EPA discovers radon

The US Environmental Protection Agency risks stirring up a hornet's nest over radon.

It is a great shame that even the natural life is not entirely free from hazard, but that appears to be the case. For centuries, no doubt millenia, people and proto-people have been dying prematurely of natural causes — catastrophes, infections, climatic fluctuations and starvation, for example. Much of what passes for modern civilization is a marvellous defence against hazards such as these. Housing, by keeping people warm and dry, helps powerfully in this sense, which it is why it is one of life's little ironies that housing has also emerged, in the past few decades only, as a hazard in its own right. For houses, especially when they are of mineral construction such as stone, are also either a source of radon, the radioactive rare gas whose atoms are inescapably intermediates in the radioactive decay of the uranium and thorium series, or traps for it. One consequence is that all creatures on the surface of the Earth take in radon with every breath they breathe. Another is that those who live in houses may be exposed to extra amounts of radon generated from the construction materials. A third is that, in fashionable regard for energy conservation, houses are now less well ventilated and thus more efficient traps for radon.

The ubiquity of radon has been known for almost as long as radioactivity itself, the best part of a century. Only in comparatively recent decades, with better measurement techniques and accompanying conceptual refinements, has it become apparent that radon exposure must be, for most people, a greater source of biological hazard than other natural sources of radiation. The 1984 report of the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) gives a good synoptic account of the problem. The hazards of this exposure, chiefly the risk of usually fatal lung cancer, have been estimated from records of the incidence of lung cancer in people occupationally exposed to radon in, for example, uranium mines (see, for example, Evans *et al. Nature* **290**, 98; 1981). In very round numbers, the radon contributes more than a half of the average effective dose equivalent of about 2.0 mSv a year which people acquire on account of exposure to natural sources of radiation. The dose due to cosmic rays is roughly 0.30 mSv a year, varying with latitude and altitude.

Most public authorities appear to have awakened only late in the day to the importance of radon as a natural hazard, but the US Environmental Potection Agency (EPA) has been later than most. It seems now to be embarking on a crusade against radon pollution with a zeal and innocence that suggest it may have heard of radon only recently. In Washington two weeks ago, James A. Barnes, deputy administrator of EPA, acknowledged that "radon is a serious public health problem" and that "virtually no one" recognized it as such eighteen months ago. He added somewhat regretfully that radon, being a natural hazard, "does not lend itself to traditional regulatory solutions".

Precautions

What EPA has done so far is to publish two helpful booklets, one for members of the public explaining what the problem is and the other for householders and/or their builders suggesting what might be done about it (sealing off ground beneath houses, better ventilation and so on). There is also a modest programme of survey and demonstration, in conjunction with the states (especially Florida, Pennsylvania, New Jersey and New York), and the promise of more action in the future.

How to give radon the attention it deserves without creating panic? Part of the difficulty is that the two isotopes, ^{220}Rn (commonly called thoron) and ^{222}Rn, with half-lives of 55 seconds and 3.8 days respectively, are ubiquitous only in the sense that small concentrations are found in the atmosphere everywhere; on the basis of the total content of radon in the atmosphere (which, measured in bequerels, is merely an order of magnitude less than that released from the Chernobyl reactor in April), the activity at ground-level should range from 1 to 100 Bq m^{-3}, depending on the weather. But there are huge variations from one place to another, depending on such things as the upward flux of radon from the soil in the immediate locality, the flux from buildings and volcanic regions and even that artificially released into the atmosphere by drilling holes through granitic rocks in the pursuit of petroleum or of geothermal steam.

This is why the radon problem is a haunting problem. While the average effect of atmospheric radon on people living in the United States may be small, enough people are probably subjected to enough radiation dose for the personal consequences to be significant. Mr Barnes said that there may be 8 million people whose involuntary risk of death from lung (and other) cancer caused by radon and its decay products is comparable with that smoking from a pack of cigarettes each day, a lifetime chance of, say, less than one in six.

Costs

Mr Barnes' problem (and other people's) is that there is no way of telling what will be the financial consequences of avoidance. The retro-construction of buildings is not cheap, especially when the few people competent to do the work know that there is a panic on. So, in a roundabout way, the radon question raises a more general and difficult conundrum: by what means does a civilized community strike a balance between precaution and cost in the pursuit of an environment free from a natural risk? Can the community afford the cost of being as free from avoidable risk as it would like to be?

In due course, no doubt, in the special circumstances of the United States, the market may help solve Mr Barnes' problem. Realtors may be required to quote measurments of radon doses when they offer houses for sale, and may find that higher doses mean cheaper prices; that exceptional dwelling will be significantly if stochastically hazardous, people will for the first time find themselves picking and choosing where to live on grounds of radiation exposure.

Two particular considerations complicate EPA's problem: houses built in the 1950s in western states with US funds from materials salvaged from the tailings of uranium mines and subsequently found to leak radon were dealt with stringently at government expense, while the more recent recognition that radon concentrations in the so-called Reading triangle reaching north from Pennsylvania affect millions of people, on whose behalf such stringent standards will not be as readily applied.

Buildings accentuate the natural patchiness of radon distribution. The materials of which they are constructed are a source of radon, while the fact that they are of necessity enclosed allows them to become storage reservoirs for radon from the subsoil. The concentration of radon in the atmosphere of a room will be determined by competition between the rate at which the radon accumulates from external sources, abated by its natural decay, and ventilation in the sense of the rate at which air is exchanged with less contaminated air from outside.

The consequence is that radon radiation doses to the tissues of the human lung vary enormously with location and circumstances. The mean dose (arithmetical, geometrical or some other) will reflect regional characteristics, but the doses to which individuals are exposed will more often be very much greater than very much smaller (which is to say that the distribution is skewed). EPA's problem is that of helping individuals especially at risk to identify themselves, and perhaps to protect themselves, without alarming others. That, no doubt, is why the agency sounds so much like a newcomer to the scene. But it must also face the more enduring and, in the long run, more daunting task of knowing what to say to people whose radiation exposure is about average for where they live, but who know (perhaps by reading journals such as this) that their norm is higher than that of others. □