

American Association for the Advancement of Science

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Publisher: Richard S. Nicholson

Editor: Daniel E. Koshland, Jr.

Deputy Editor: Ellis Rubinstein

Managing Editor: Monica M. Bradford

Deputy Editors: Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*); Thomas R. Cech (*Biological Sciences*)

EDITORIAL STAFF

Senior Editors: Eleanore Butz, Martha Coleman, Barbara Jasny, Katrina L. Kelner, Phillip D. Szurmi, David F. Voss
Associate Editors: R. Brooks Hanson, Pamela J. Hines, Kelly LaMarco, Linda J. Miller

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*; Teresa Fryberger

Contributing Editor: Lawrence I. Grossman

Chief Production Editor: Ellen E. Murphy

Editing Department: Lois Schmitt, *head*; Julianne Hunt, Patricia L. Moe, Barbara P. Ordway

Copy Desk: Joi S. Granger, Margaret E. Gray, MaryBeth Shartle, Beverly Shields

Production Director: James Landry

Production Manager: Kathleen C. Fishback

Art Director: Yolanda M. Rook

Assistant Art Director: Julie Cherry

Graphics and Production: Holly Bishop, Catherine S. Siskos

Systems Analyst: William Carter

NEWS STAFF

Managing News Editor: Colin Norman

Correspondent-at-Large: Barbara J. Culliton

Deputy News Editors: John M. Benditt, Jean Marx

News and Comment/Research News: Ann Gibbons, David P. Hamilton, Constance Holden, Richard A. Kerr, Eliot Marshall, Joseph Palca, Robert Pool, Leslie Roberts, M. Mitchell Waldrop

European Correspondent: Jeremy Cherfas

West Coast Correspondent: Marcia Barinaga

Contributing Correspondents: Barry A. Cipra, Robert Crease, Karen Wright

BUSINESS STAFF

Marketing Director: Beth Rosner

Circulation Director: Michael Spinella

Fulfillment Manager: Marlene Zendell

Business Staff Manager: Deborah Rivera-Wienhold

Classified Advertising Supervisor: Amie Charlene King

ADVERTISING REPRESENTATIVES

Director: Earl J. Scherago

Traffic Manager: Donna Rivera

Traffic Manager (Recruitment): Gwen Canter

Advertising Sales Manager: Richard L. Charles

Marketing Manager: Herbert L. Burkland

Employment Sales Manager: Edward C. Keller

Sales: New York, NY 10036: J. Kevin Henebry, 1515 Broadway (212-730-1050); Scotch Plains, NJ 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); Hoffman Estates, IL 60195: Jack Ryan, 525 W. Higgins Rd. (708-885-8675); San Jose, CA 95112: Bob Brindley, 310 S. 16th St. (408-998-4690); Dorset, VT 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581); Damascus, MD 20872: Rick Sommer, 11318 Kings Valley Dr. (301-972-9270); U.K., Europe: Nick Jones, +44(0647)52918; Telex 42513; FAX (0647) 52053.

Information for contributors appears on page XI of the 29 June 1990 issue. Editorial correspondence, including requests for permission to reprint and reprint orders, should be sent to 1333 H Street, NW, Washington, DC 20005. Telephone: 202-326-6500. **Advertising correspondence** should be sent to Tenth Floor, 1515 Broadway, New York, NY 10036. Telephone 212-730-1050 or WU Telex 968082 SCHERAGO, or FAX 212-382-3725. **Subscription/Member Benefits Questions:** 202-326-6417.

Uncertainties About Health Effects of Radon

The Environmental Protection Agency is preparing to launch a nationwide campaign to increase public concern about dangers arising from exposure to indoor radon.

This will represent an intensification of an ongoing program. Homeowners are discovering that potential buyers are insisting on radon inspections before agreeing to purchase a home. Some owners have already incurred costs of \$1000 to \$2000 to decrease radon levels to current EPA recommended action levels (4 pCi/liter). But EPA may promulgate more demanding standards. In late 1988, Congress passed the Indoor Radon Abatement Act setting for EPA the goal of reducing indoor levels to those of outdoor air. On average the cost to homeowners would be on the order of \$10,000 each.

Health physicists have become increasingly critical of what they deem to be EPA overestimates of indoor radon concentrations and of their effects on producing lung cancer. For screening measurements, EPA has recommended locating monitoring devices in basements and making measurements during the winter. In homes, a principal source of radon is from beneath the basement floor. During the winter householders tend to ventilate the home less than in other seasons. The recommended screening procedure yields results as much as four times those obtained in yearlong observation of areas in which residents actually dwell. The screening data have been used by EPA to estimate the number of homes needing remediation and the risk of incurring lung cancer from exposure to indoor radon.

The EPA has indicated that annually as many as 20,000 lung cancers would be due to exposure to radon. EPA Administrator William K. Reilly stated at a press conference that people living in a house with an indoor air level of 4 pCi/liter of radon would incur a risk of lung cancer greater than that created by smoking half a pack of cigarettes a day.

To justify its statements about radon, EPA leans heavily on studies of the incidence of lung cancer in miners. The most recent is a 1988 report issued by the National Research Council (1). The relevant committee made an analysis of data available from four different cohorts of miners. The majority of excess lung cancer deaths of the total occurred among uranium miners of the Colorado Plateau. There, smoking habits were known, and it was possible to show that the risks of lung cancer for smokers were substantially increased by large exposures to radon. Hard data concerning large exposures to miners during the late 1940s and early 1950s are sparse, and the committee had to rely on estimates. Conditions in many mines at that time were cramped and primitive, and there was often no ventilation.

The NRC report included the following statement: "In summary, a number of sources of uncertainty may substantially affect the committee's risk projections; the magnitude of uncertainty associated with each of these sources cannot readily be quantified. Accordingly, the committee acknowledges that the total uncertainty in its risk projections is large" (1, p. 47). In its projections to low exposures the committee made the conventional assumption that risk is a linear function of dose. That is, one can extrapolate from high-dose effects to predict those at low doses. This is an assumption that has never been proved.

Uncertainties in a foundation document (1) on which EPA bases its policies create a great need for an epidemiological approach. Such an effort is fraught with the difficulties of trying to measure a small effect due to radon in the presence of a large effect due to smoking. In addition confounding variables are possible. Information is available concerning possible confounders. The electronic computer makes it feasible to store the relevant data and to subject it to multivariate analysis. Bernard L. Cohen at the University of Pittsburgh has accumulated a data set that provides substantial coverage of about a third of the counties of the United States. He has performed a large-scale analysis of the data and concludes that at low doses found in the average home, radon does not have an adverse effect (2). Were his findings to be confirmed by further studies costing some millions of dollars, the public might be saved not only needless anxiety but many billions of dollars as well.

Instead of efforts directed at all homeowners, EPA should give priority to identifying rare circumstances (including high soil permeability and radium content) where elevated levels of radon prevail and encourage remediation there.—PHILIP H. ABELSON

1. *Health Risks of Radon and Other Internally Deposited Alpha Emitters, BEIR IV* (National Academy Press, Washington, DC, 1988). 2. B. L. Cohen, "Multi-stratified multiple regression tests of the linear-no threshold theory of radon-induced lung cancer," unpublished paper.