CANCER POSTPONEMENT WITH RADON

Access to Energy has published articles about radiation hormesis for many years. Petr Beckmann even wore a vest filled with low-level radioactive material in order to illustrate this effect and to take advantage of its health benefits. Although there is a large and rapidly grow-research literature demonstrating radiation hormesis under many different conditions, the work by Bernard L. Cohen at the University of Pittsburgh on radon and lung cancer is probably the most spectacular. We first reported this in the *Access to Energy* article entitled "Vitamin R?" in *AtE* **21**, No. 4, p 4, December 1993. Cohen (who will be speaking at our annual DDP meeting to be held in San Diego on June 14-15) has continued to refine this work until it has become a giant, irremovable spike driven through the heart of the no-threshold linear hypothesis. Since this hypothesis is the foundation of virtually the entire antinuclear fear industry, Cohen's work is revolutionary. Without the no-threshold linear hypothesis, the enviro radiation bogey from fear of nuclear power plants to concerns about radioactive waste dis- posal becomes baseless propaganda. Moreover, since the antinuclear movement was the first of the great enviro success stories, the collapse of the credibility of this movement can seriously damage the effectiveness of current enviro propaganda in other areas as well.

Cohen's most recent paper, "Lung Cancer Rate vs. Mean Radon Level in U. S. Counties of Various Characteristics," *Health Physics 72, No.* 1, January 1997, is even more of the same. At this point, the only real question is: Why are we not reading about Cohen's work in lRe *Wall Street Journal* and the *Reader's Digest?*

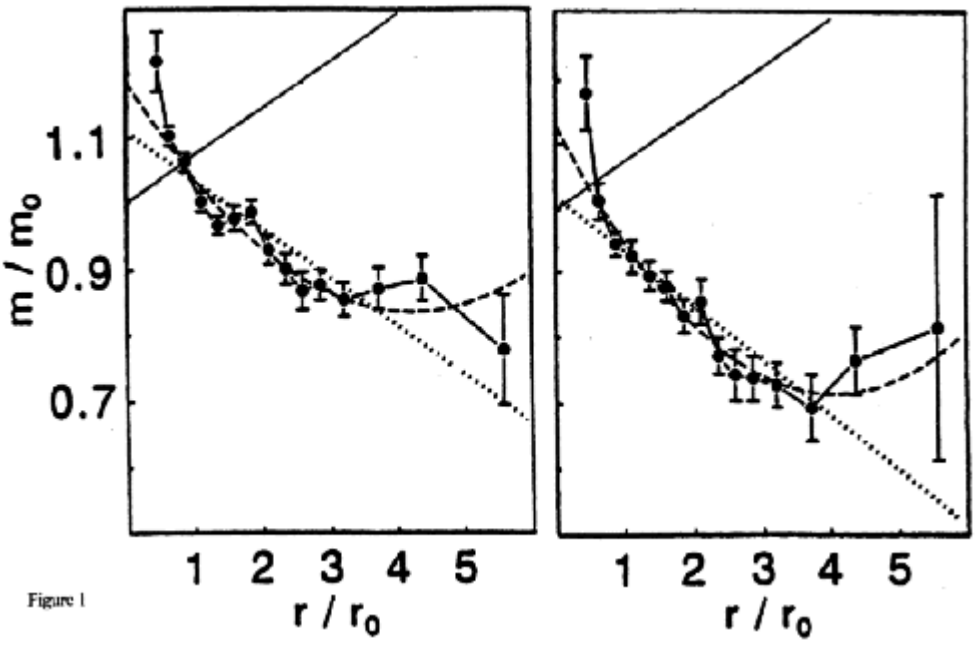

Figure 1

Figure 1, adapted from Cohen's paper, shows the essence of this work. These are graphs (men on the left and women on the right) of lung cancer incidence "**m**" average home radon levels "I=" in

more than 1,600 counties containing 90% of the population of the United States. These counties have been combined into groups having similar radon levels. The lung cancer incidence for each of these groups has been averaged to produce a single data point.

The error bars shown above and below each point give one standard deviation of the variance of the sets of individual counties. This means that there is an approximately 67% chance that the actual mean value is within this mnge. There is about a 95% chance that the mean lies within two standard deviations or twice the range in the error bars on the graph. Errors are larger for the points at each end of the graph because fewer counties are averaged to calculate these values. The point-to-point consistency of the data along the graph makes the chance that the observed effect is a random fluctuation essentially zero.

"M_o" is a correction factor that removes smoking as a systematic variable, and "r_o" is a consmt that is applied so that the units of the bottom axis will be pCi per liter of air. The dotted line is a least- squares straight line fitted to the data e dashed line is that of an equation of the form $m / m_o = A + Br + C_2$ fitted to the data. The solid straight line that is aimlessly crossing the upper left comer of each fig- ure is predicted by the no-threshold linear hypothesis. This line rises I linearly from zero & one to intersect data at very high radiation doses.

