ENVIRONMENTALLY SPEAKING

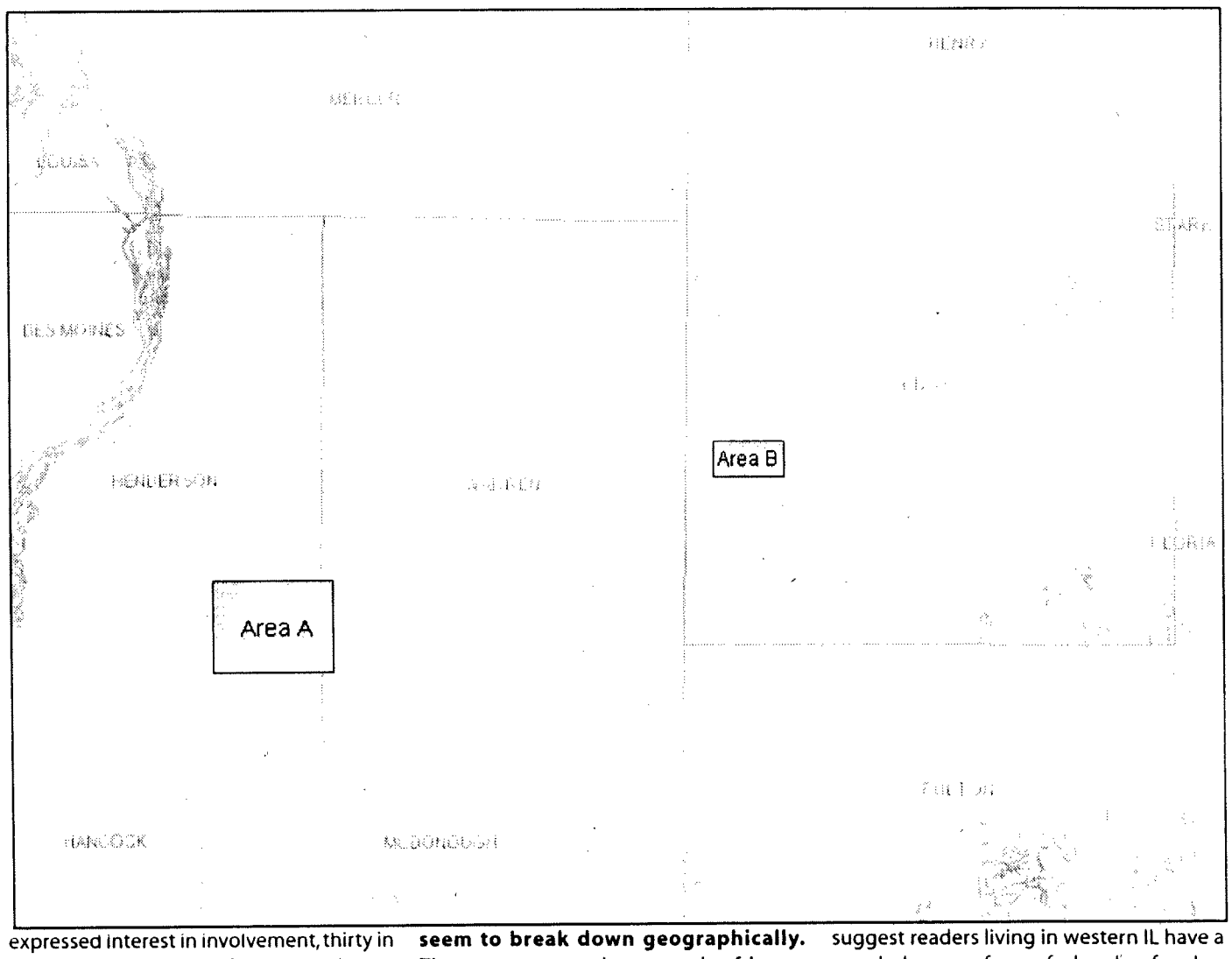
Peter Schwartzman

Radon: How much of it do we have?

by Jenny Van Arsdale and Peter Schwartzman

Part II

As described in Part I (published in The Zephyr July 25, 2002), radon is a radioactive gas that creeps into homes and buildings when naturally occurring radium decays in the soil. Radon disperses and becomes much less of a threat outdoors, but it can become trapped and build up to dangerous levels inside of homes and buildings. Radon has potentially deadly effects and according to the EPA it is the second leading cause of lung cancer, surpassed only by smoking (Darby). Earlier studies have established that western Illinois is a location where elevated, and even dangerous, levels of radon are often found. In the following essay, we will describe research that we conducted this summer in Galesburg and Henderson County, compare it to findings from previous radon studies, and present an overview of methods to mitigate radon levels in one's residence. Hopefully, since Part I, some of you have conducted a radon test and therefore will feel more personally attached to what follows. If you haven't tested, it certainly isn't too late and the information provided here may persuade you that a test is clearly warranted.



