Introduction to the Natural Environment

Chapter Highlights:

In recent decades, there has been a growing realization that what we release into our environment will eventually be transferred back to us, in some cases with adverse consequences. Air, water, food and soil are the four principal media by which people can be exposed to environmental contaminants. This report explores the relationship between our health and the health of our natural environment by focussing on the quality of the air, water, food and soil in Canada.

- There are three broad categories of environmental contaminants. *Biological agents* include living organisms, such as bacteria, protozoa, viruses, fungi and algae (as well as the by-products that these organisms produce); house dust mites; and seasonal allergens, such as pollen grains. *Chemical* contaminants include organic and inorganic compounds of both natural and human origin. Organic compounds contain carbon usually combined with hydrogen and often other elements as well, such as fluorine, chlorine, bromine, iodine, oxygen, nitrogen, sulphur and phosphorus. Inorganic compounds include air pollutants, such as ozone, nitrogen oxides and sulphur dioxide; metals, such as lead, mercury, cadmium, arsenic and uranium; and other compounds, such as nitrates and fluoride. *Radiation* is wave or particle energy. Canadians are exposed to both natural and artificial sources of high-energy *ionizing* radiation — a form that has sufficient energy to remove electrons from atoms—and lower-energy *non-ionizing* radiation, such as microwaves, ultraviolet light, low-frequency electromagnetic fields and sound.
- In nature, contaminants that are released into air, water or soil often migrate throughout the environment. Although exposure to specific contaminants often occurs through more than one medium, this report describes contaminants and their relationship to human health in terms of the most important medium of exposure, unless there is a potential for significant exposure from multiple media.
- Direct physical health effects of environmental contaminants are typically easier to measure than indirect non-physical health effects, such as stress. As a result, there is frequently much more information available on the former. This report focusses on the effects of environmental contaminants on our physical health. More difficult to quantify, but no less important, are the social, cultural and psychological effects observed when environmental pollution disrupts a community's way of life.
- Although this report attempts to provide a comprehensive view of the contaminants that are of greatest concern to the health of Canadians, it is by no means the final word on the subject. Our understanding of the effects of environmental pollution and its potential impact on human health is continuously growing and evolving. As well, despite the constant vigilance of public health authorities, new threats to our health can and will continue to emerge.

INTRODUCTION TO THE NATURAL ENVIRONMENT

Canada is a vast land blessed with abundant natural resources and a diverse and beautiful environment. Our country is home to only 0.5% of the total human population, yet it covers more than 6% of the Earth's surface and contains 9% of its renewable freshwater resources. Despite Canada's immense proportions, however, the health of the Canadian environment cannot be taken for granted. In recent decades, there has been a growing realization that what we release to our environment will eventually be transferred back to us, in some cases with adverse consequences.

The following four chapters explore the relationship between our health and the health of our natural environment, by focussing on the quality of the air, water, food and soil in Canada. Air, water, food and soil are the four principal media by which people can be exposed to environmental contaminants. Each chapter explains how the medium becomes contaminated, outlines the routes by which people are exposed to contaminants of natural and human origin, notes the levels of contaminants in the Canadian environment together with the extent of exposure (where this information is available) and describes how contaminants can affect our health.

Types of Contaminants

There are three broad categories of environmental contaminants: biological agents, chemicals and radiation.

Biological agents include living organisms, such as bacteria, protozoa, viruses, fungi and algae (as well as the by-products that these organisms produce); house dust mites; and seasonal allergens, such as pollen grains. Biological agents occur naturally in our environment and may also be released through human activities, such as agriculture or sewage disposal. Depending on the dose, different biological agents can produce a variety of health effects, ranging from allergies to respiratory problems, gastrointestinal illness and, in severe cases, death.

Chemical contaminants include organic and inorganic compounds of both natural and human origin. Organic compounds contain carbon usually combined with hydrogen and often other elements as well, such as fluorine, chlorine, bromine, iodine, oxygen, nitrogen, sulphur and phosphorus. Examples of organic compounds include pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and trihalomethanes (THMs).

Inorganic compounds include air pollutants, such as ozone, nitrogen oxides and sulphur dioxide; metals, such as lead, mercury, cadmium, arsenic and uranium; and other compounds, such as nitrates and fluoride. Chemicals occur naturally in our environment through such processes as weathering and erosion and are also released by human activities, such as agriculture, manufacturing, power generation, transportation and the use and disposal of consumer products. Exposure to high levels of chemical contaminants may result in a variety of health effects, including allergies; skin and eye irritation; cardiac, respiratory, reproductive, kidney or neurological problems; and cancer.

Radiation is wave or particle energy. Canadians are exposed to both natural and artificial sources of high-energy *ionizing* radiation—a form that has sufficient energy to remove electrons from the atoms of the material through which it passes—and lower-energy *non-ionizing* radiation, such as microwaves, ultraviolet light, low-frequency electromagnetic fields and sound. Natural sources of ionizing radiation include cosmic rays and naturally occurring radioactive elements found in the Earth's crust and air. Most of our exposure to ionizing radiation is from natural sources. The remainder of our exposure comes from nuclear weapons fall-out, nuclear power generation and the use of radiation in hospitals and research facilities.

