RISKS, RADON AND PUBLIC PERCEPTIONS

John F. Ahearne (September 1988, page 36) indicates that he has become disenchanted with the relevance of objective scientific studies of comparative risks. He cites the views of eminent social scientists as having led to this change of heart. But he does not comment on the possibility that these references may reflect an element of vested interest.

It is understandable that specialists like to feel that their own discipline provides the key to resolving burning public issues. Thus social scientists, who are skilled in the study of public perceptions and the power of political constituencies, tend to reject as irrelevant the issues of technological and economic realism, with which they are unfamiliar and uncomfortable, but which would have to be addressed in objective scientific evaluations of alternative societal options. Similarly, most members of the legal profession seem reasonably satisfied with adversarial litigation, and may sense that attempts to introduce a higher degree of scientific rationality into judicial proceedings would cause the attorneys to lose a measure of control.[1]

Horror stories concerning the squandering of resources that results from ignoring objective scientific conclusions about relative risk are finally beginning to surface.[2] The indoor radon problem illustrates particularly well the glaring inconsistencies in our present national approach to risk mitigation.[3] As Anthony Nero recently observed in PHYSICS TODAY (April, page 32), "in a given house, decreasing ventilation does tend to increase the radon concentration." The associated incremental radiological exposure to occupants of a sealed-up home could be orders of magnitude larger than is tolerated from a nuclear facility or radioactive waste repository. (Nero estimates that the radon level exceeds 150 Bq/m^3, or 4 pCi/liter, in some 6% of US single-family dwellings. This causes an estimated cancer risk to occupants equivalent to that from an exposure rate of about 800 millirems/year to the entire body.) As little as a 5% increase in the indoor radon level in an otherwise "safe" home would cause an equivalent incremental exposure of 40 millirems/year, which is above the emission level at which operators of a nuclear power plant are now required to recommend mass public evacuation.

Those who recommend and subsidize the sealing up of homes for purposes of energy conservation continue to steadfastly reject all suggestions of careful "before and after" measurements of indoor radon levels when energy-conserving home modifications are made. Proponents of residential energy conservation take refuge in pointing out that any incremental radiological exposures from sealing up homes would probably be far lower than the naturally occurring variations in the exposures the public receives. But this consideration is routinely ruled out of order in debates concerning nuclear meltdowns, to say nothing of the analogous controversies concerning trace carcinogens from residual pesticides in food.

In part because of the aversion of individuals like Ahearne to objective scientific studies of comparative risk, the nation is allocating to the mitigation of risks from nuclear meltdowns and radioactive waste repositories resources that are many orders of magnitude larger than what is allocated to the mitigation of the much larger public risk from indoor radon. Such absurdities will continue to sap the vitality of our nation until the public is made to realize how much they detract from the quality of our lives.

References

1. P. Huber, *Liability: The Legal Revolution and Its Consequences*, Basic Books, New York (1988).
2. P. Passell, "Risk and Public Policy" (two-part article), New York Times, 8 May 1989, p. A1; 9 May 1989, p. A1.
3. H. Hurwitz Jr, Risk Anal. **3**, 63 (1983).

HENRY HURWITZ JR
Schenectady, New York

5/89

Anthony Nero's article "Earth, Air, Radon and Home" attempted a broad

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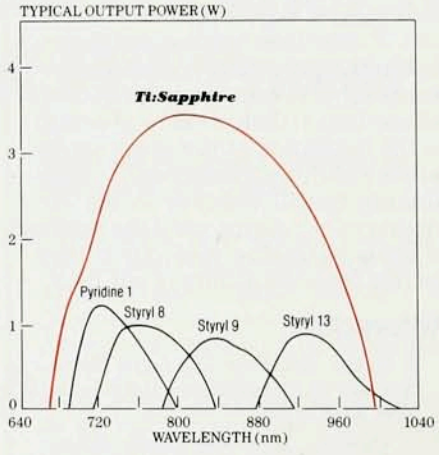

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overview of the radon question. His introductory discussion of epidemiological conclusions based upon studies of uranium miners is misleading. He fails to distinguish between the early Colorado and Utah miner study and later ones in Canada, Sweden and elsewhere. Duncan A. Holaday found radon concentrations as high as 50 000 pCi/liter, with typical levels of 2500–5000 pCi/liter, in the Colorado–Utah miner study.[1] These levels would be several thousand times those found in US homes.

The cursory retrospective study of the Colorado–Utah miners did indeed establish that the older miners exposed to more than 120 WLM (work level months) of radon exposure had a higher incidence of lung cancer.[2] However, such obvious causal factors as smoking (most older miners smoked), the presence of dusts and various pollutants, age, physical health, the job stress of deeper pit mining and other variables were ignored.

The claimed hazardous levels of radon in American homes have been trumpeted by the Environmental Protection Agency since the 1984 finding of 1350 pCi/liter of radon in the Watras home in the Reading Prong area of eastern Pennsylvania. Subsequent detailed remediation did reduce the radon concentrations to normal levels (the immediately adjacent homes were already at normal background—about 1 pCi/liter). The EPA has estimated that 5000–20 000 lung cancer deaths per year in the US are attributable to Rn progeny exposure. No proper epidemiological study supporting this risk projection has yet appeared.

"A Citizen's Guide to Radon" has been widely distributed by the EPA. This brochure, in addition to trying to correlate various exposure levels of radon with *estimated* lung cancer deaths, offers comparable risks from such known health hazards as cigarette smoking. These correlations have been criticized for having absolutely no supporting clinical or experimental evidence.

I checked Nero's reference to a calculation by A. C. James[3] of the deposition of Rn^{222} decay products in lung tissue. James states unequivocally, "The dose to lung tissue cannot be measured." He goes on to describe the disparate assumptions made by various authors in modeling lung dose, which lead to divergent estimates of risk.

Newer epidemiological studies are under way. Such research is difficult and time consuming if done in an objective and sound manner. Until the new information is available, a more balanced approach to dealing with possible hazards of radon in the home is needed. It seems prudent to adopt the attitude that until the evidence is established, let us be safe and assume that the hazard is real. Unfortunately, that thinking has spawned all sorts of confusion, hysteria and rip-off artists in addition to well-intentioned efforts to deal with the radon question.

Some areas of the country have already seen real estate transactions requiring certification of a radon level of less than 4 pCi/liter before consummation of a home sale. Rn measurement conditions can vary widely, resulting in legitimate fluctuations in radon quantification. One can easily imagine the possible machinations undertaken to acquire the 4-pCi/liter certification in order to close a lucrative real estate sale. Other abuses, such as overpriced remediation work performed unnecessarily, have been reported.

Lynn M. Hubbard's book review of several recent radon books (including one coedited by Nero) in the same issue (page 72) provides an excellent conclusion for this letter: "Given the magnitude of our exposure to radon and its progeny, continued research is necessary both to make the problem more tractable and to enable intelligent policy decisions."

References

1. D. A. Holaday, Health Phys. **16**, 549 (1969).
2. K. L. Jackson, J. P. Geraci, D. Bodansky, in *Indoor Radon and Its Hazards*, D. Bodansky, M. A. Robbins, D. R. Sadler, eds., U. Washington P., Seattle (1987), chap. 8.
3. A. C. James, in *Radon and Its Decay Products in Indoor Air*, W. W. Nazaroff, A. V. Nero, eds., Wiley, New York (1989), p. 259.

AHREN JACOBSON
University of Louisville
Louisville, Kentucky

5/89

Unlike John Ahearne, I do not believe that the public mistrusts technical experts because "the public doesn't understand us." I think, rather, that it's because the public understands us all too well. The public perceives, and perceives correctly, that scientific experts are often more interested in achieving their own agendas than in offering disinterested advice. Thus when nuclear engineers readily reassure us of the safety of nuclear power, we must remember that most nuclear engineers earn their living from the nuclear power industry.

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Many of the staunchest advocates of particular weapons systems (be it the B-1 bomber, the MX missile or SDI) work for contractors who stand to make millions from these weapons systems. Scientists who tell us that environmental pollution is not a problem are often employed by the worst polluters. Advocates of expensive "big science" projects, such as the Hubble Space Telescope, the Human Genome Project and the Superconducting Super Collider, that will enhance their own research areas often seem totally oblivious to other, more pressing national needs. The first law of expertise is that if you want disinterested advice, "don't ask the barber if you need a haircut."

ROBERT J. YAES
University of Kentucky
Lexington, Kentucky
9/88

NERO REPLIES: Ahren Jacobson's discussion of the health data is a bit perplexing. We would all agree with Jacobson's cautions about the confusion and even machinations with respect to radon testing and remediation now occurring, which are due largely, I think, to the way the Environmental Protection Agency has portrayed the problem and organized its "action" programs. A particular difficulty is its recommended monitoring protocol, which—because it does not indicate concentrations to which people are actually exposed—commonly results in misinterpretation, even of the EPA's own data.