Notice that the incidence of lung cancer falls as the radon level in the homes rises. This is not a small effect. There is a reduction of approximately 30% in the incidence of lung cancer in homes averaging 4 pCi per liter of air vs. homes with ten-fold less radiation. At high enough levels of radon, of course, it would be expected that the lung cancer rate would rise back to the control level and then continue to increase with increasing radon doses. There is some indication in Cohen's data that the plateau from which that rise occurs may be in the 4 to 5 pCi per liter range. Until that range is reached, however, the more radon in the home, the lower the lung cancer rate.

Although Cohen's discovery cannot be a random fluctuation, it is theoretically possible for it to be the result of an uncontrolled systematic variable - some extraneous thing that causes the correlation. Two questions are at issue. First, does the correlation really exist? If so, then most people who live in "radon contaminated" homes have a smaller chance of contracting lung cancer. Second, although correlation cannot prove causality, is the radiation the cause of the lower cancer rate?

Since there is already a sound theoretical and experimental basis for reduction in cancer incidence caused by ionizing radiation in other in- stances (see, for example, "Intrinsic Mutations" in Access *to Energy 24, No. 5,* p 3, January 1997), if the correlation really exists, it is prob ably a causal one. Rigorously fulfilling his ethical scientific responsi- bility to try his best to prove himselfwrong, Cohen has conducted an exhaustive, three-year search for systematic variables in his data that might account for all or part of the observed correlation. (This sort of search is virtually nonexistent among the "scientists" of the tax financed enviro industry who dominate media coverage in today's at- mosphere of political nonscience.)

He has checked for the effects of total population, population per square kilometer, rate of population growth, percent of population living in urban areas, percent of population in the age range 5 to 17 years, percent of population in the age range over 64 years, average persons per

household, birth rate, death rate, physicians per capita, hospital beds per capita, rate of births to teen-age mothers, percent of adults that are college graduates, percent of adults that are high school graduates, dollars per capita spent on education, crime rate, percent of houses that are owner occupied, percent of houses with two or more automobiles, annual income per capita percent of population below poverty level, percent unemployment, average wage (excluding farming), percent of earnings from farming, percent of earnings from manufacturing, per- cent of earnings fkom services, percent of earnings from retail trade, percent of earnings from government, dollars per capita sales of cloth- ing, dollars per capita sales by restaurants, percent of local government spending allocated to health, percent of local government spending al- located to welfare, percent of local government spending allocated to roads, geographical location, and smoking prevalence. He has grouped and calculated his data in more than 100 different ways.

In all of this work, Cohen has been unable to find any factor that changes the basic shape of the curves shown in Figure 1. In his paper cited above, he has published graphs of those variables having the largest effect on the curves,. In all essential characteristics these curves are quite similar to those in figure 1.

The conclusion to be drawn is that, if you live in a home with mdon levels higher than normal (but not ridiculously high, which is rare), you have a lower than normal chance of contracting lung cancer. Moreover, the shape of the curves in Figure 1 demonstrates a classic hor- mesis effect. As the ionizing radiation dose rises, the incidence of cancer decreases until a lower plateau is reached. Although too few American homes have high enough radon levels to demonstrate the effects of radiation above this plateau level, it is to be expected that, at some stih higher radon level, the cancer incidence rises to be equal to that in the low-radon homes. At even greater radiation levels, cancer incidence would be expected to be still higher, but there is insufficient data available to demonstrate this.

The no-threshold linear hypothesis predicts (without experimental verification) that radiation at all levels is harmful to health. "No threshold" is the notion that there is no radiation level threshold below which radiation is not harmful. According to this hypothesis, the harm- ful effects of very high radiation levels can be used to estimate the harmful effects of low level radiation by a simple linear extrapolation through zero - the point of no harmful effects at zero dose. Not only has this hypothesis never been experimentally verified, it has now been experimentally shown to be not true. It turns out that radiation in mod- erate amounts is actually beneficial to health.

Professor Cohen puts it this way: "The very foundation of the scientific method is the requirement that any theory which is not in agreement with experimental observations must be abandoned (or modified) unless a plausible explanation for the discrepancy can be provided or conflicting data which supports the theory are available. Cohen (1995) laid out such a situation for radon exposure as a causal agent for lung cancer. Statistically indisputable evidence for a very large discrepancy between observational data and the linear no-threshold theory of mdia- tion carcinogenesis was presented. In spite of the fact that these results are widely known in the scientific community, there have as yet been no convincing explanations offered by others that would support linear no-threshold in this case. There are no other observational data in the low

dose region treated by Cohen (1995) that can be interpreted as confkting with its results. To continue acceptance of the theory in this situation would appear to violate the scientific method." He points out that there are no published experimental observations that are inconsistent with his results and that, where there is overlap with other experiments, the results are entirely consistent with his.

