who* and two scientific directories. Presently researcher for college, 1958–; consultant two government (nonmilitary) agencies, one government academy. (Attending December AAAS Meeting.) Box 461, SCIENCE. X

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