Chapter 8
Environmental Ethics

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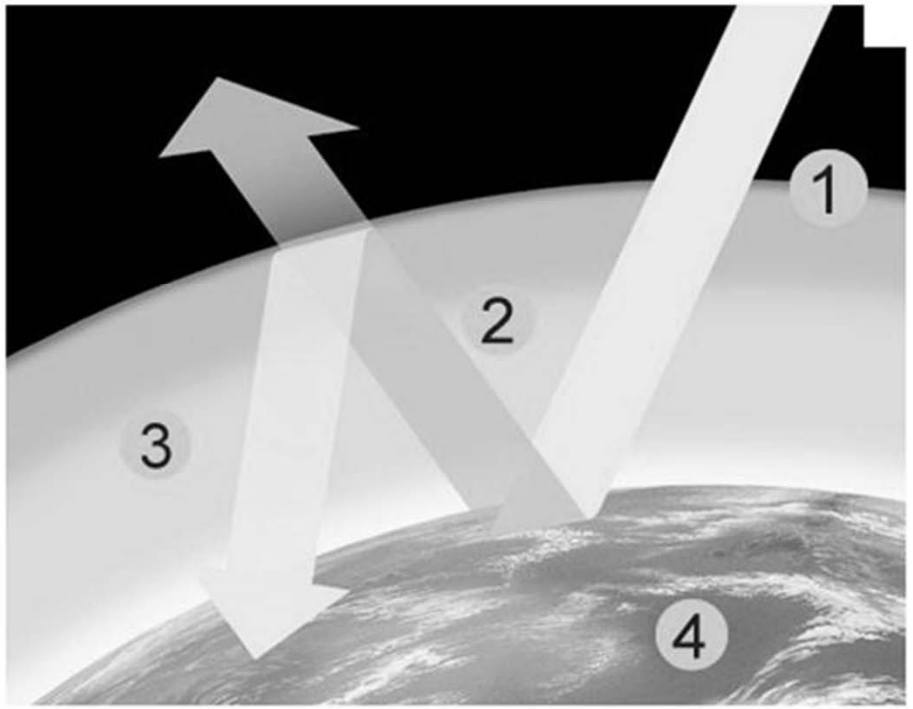
We will learn about:

- Sec 8.1: Engineering, Ecology, and Economics.
- Sec 8.2: Environmental Ethical Frameworks.

Have you ever seen a greenhouse? Most greenhouses look like a small glass house. Greenhouses are used to grow plants, especially in the winter. Greenhouses work by trapping heat from the sun. The glass panels of the greenhouse let in light but keep heat from escaping. This causes the greenhouse to heat up, much like the inside of a car parked in sunlight, and keeps the plants warm enough to live in the winter.

Greenhouse Effect...

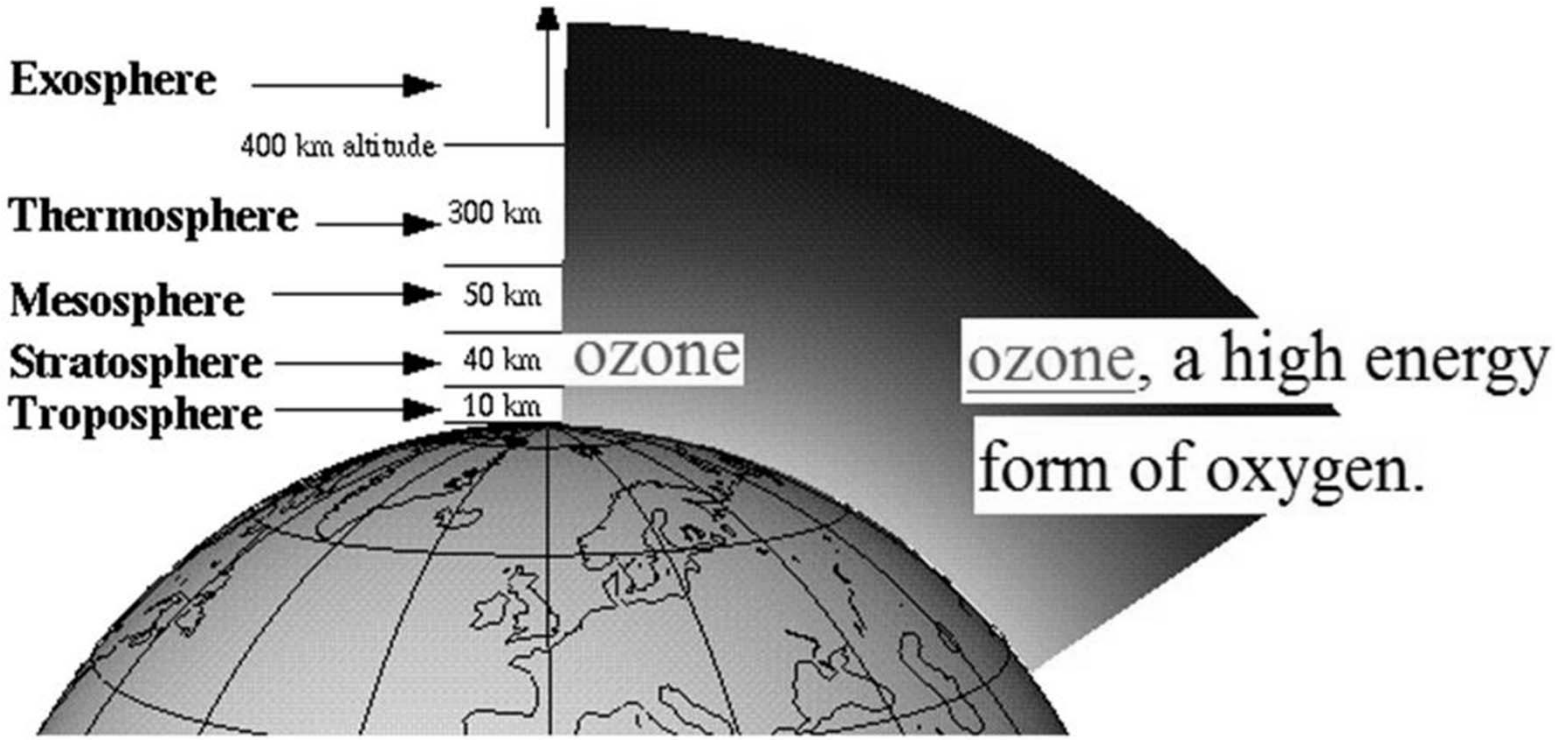
The greenhouse effect is the rise in temperature that the Earth experiences because certain gases in the atmosphere (water vapor, carbon dioxide, nitrous oxide, and methane, for example) trap energy from the sun. Without these gases, heat would escape back into space and Earth's average temperature would be about 60ºF colder. Because of how they warm our world, these gases are referred to as greenhouse gases.



