1.1. Beginning Definitions

The ideas of environmental health science, and of human health risk analysis, come from a wide array of disciplines. This introduces two problems. The reader must master definitions in several very different subject areas (from the physical, chemical and biological sciences, as well as the language of environmental decisions and engineering) and these definitions are not necessarily consistent across the different disciplines. An example of the latter problem is the definition of “dose”, which in the literature can mean anything from the amount of a substance taken into the body to the density of energy absorbed in cells following irradiation.

A hallmark of rationality is conceptual clarity, in which terms used in discourse are defined clearly and used consistently. This brief introduction provides some basic definitions that will be used consistently throughout this book. Every attempt has been made to select definitions that are used most commonly, that combine relevant features from several disciplines, and that represent where the language of risk analysis and environmental health science is likely to be in the coming years.

First things first, and that is the definition of environmental health science itself:

*Environmental health science* is the study of principles governing chemical, biological and physical processes by which substances (such as bacteria) and energy (such as radiation) in the environment influence the state of health of human populations. These processes control how the material and energy come into contact with humans; how they move into and through the body; how they are transformed by the body into more or less hazardous forms; how they affect the health of people; and how those people in turn affect the conditions of the environment in ways relevant to health. Environmental health science also includes study of science-based methods by which an environment may be changed to bring about the best state of health in a population.

This leads to the related concept of health risk analysis:

*Environmental health risk analysis* is the study of the possible consequences associated with a situation in which a person is brought into contact with a particular environment. There must be several potential consequences and a possibility that any one (or any combination) of them will occur. Environmental health risk analysis
produces a listing of potential consequences; the possibility of their occurrence as a result of the environment; the severity of each consequence; the variability of each consequence across well defined subpopulations; and the degree of confidence in any part of this description.

These relatively simple definitions hide an important difficulty in deciding what to include as the subject matter of the field. That difficulty arises because almost anything can, in some sense, be counted as part of the environment and as an influence on health. What causes the health of a person or population to change? In speaking of health effects, it isn't proper to say that the environment is the cause. There is no single cause of any phenomenon in nature. Instead, we need a more complete conception of causality:

A causal network or causal web is the collection of factors in the environment and in the body playing some role in producing consequences on health. The chief factors are

- substances or energy present in the environment called environmental agents or risk agents; this book uses a simpler term, environmental pollutant or just pollutant, since it is more commonly used, although it's a misnomer in cases where the agent is a normal part of the environment;

- the biological characteristics of affected humans, called biological or genetic factors;

- the presence of the pollutant in specific media or compartments of the environment;

- the organization of these media into an interconnected environmental system which allows the pollutant to come into contact with humans;

- the ecological interactions which cause a person to come into contact with the environmental system (e.g. foraging for food); and

- the social, economic, and political organization that act in part to determine the relationship between populations and their environment, called the social structure.

Each of these five aspects is part of the causal network for health effects and must be accounted for in coming to a complete understanding of environmental health and disease. And yet, the task of producing this understanding is too broad for this book, being more the topic of environmental health (of which environmental health science and risk analysis are only a part). This book focuses on the first four "bullets" above, recognizing that the study of social structure often is needed in understanding how and why humans come into contact with pollutants, and in understanding the chain of events begun by the appearance of a health effect. Continuing with the necessary ideas: