women "stay home and mind the children" is underutilizing the abilities of half of its citizens. It is true that women have a variety of abilities to offer to society, a variety at least as great as men, but it does not follow that women or men who choose to use their talents in raising children are being underutilized. If I had chosen to stay home and mind the children instead of being the more traditional breadwinner, I would not say that my abilities were being underutilized.

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■

Radon Risk Estimates

We are writing in reference to the article by Richard Stone "EPA analysis of radon in water is hard to swallow" (News & Comment, 17 Sept. 1993, p. 1514), and his more recent remark on the same topic in another News & Comment article "Can Carol Browner reform EPA?" (21 Jan., p. 312). Stone attributes much of the debate over regulation of radon in drinking water to the scientific merit of Environmental Protection Agency's (EPA's) risk assessment for radon. The purpose of this letter is to clarify several issues related to that assessment.

Although Stone emphasizes that there are "uncertainties in the science underlying the risk analysis" for radon in drinking water, he does not report that EPA itself conducted a quantitative uncertainty analysis of the radon risks (*1*). In that analysis, inhalation and ingestion risk estimates were characterized in terms of median values and credible ranges that were based on uncertainties of various parameters used in the risk calculations. The analysis was reviewed and generally well received by the Radiation Advisory Committee of EPA's Science Advisory Board (SAB) (*2*).

In discussing EPA's estimate "that radon in drinking water causes 192 excess cancer deaths," Stone states that this figure was based "primarily on an unpublished study . . . on . . . xenon." The xenon study is an EPA-funded project to improve the dosimetric estimates of ingested radon (*3*). This report has been available to the public since July 1991, when EPA published the proposed national primary drinking water regulations for radionuclides (*4*). More important, the findings of the uncertainty analysis indicate that the inhalation risk of decay products from waterborne radon actually dominates ingestion risk of radon in water. The median value of estimated cancer deaths per year (113 cases) from inhalation is 2.5 times higher than the 46 cases from ingestion (*1*, *5*). Furthermore, the inhalation risk estimate is based on strong epidemiological evidence from studies of underground miners and is supported by animal studies (*6*).

Stone quotes the SAB Executive Committee's letter (*7*) to the effect that (in absence of direct human or animal data) "it is not possible to exclude the possibility of zero risk from ingested radon." Although there are no human or animal data that directly demonstrate risks attributable to ingestion of radon, ingested radon irradiates tissues of the body with alpha particles and can lead to cancer risk (*1*, *8*, *9*). EPA's estimate of risk is derived from information on (i) the biokinetics of radon in the body; (ii) the radiocarcinogenic effects of ionizing radiation in humans, primarily the information on effects of gamma rays from atomic bomb studies; and (iii) the relative biological effectiveness of alpha particles compared with gamma rays, inferred mostly from animal studies (*1*). While EPA has followed the recommendations of the National Academy of Sciences committees in estimating the risks from internally deposited alpha emitters (*6*, *8*, *10*), we recognize that there is not universal agreement with this approach. To the extent possible, EPA quantified the uncertainties in its estimates and discussed in qualitative terms uncertainties that could not be quantified (*1*, *5*).

Risk assessment is a continuing process that evolves as new data becomes available. There is always room for scientific debate over radon risk estimates and their associated uncertainties. However, in our opinion, most of the controversy surrounding the regulation of radon in water is really about whether EPA should examine the risks of radon in greater context and focus its efforts on the problem of radon in indoor air (*2*, *7*). EPA's risk assessment shows that the magnitude of population risk attributable to waterborne radon is relatively small compared with that attributable to radon entering homes from soil. Whether or not a well-characterized estimate of 192 annual excess cancer deaths from waterborne radon indicates a major threat to public health, and whether or not waterborne radon risk should be balanced against indoor air radon risk are legitimate topics for public debate. We believe that it is incorrect, however, to imply that the basic issue is a scientific one.

