Environmental Physics

Egbert Boeker and
Rienk van Grondelle
Wiley, New York, 1995. 448 pp.
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It is a pleasure to read a book on the environment that emphasizes equations of scientific process rather than descriptive words of summation. Though equations won't answer all environmental questions, they can often yield the partial answers. If I were teaching a graduate level course on the physics of the environment, *Environmental Physics* by Egbert Boeker and Rienk van Grondelle would be one of the required texts for the course. I was delighted to find, for instance, materials that I have collected from books and articles over the years now concisely gathered in one place. Since *Environmental Physics* goes further into the well of knowledge than most undergraduates would wish to travel, I would select the book only as recommended reading for them and put it on reserve in the library.

Rather than giving a thin discussion of the entire book, I will review two sections: chapter 3 on the global climate and chapter 5 on the transport of pollutants.

Since it is very likely that the carbon-dioxide content of the atmosphere will double during the 21st century, it is necessary to understand the effects of this doubling. In chapter 3, Boeker and van Grondelle nicely extend the simple energy balance to consider the temperature of both the Earth's surface and its atmosphere. This is followed by an estimate of the radiative forcing term that raises the surface temperature as a consequence of the heat trapping by carbon dioxide. The estimate of a 1.4 K rise caused by an intensity increase of 5 W/m^2 is not a proof, but it helps us physicists to understand the mechanisms for such a predicted temperature rise. With this understanding, perhaps we can interpret the new results on enhanced solar absorption by clouds. A nice calculation of lapse rates (the reduction of temperature with a rise in height) is followed by estimates of stable and unstable vertical motions of air. The chapter concludes with a mathematical discussion of some of the elements of the general circulation models, an extremely relevant topic since the calculations from such models have thus far led the experimental data in the conclusion that carbon dioxide is the problem.

The rather long (99-page) chapter on the transport of pollutants is important because the authors have gathered here considerable basic information on pollutant transport in air and in surface and underground water. It is a pleasure to follow the development of differential equations and their solutions to establish a firm foundation for more complicated issues. *Environmental Physics* does not enter into the present issue of underground burial of nuclear wastes, for instance, but the text clearly establishes the methodology that should be used. After reading this chapter we may not be able to pass professional

judgment on the safety of proposed nuclear waste depositories, but at least we will be able to ask better questions. Most recently Charles D. Bowman and Francesco Venneri have theorized that leached plutonium from spent fuel rods in Nevada might collect in localized spots and create an underground explosion of 0.3 kilotons. (C. D. Bowman and F. Venneri, "Underground Autocatalytic Criticality from Plutonium and Other Fissile Materials," report no. LA-UR 94-4022, Los Alamos Nat. Lab., 1994.) My examination of their paper shows no application of the equations on underground water flow, which predict diminished concentration from speeding gaussian distributions, given in chapter 5.

Because of the high quality of *Environmental Physics*, it will be immediately useful to the environmental movement in the United States. Many of the environmental laws are now under attack and undoubtedly will be softened. It is a pity that, in the larger debate on the environment, the environmental movement has been wounded because each environmental group has wanted to maximize the regulations in its area without concern for the broader establishment of therapeutic priorities for "patient Earth." A good study of *Environmental Physics* should help us all in our efforts to separate the larger problems from the smaller ones.

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