So, radon levels are *negatively* correlated with lung cancer up to levels of 2.5 pCi per liter and are not positively correlated with lung cancer until radon levels are above 4 pCi per liter. Radon levels must rise substantially above 4 pCi per liter before cancer incidence equals that of low-radon homes. There are about seven lung cancer deaths per 10,000 Americans per year in low-radon homes (less than 0.5 pCi per liter) and about five lung cancer deaths per 10,000 Americans in homes with 2.5 pCi per liter (see Access to Energy 21, No. 4, p 4).

Calculating as follows: (7 - 5) (250,000,OOO) / (10,000) = 50,000. Dividing by two (since the cancer rate falls linearly with increase in dose and the distribution of counties is approximately uniform), and rounding conservatively downward, one might estimate that at least 20,000 people are dying of lung cancer each year in the United States who could have been saved by raising the radon concentration of the airintheirhomes. Does this mean that, in part, lung cancer is a radon deficiency disease - or, more correctly, lung cancer is partly an ionizing radiation deficiency disease?

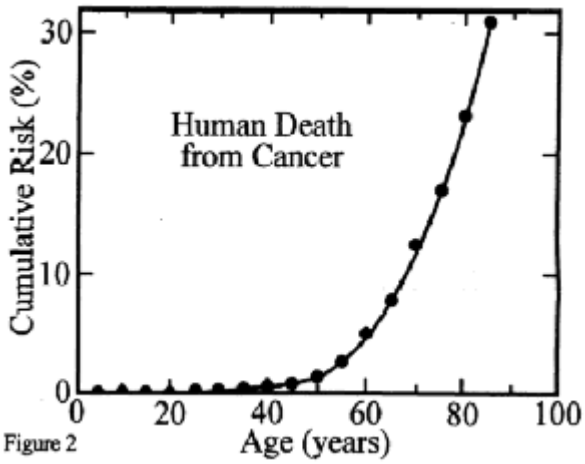

Figure 2

Perhaps, but consider Figure 2, adapted from the publications of Bruce Ames (see Access to Energy **21, No. 8,** p 2, April 1994, for refm- ences). With current knowledge, people are engaged primarily in cancer postponement rather than cancer prevention or cancer cure.

Ionizing radiation apparently strengthens the ability to resist cancer, thereby, in the case of radon, mducing the lung cancer death rate. If, however, one is able to avoid an earlier death from all other causes, his chances of contracting cancer rise so rapidly with age that he will probably eventually die of that disease. It is misleading to suggest that ionizing radiation or any other preventive measure currently in use prevents cancer indefinitely. The only known way to completely avoid death from cancer is to arrange to die from some other cause first.

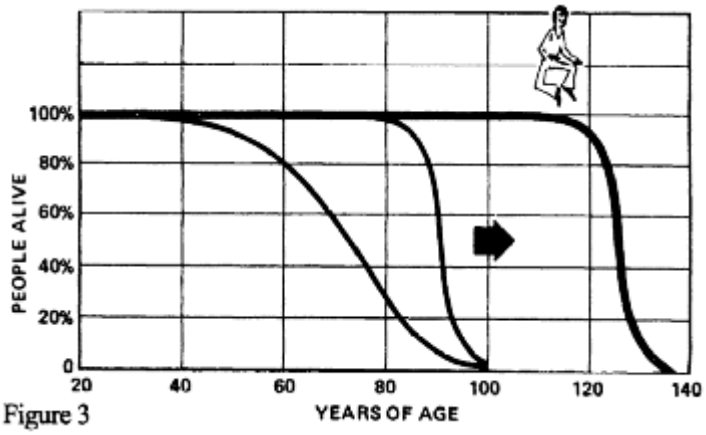

Figure 3

The first curve in Figure 3 represents the current American l&span (see A. B. Robinson and L. R Robinson, *Mechanisms of Ageing and Development* 59, pp 47-67 (1991)). The second curve represents the improvement possible through prevention of early deaths, while the third illustrates extending the intrinsic lifespan. Ionizing mdiation helps us to turn the first curve into the second. It may have no effect upon intrinsic lifespan. No one now knows.

We now do know, however, that low level radiation is not harmful to us and that, in all cases studied so far, it is actually beneficial to our health. This is a wonderful discovery. It is also very damaging to the machinations of those whose antiradiation propaganda has diminished our access to nuclear energy.