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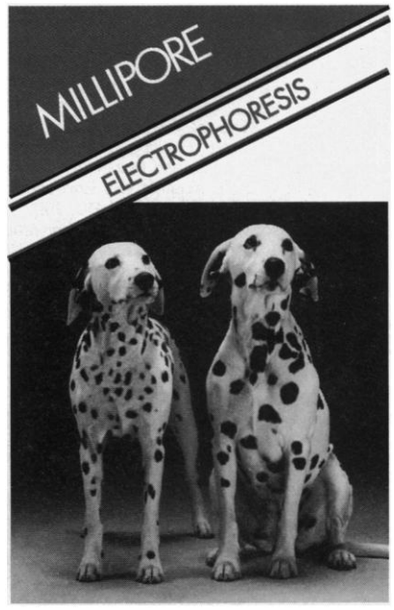

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Corrections and Clarifications

The enzyme shown in the photo on page 1363 accompanying the 11 March ScienceScope item "Lobbying backfires on LBL, Berkeley" was not a "designed enzyme" or an engineered protein, nor was it human glutathione S-transferase. It is a representation of the mu 3-3 isozyme of rat liver glutathione S-transferase with an inhibitor, 9-(S-glutathionyl)-10-hydroxy-9,10-dihydrophenanthrene. The structure was determined at the Center for Advanced Research in Biotechnology as a result of collaborative work between the laboratory of Gary L. Gilliland and that of Richard Armstrong in the Department of Chemistry and Biochemistry at the University of Maryland, College Park [X. Ji *et al.*, *Biochemistry* **33**, 1043 (1994)].

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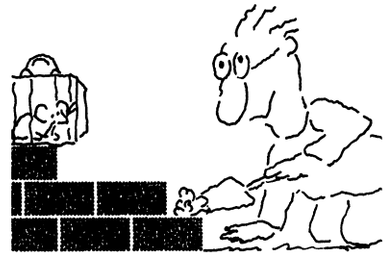

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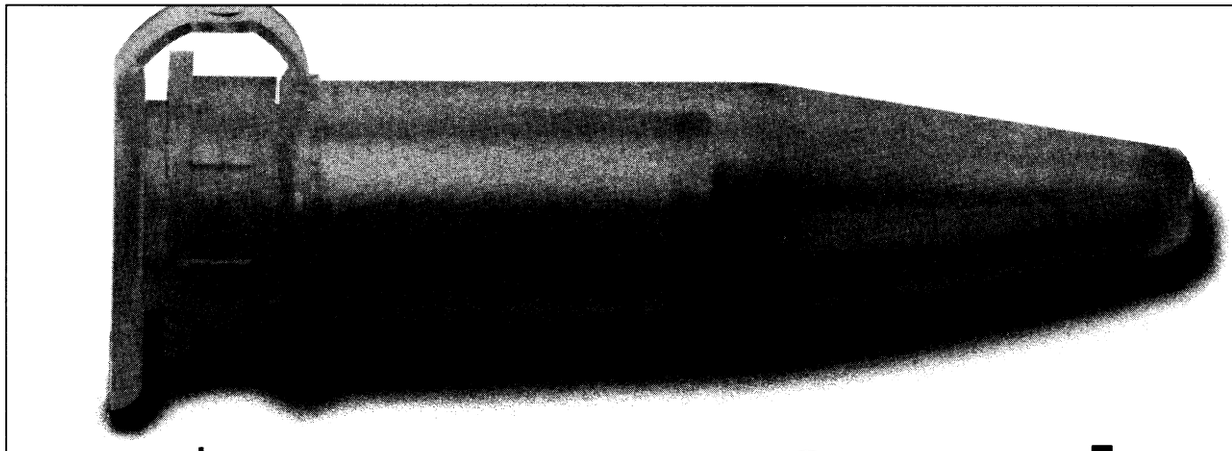

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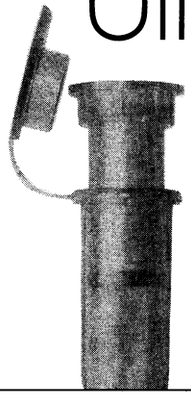

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