However, Jacobson's representation of the available epidemiological data and their interpretation is misleading. He does not refer to the many studies, reported in papers later than Duncan Holaday's, where exposures were much lower than in the Colorado plateau studies—in fact, where the concentrations and exposures were the same as occur in many homes. Moreover, researchers *have* examined a wide variety of confounding factors, with special attention to the most important one, smoking. And in a wide variety of studies, the added risk of lung cancer does appear proportionate to the exposure. This information, together with the unusually consistent dose–response factor and the confirmatory evidence from animal studies and also from dosimetric calculations, suggests that the estimated risk from radon is probably actually occurring. As to awaiting better epidemiological data, presumably from among the general public, these will almost certainly be long in coming and, even then, equivocal because of the huge background due to cigarette smoking. But in view of the large risks estimated for people with exposures well above the average, and lacking a final word on risks, we are left with the need for considered action.

Henry Hurwitz Jr asserts the need to reach an "objective scientific conclusion" about relative risk, but what he really appears to be doing is using the case of radon to grind an ax about the (supposed) overregulation of nuclear power. In striving for this objective, he overlooks the fact that one does not expect numerical limits on exposure to be the same in different circumstances. His comparison between exposure limits for nuclear power and the effect that "tightening" homes might have on radon exposures is akin to my inferring that because 200 lbs is considered to be too much weight for most people, my 2000-lb car must be vastly overweight! The point is that similar underlying criteria for cost per unit risk reduction will yield different numerical limits in different settings. And the resulting limits can diverge even more if the underlying criteria differ, as they often do when contrasting a risk caused by an outside agent—such as an industrial polluter—with one arising from circumstances under the individual's own control—such as one's home.

This is not to say that none of our choices are out of whack. For example, my colleague Art Rosenfeld and I have speculated that 1% of the $50–100 billion being talked about to clean up the US weapons production facilities would, if spent to find and fix the 100 000 "hottest" radon houses, bring about on the order of 100 times the risk reduction of the facilities clean-up. The implied difference of a factor of 10 000 in cost–benefit ratios suggests a very large discrepancy in how these risks are evaluated. But we learn little from a direct comparison of numerical exposure limits themselves, such as Hurwitz presents in his supposely "objective" risk comparisons.

ANTHONY V. NERO
Lawrence Berkeley Laboratory
Berkeley, California
7/89

AHEARNE REPLIES: It is not "views of eminent social scientists" that have led to may change of opinion (not "of heart"—in my physicist's "heart" I still prefer technical analysis). My views have changed because of years of experience dealing with the public on controversial issues, such as reactor siting and operations, the Three Mile Island accident, allocation of money for community services, and the Vietnam War. My change is

based on empirical data, not theory.

I certainly have no aversion to studies of risk, although I am less of a supporter of "acceptable risk" studies. However, as I wrote in my article, "scientists and engineers have the most to learn about the process of making sound technology policy." I believe we do not understand that in most disputes involving technology, the public is arguing values, not facts—and technologists seldom address values. Developing the best available information and performing thorough analyses, including identifying uncertainties in knowledge, remains necessary for understanding the technical aspects of the issues. However, such analyses often (usually? always?) overlook the value issues that are at the heart of most public concerns.

I agree that there is a need to get disinterested advice. Organizations such as the National Research Council and the Office of Technology Assessment serve that purpose, as would the "friends of the court" system I advocated in my article.

Finally, 40 millirems per year is not "above"—or at—the evacuation level for nuclear power plant accidents. The Nuclear Regulatory Commission regulation requires that emergency plans be developed for areas surrounding nuclear power plants in case of an accident that might release radiation. As part of these plans, utilities are required to have a process for providing recommendations for action to the local and state governments. The regulations do not specify any levels for action. However, in discussion with the planning groups, the Federal representatives will suggest using as trigger levels the action levels provided in draft EPA regulations. These levels are based not on dose rate, but on projected doses received by the general public. Following these action levels usually would lead to recommending sheltering when the estimated dose exceeds 1 rem to the whole body, or 5 rems to the thyroid gland, and recommending evacuation when the projected dose exceeds 5 rems to the whole body, or 25 rems to the thyroid. The actual recommendations would be based on the state of the reactor, weather conditions and other local factors.

JOHN F. AHEARNE
Resources for the Future
Washington, DC

6/89

Thoughts Unbottled by Cold Fusion

I very much enjoyed reading Barbara Goss Levi's characteristically fine re-