A Field Guide to Radiation
Wayne Biddle

A lot of excellent knowledge, a bit less wisdom

The tone of the Field Guide to Radiation is more negative than I had expected. Certainly there is a lot to be afraid of concerning radioactivity. It is equally true that the threat from radiation is inherently harder for mere humans to judge than danger from almost any other source. We are easily spooked. To my mind Biddle plays a bit too much to our fears. Radiation is dangerous, but we live in a world of dangerous alternatives. He would do a greater service by putting it into perspective.

Let's talk about what is good about the book. It describes the various kinds of radiation, which include alpha, beta, and gamma rays, neutrons, and X-rays. Some of them are particles; some of them are pure energy.

Destructive radiation is what they call ionizing radiation. The book could do a somewhat better job of explaining how it damages living organisms. My lay view is that it essentially amounts to this. Some particle or beam of energy enters living tissue, striking it with enough energy to break the atomic bonds holding together a molecule. When there is enough such damage, the cells cannot keep up with replacing the molecules. They cease to function and they die. Germ cells may suffer genetic damage, causing mutations. The most severe radiation poisoning kills things like the lining of the stomach so that a person can no longer digest food, and death quickly ensues.

Lower doses of radiation can cause problems over the years, especially cancers. One of the points that the author makes is that there is no bottom, no lower bound or safe limit for radiation. He calls this linear no threshold, or LNC. Any radiation at all can be bad. This includes the background radiation in our lives, cosmic rays, radon and the other things to which we are exposed simply by living.

Biddle does an excellent job of describing the many different measures of radiation and how well they convey the threats actually posed. The factors include:
1. How much raw radioactive power is present? The measure is Becquerel or curies. However, this measure does not take into consideration how suddenly it impacts an organism, and the relative destructiveness of the types of radiation given off.
2. Distance from the source,
3. Duration of the exposure
4. How much radiation, and what type, actually enters an object (Roentgens). The predicted effect of that radiation on living tissues (Sieverts). Getting finer, the effect on given organs within the body (skin, a little - gonads, a lot).
There are more than these, and Biddle does a masterful job of explaining them. Don't trust this review - buy the book and use him as your expert.

The field guide format of the book is most appropriate to his discussion of radioactive isotopes. For each element with isotopes widely enough known that you might have heard about them, he tells you how the isotopes are created, what the half-lives of the various isotopes of the element are, what they are good for, how common and how much of a danger they are.

Everything that is radioactive is therefore somewhat dangerous to human health, in that it can cause cancers. It can cause some long-term damage. The question is how much. Here the author lets us down. He does not put things in comparison.

For instance, he says that there were a number of cancers of thyroid cancers caused by iodine 131 resulting from the Chernobyl incident in 1986. I'm willing to believe this. The Chernobyl accident caused a bit more than 50 deaths at the time of the incident. The United Nations has estimated the total number of excess deaths that may have been caused by the incident, primarily from cancer, at 5000. That's a high-end. So granted that some thyroid cancers may have been caused, the question is how many, compared to other causes of death?

Wikipedia tells us that no people have been killed by nuclear accidents since Chernobyl, 26 years ago. Zero. There are no good figures for worldwide excess lifetime cancer mortality risk, but such figures as there are would lead you to believe the figure is not high, perhaps in the tens of thousands annually, worldwide.

We do not see as a matter of perspective. If Biddle were writing frightening stories about water he would tell us that 388,000 people drown every year, certainly a good number, and that doesn't include the people who die of starvation because of flooding, and the people who die of waterborne diseases like typhoid. He could make us believe that water is indeed a very dangerous substance. He would be right. Motor vehicle fatalities? 1,200,000 per year, and yet we drive. And those people are gone for good, right now, instead of simply having a few years shaved off the end of their lives. We know that water and driving are essential to modern life, and that deaths caused by them are a natural part of our existence. Deaths caused by radiation are likewise a part of our existence. For primitive man, deaths caused by lions and tigers were also a part of life. They took it in stride.

The question is not whether or not radiation kills - that point is conceded. The question is the rate at which it kills. How dangerous is radiation compared with everything else? In particular, inasmuch as nuclear energy is being used to generate a great deal of the world's electricity, we need to know how dangerous it is in comparison with other sources of energy, especially fossil fuels such as coal and natural gas. The author does not tell us this. Wikipedia tells us that 20,000 coal miners die annually in China alone. Let's compare apples with apples.

Some questions are left hanging. Nuclear wastes are one. He says there are about 250,000 tons of it accumulated around the world. How much is that? By my arithmetic, enough to fill perhaps five or six Olympic-sized swimming pools. Seen that way, the problem appears manageable.

He says that some radioactive waste generates so much heat through ongoing radioactive decay that it must be continually cooled. Hence the cooling ponds next to nuclear plants. This poses an engineering problem for any permanent waste disposal site, but it does not seem insuperable. The primary reasons that Yucca Mountain was rejected as a nuclear waste disposal site are political. He talks about the island of Nova Zemlye, north of Siberia, in the context of USSR nuclear testing. I would bet they could find a lot of empty space there, and a way to keep things cool, if the world could handle seeing the Russians manage its nuclear waste. Again, a political problem. And what about Canada, Alaska and Antarctica? Prompted by reading Biddle, I bought the 2009 "Managing Spent Nuclear Waste," by the RAND corporation. Admittedly they are somewhat a captive of government, but I found their analysis to be thoroughly rational. Dealing with nuclear waste is a matter of money and political will.

Biddle says there are two sources for the earth's endowment of radiation: primordial, here from the beginning, and that resulting from cosmic radiation. I believe that the heavy elements are just about all primordial. Also, radioactive decay is pretty much a one-way street. Big atoms decay into smaller ones, releasing energy as they go. The earth's endowment of heavy elements must be slowly shrinking over time. Therefore, I extrapolate, the earth's total endowment of potential radioactive energy is continuing to decrease. Somebody tell me if I'm wrong.

Mankind accelerates radioactive decay by bringing fissionable materials into critical mass. There is less U235 on the planet because we put it into bombs and atomic piles where it could deplete itself, giving us energy. The most radioactive products of decay have short half-lives. Pretty soon the products of decay transmute themselves into long lived or inert isotopes. All that said, I would have to assume that on a planet-wide basis there is somewhat less radiation being emitted today than before mankind started messing with it. For the most part, we have just rearranged the distribution of radioactive emissions. To me that begs the naïve question of why we can't just rearrange it back in some way that poses no more danger than the pitchblende did before it was mined. Radioactive waste does not seem like it should be an insuperable problem. Somebody post a comment and enlighten me.

Biddle is shocked that the US government would lie to its citizens about the dangers of atomic fallout, and would administer radioactive substances to unsuspecting citizens to see what happened. Hasn't he read a history of the CIA? About Tuskegee? About forced sterilizations? About the Army's tests with LSD? C'mon. It is the nature of government. Though the subjects of the lies have changed, government's willingness to deceive the people has, if anything, increased. Read "Legacy of Ashes" or "The Assassin's Gate."

I bought the book precisely because I am not an expert. I learned a lot from it. Biddle writes well and explains many things better than any other source I have read. I pose my questions about comparisons with other energy sources and about radioactive waste because I really want to know. Look forward to other readers' comments.