Recognizing the potential importance of radon in our region, we set out to learn how radon varies geographically and to look at connections between radon levels and other potentially relevant factors, such as age of home and basement structure. Jenny, having received a summer research fellowship from the Rockefeller Brothers Fund, initiated the project in June 2002 by seeking out volunteers for the testing of private residences in Knox and Henderson Counties. Given limitations of time and ease of communication (i.e., e-mail), volunteers were limited to members of the Knox College community and Jenny's acquaintances residing in Henderson County. She then distributed two charcoal test kits (from the Knox County Health Department) and informative pamphlets (from the Illinois Department of Nuclear Safety — IDNS) to each volunteer homeowner. She asked each volunteer to place one kit in the basement and the other on the level where bedrooms were located. This was done to establish the maximum load, expected to be in the basement (or lowest floor), as well as in an area where a large amounts of time are normally spent. Each participating homeowner was also asked to complete a questionnaire to ascertain information that we had reason to believe might be relevant to the radon levels observed, including, the age of the home, cooling methods utilized, level of ventilation, and basement structure. While the kits recommend that the tests (which took between 3 to 7 days to run) be conducted in closed house conditions, homeowners were asked to ignore this recommendation and to maintain the house in as normal conditions as possible. It is believed that this method allows for a truer ambient radon level, and therefore a better picture of the typical amount of radon exposure, rather than the more elevated level expected in a home with limited ventilation. Once the test results (interpreted by Air Chek, Inc.) became available, they were analyzed with various techniques, including Geographical Information System (GIS) software which allows the construction of maps (such as the ones included). The geographic coordinates of each tested home were recorded using a Global Positioning System (GPS) tool.