Both ionizing and non-ionizing radiation can cause harm, although the potential health effects are quite different. Exposure to elevated levels of ionizing radiation can damage living tissues or alter genetic material, causing an increased risk of cancer, which is proportional to the dose received. There is also a small risk of hereditary changes being passed on to future generations. The health effects of non-ionizing radiation depend on the amount and specific type of radiation involved.

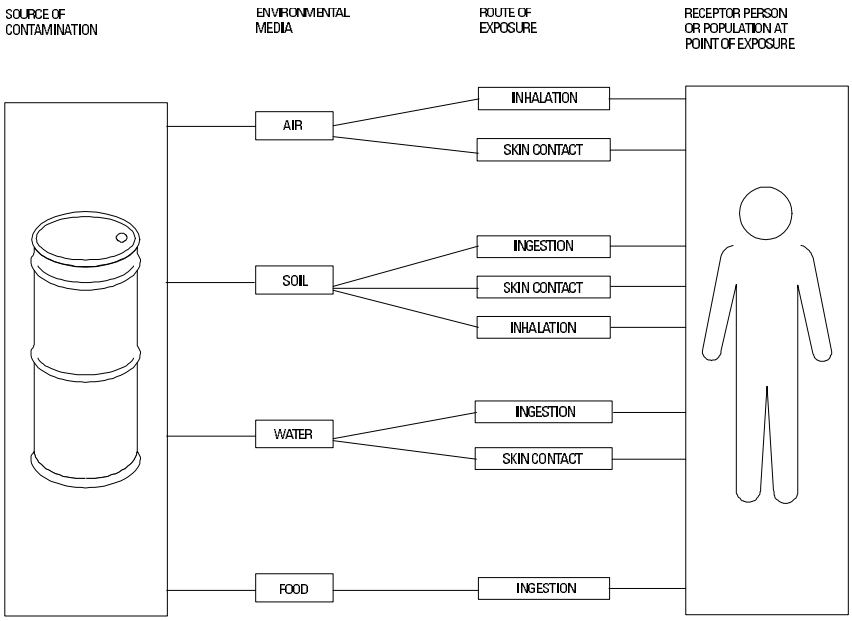
Routes of Exposure

In nature, contaminants that are released into air, water or soil often migrate throughout the environment. For example, air pollutants may be inhaled directly from the ambient or indoor air; may fall on drinking water sources and may subsequently be ingested in drinking water, if they are not removed during drinking water treatment processes; may be deposited on recreational water bodies, where they may be absorbed through the skin or ingested; and may fall on farmers' fields, where they may end up in food. Water pollutants may also end up in our food supply via irrigation and food production or processing. Soil pollutants may leach into groundwater or contaminate indoor air through cracks in basement floors. Although exposure to specific contaminants often occurs through more than one medium (see Figure 7), this report describes contaminants and their relationship to human health in terms of the most important medium of exposure, unless there is a potential for significant exposure from multiple media.

Physical Health Effects

Direct physical health effects of environmental contaminants are typically easier to measure than indirect non-physical health effects, such as stress. As a result, there is

Figure 7
Major Pathways and Routes of Human Exposure to Environmental Contaminants



Source: ***Investigating Human Exposure to Contaminants in the Environment: A Handbook for Exposure Calculations,*** *Draft, Health Canada, 1994, p. 7.*

frequently much more information available on the former. This report focusses on the effects of environmental contaminants on our physical health. The following chapters provide information on both the potential of contaminants to cause adverse effects, such as cancer, gastrointestinal disease and respiratory or reproductive problems, and, to the extent possible, the likelihood of becoming ill as a result of exposure to the contaminants. Although some contaminants can cause a wide range of effects at different doses, the focus is on the most likely effects at the concentrations present in our environment. With respect to risk, the potential of a specific contaminant to cause harm depends not only on exposure levels, but also on its inherent toxicity, the route by which individuals take in the contaminant (e.g. ingestion versus inhalation) and the susceptibility of different groups. For example, infants, young children, the elderly and people with weakened immune systems are generally more susceptible to infectious agents and chemicals.

Non-Physical Health Effects

More difficult to quantify, but no less important, are the social, cultural and psychological effects observed when environmental pollution disrupts a community's way of life. For example, concern about the presence of elevated levels of methyl mercury in the natural environment may have caused more damage to the social fabric of some First Nations communities than to the physical health of those individuals at greatest risk of exposure. In some cases, concerns over the risks posed by contaminated foods, such as fish and game, have triggered some negative changes in diet and lifestyle. Concern about the occurrence of toxic chemicals in municipal water supplies—although they are present at very low levels—has led thousands of urban residents to install water filtration devices. However, when water treatment devices are not used or maintained properly, they can actually increase the levels of hazardous contaminants found in our drinking water.

A Final Note

While this report attempts to provide a comprehensive view of the contaminants that are of greatest concern to the health of Canadians, it is by no means the final word on the subject. Our understanding of the effects of environmental pollution and its potential impact on human health is continuously growing and evolving. As well, despite the constant vigilance of public health authorities, new threats to our health can and will continue to emerge.