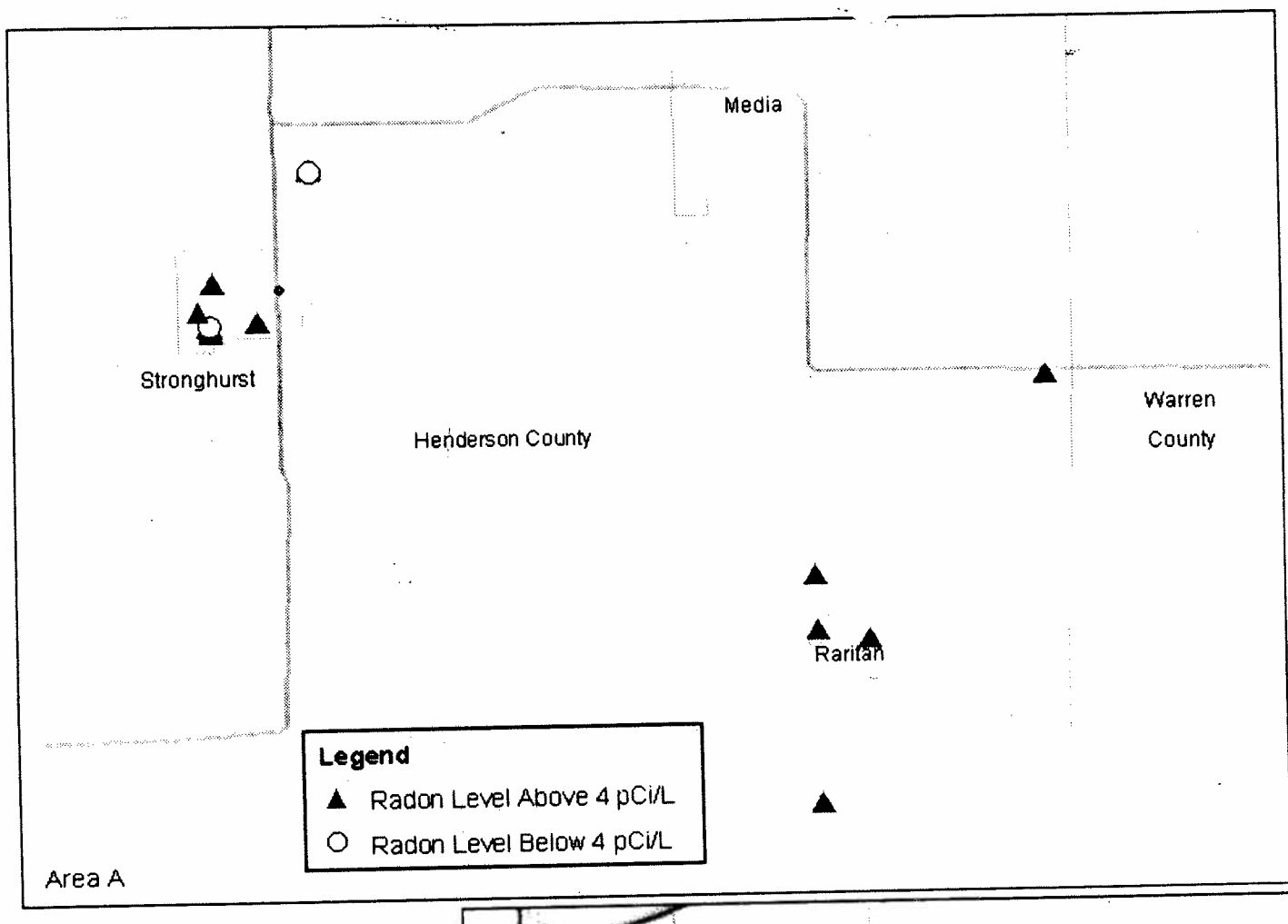
Despite having solicited more than 400 people for the radon study, only fifty-five expressed interest in involvement, thirty in Galesburg and twenty-five in Henderson County. As of the time of publication, test results have been obtained for twenty-one homes in Galesburg and eleven in Henderson County (all located in the southeastern section). This is too small a sample size to say much conclusively about radon in west-central Illinois, but nonetheless the following results warrant reflection. Ambient outside air usually contains up to 2 picocuries per liter (pCi/L) of radon; the average U.S. value is 0.4 pCi/L. The EPA recommends taking action to reduce indoor radon levels when they exceed 4 pCi/L; a home or building that has levels exceeding 20 pCi/L is said to be an urgent problem. Of the twenty-one homes in our study of Galesburg, nine (or 43%) had basement radon levels exceeding the EPA's recommended action level of 4 pCi/L. Four of these nine homes had basement radon concentrations more than three times this level. The average basement radon level found in Galesburg was 6.2 pCi/L and the maximum level observed was 20.5 pCi/L. Of the eleven homes tested in Henderson County, nine (or 82%) had basement radon concentrations above the EPA's recommended action level. The diagram included presents a visual representation of these results. (Note that the geographic distance between Area A and Area B is roughly 30 miles.) The average basement radon level for Henderson County was 7.8 pCi/L and the highest level observed was 22.7 pCi/L. Interestingly, the maximum level in Henderson County was observed just blocks away (in Stronghurst) from the lowest level observed (2.0 pCi/L). On average, the basement radon levels were about twice that of the levels found upstairs in both counties, a finding consistent with other literature. A statistical analysis between the basement values of Galesburg and Henderson County reveal no significant difference, indicating that both areas had similar radon levels, though the 4 pCi/L threshold was met more frequently in Henderson County.

Other analyzes were desired, given the purported home characteristics impacting interior radon levels. Qualitatively, the Galesburg results do seem to break down geographically. There appears to be a swath of lower radon levels that runs from the southwest to the northeast of the city. A statistical analysis of homes tested with windows open and those with windows closed revealed no significant difference in the basement concentrations of these two groups. Unfortunately, there were only eight homes that were tested with windows open as compared to twenty-four homes with windows closed during testing making this conclusion preliminary. Further analysis of the data collected is unduly complicated because variables cannot be easily separated. For example, since most of the older homes are clustered together, is it difficult to decouple the impact of geography from age of home. Also, since age of home is often strongly connected with the basement flooring type (brick, concrete, etc), it is difficult to disentangle age from basement floor type. A more elaborate and informative analysis of the data will require a larger sample size and a more diverse representation of homes.

The Illinois Department of Nuclear Safety (IDNS) completed a study on radon in Illinois in 1992. Between 10 and 261 homes were tested in each of its 102 counties; more were tested in more highly populated counties. Based on their findings, approximately 775, 000 homes in Illinois have radon levels which exceed the EPA's action level of 4 pCi/L. The study also estimates that ~33% of the homes in Henderson County have elevated radon levels (at least 4 pCi/L), while homes in Knox County have a ~62% chance of having these levels; recall that these numbers compare to our findings of 82% and 43%, respectively. It is difficult to say how different these results are from ours, given our smaller sample size. Interestingly, no clear link between construction characteristics and elevated radon levels in homes was found by the IDNS.

Our empirical results provide an initial glance at radon in west-central Illinois. (A more comprehensive study of Knox County is anticipated this winter in collaboration with that county's Health Department.) Both our results and previous studies suggest readers living in western IL have a good chance of unsafe levels of radon exposure. Thus, testing one's home and workplace is strongly recommended. However, there are several limitations to our study that must be kept in mind when reflecting on the utility of the results. First, the sample of homes was limited in number and geographical diversity. Since the participating homeowners live in only a few neighborhoods in Galesburg, many areas of this city or other cities and communities in Knox County weren't represented; similar clustering holds true for the Henderson County subjects also. The low response rate (~15%) must also be dealt with somehow; many people that were solicited didn't seem interested in knowing how much radon they had in their house. Second, while the test kit procedure is very easy to conduct, the instructions were confusing to many homeowners. This may have resulted in spurious results, yet this isn't expected to be a major problem . And finally, while including test results from homes that were not "closed up" does provide a truer sense of the radon levels in summer, it complicates things when attempting to draw conclusions on a yearly value. Residents are obviously exposed to the radon in their homes each minute they are there. Typically, radon exposure is higher in winter than summer because more radon gets trapped in homes during the colder seasons when homeowners are more likely to have their house "shut up." Thus, since our results were conducted during the summer, we expect them to underestimate the true human radon exposure found in homes, but by how much isn't known.

No one is exempt from this imperceptible villain. It could be lurking in any home or building at dangerous levels. Testing is the only way to know what the radon levels are in your house. During the late 1990's more than one million homes were being tested each year. If a test reveals an elevated level of radon, then you should first test again. Test kits can be obtained from the Knox County Health Department for $4. For this price you not only get the kit, but also its examination which is conducted by a company in North Carolina. Results from the test are usually sent back within two



can sleep more easily with this mind. On the other hand, if your home has elevated levels, you can take concrete steps, some structural and some behavioral, to reduce this health risk from you and your loved ones. Given what we now know about radon, there is no need living with our heads in the sand this time.

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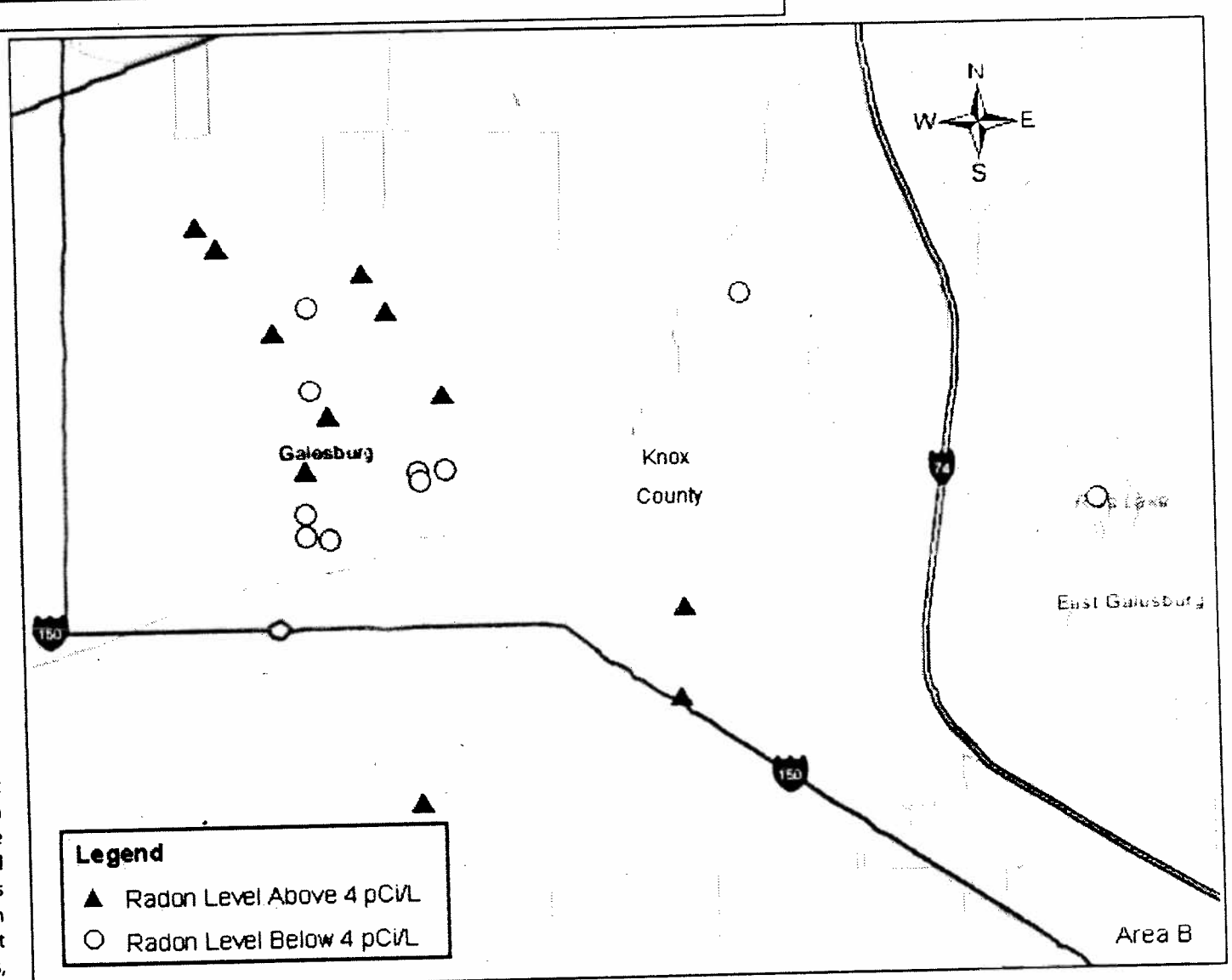
weeks.

Once you confirm what your home radon level is, you must determine if this level needs to be reduced. It is impossible to rid your house of radon entirely and, on a national basis, the average indoor radon level is estimated to be about 1.3 pCi/L. However, the EPA recommends that you fix your home if the you have radon levels above 4 pCi/L. Obviously, the more that your home radon level is larger than this threshold, the more likely it is that you will develop lung cancer from this exposure, and therefore the more important it is for you seek mitigation. According to the EPA, one's risk goes up linearly with the amount of radon exposure, in other words, a 12 pCi/L exposure is three times more risky than a 4 pCi/L exposure over one's lifetime. If one is a smoker, their risk of developing lung cancer multiplies by nearly seventeen-fold (largely because of synergistic interactions between smoking and radon), so clearly reducing or eliminating smoking from one's lifestyle greatly reduces the risk.

Assuming that you decide to mitigate your radon problem, there is a wealth of responses one can make, some more financially draining than others. Most methods attempt to keep the radon from getting into the home in the first place. The most effective, yet most costly, method involves active soil depressurization. In this technique, which typically costs between $1,000-$3000 for installment of equipment and $100 for electricity per year afterwards, a hole is made through one's basement floor and into soil below. From this hole, a fan draws air from the surrounding soil through a network of pipes up to the roof level where the radon-laden gas is released into the atmosphere. The second method involves mechanical ventilation. Here, a fan in the home circulates air on a continuous basis. This method, which is preferred when soil depressurization fails (because ground is too compact or the building materials themselves are a major source of radon), is prohibitive in cold climates because heating expenses preclude additional drawing in of cold air. If you have financial means to carry out one of these more sophisticated methods, be sure to find a contractor who is listed by EPA's Radon Contractor Proficiency (RCP) Program. This way you can be sure that you receive a technically qualified person to perform a successful and effective installation.

For those on limited budgets, there are several things that one can do as well. First of all, one can avoid putting a room which gets a lot of activity (such as a children's room or family room) in the basement, where radon levels are typically much higher. Second, one should seal all cracks in concrete or other masonry that have direct contact with the ground or crawl space; polyurethane caulks and sealants are highly recommended for this purpose due to their durability. Third, one can attempt to ventilate the interior air as much and often as possible. In the summer this means either using an air-conditioning system that draws air in from outside or living with slightly elevated temperatures and fans; the latter not only saves tons of money but, from personal experience, one can definitely get used to it as well. In winter, ventilation is more difficult, but ventilation is highly recommended whenever a "warm" air-mass passes through town. Fourth, for those that are planning to live in soon-to-be built structures, there are several radon-resistant construction techniques that can be employed during a home's construction. These, which include the inclusion of a gas permeable layer, plastic sheeting, and proper sealing and caulking, can save one about 80% on retrofitting a home against radon once the home is already built. (The EPA provides for free an 84-page document that spells out how to use basic construction principles to reduce radon levels; go <www.epa.gov/iaq/radon/images/buildradonout.pdf>.) And lastly, you and your loved ones can spend more time outside. Not only will this probably enhance everyone's physical fitness and allow you to more readily appreciate the natural environment, but it will also reduce the amount of time you spend breathing in radon-enhanced air.

In conclusion, radon levels in homes in west-central Illinois have a good chance of having elevated radon levels. Thus, everyone should at least take the time and limited money ($4) to find out what kind of problem they are dealing with. If you find your home has safe radon levels then you



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