Human life is possible because of the greenhouse effect, in which atmospheric gases such as water vapor and carbon dioxide block solar energy from escaping, after being reflected from the earth's surface.

In 1988, however, NASA scientist James Hansen warned that the greenhouse effect is accelerating owing to human burning of fossil fuels that increase levels of greenhouse gases such as carbon dioxide (CO_2). The change is small, but even a few degrees of global warming could melt enough of the polar ice caps to raise the oceans enough to cause severe flood damage. Other effects include major disruptions in weather patterns, such as increased drought, major shifts in rain patterns, and increased severity of hurricanes caused by rising ocean temperatures.

For years, the complexity of the issue divided scientific opinion, but an emerging consensus led to the 1997 Kyoto agreement, signed by 150 governments, to reduce carbon emissions to 5.2 percent below 1990 levels by 2012.


Exosphere
400 km altitude
Thermosphere
300 km
Mesosphere
50 km
Stratosphere
40 km
Troposphere
10 km
ozone
ozone, a high energy
form of oxygen.

Environmental **Challenges**

- Global warming.
- Population rapid growth.
- Extinction of species.
- Acidic Rain
- Destruction of ecosystems.
- Depletion of natural resources.
- Nuclear waste
- Ozone depletion (CFC-Freon)

Today there is a wide consensus that we need concerted environmental responses that combine economic realism with ecological awareness. For their part, many engineers are now showing leadership in advancing ecological awareness. In this chapter, we discuss some ways in which this responsibility for the environment is shared by engineers, industry, government, and the public. We also introduce some perspectives developed in the new field of environmental ethics that enter into engineers' personal commitments and ideals.

8.1 Engineering, Ecology and Economics

- Ecology: The science of the relationships between organisms and their environments.

- The expression ***Environmental Ethics*** can have several meanings. We use the expression to refer to:

  1) The study of moral issue concerning the environment
  2) Moral perspective, belief, or attitude concerning these issues.

8.1 Engineering, Ecology, and Economics

Two powerful metaphors have dominated thinking about the environment:

1) Invisible Hand
2) Tragedy of the Commons

Both metaphors are used to highlight unintentional impacts of the marketplace on the environment, but one is optimistic and the other is cautionary about those impact. Each contains a large part of the truth and they need to be reconciled and balanced.

(1) The Invisible Hand

- The ways in which pursuing self-interest in the competitive marketplace promotes the public good, for example, by providing quality products at lower cost, job, and wealth and philanthropy.

(1) The Invisible Hand

The first metaphor was set forth by Adam Smith in 1776 in *The Wealth of Nations,* the founding text of modern economics. Smith conceived of an invisible (and divine) hand governing the marketplace in a seemingly paradoxical manner. According to Smith, businesspersons think only of their own self-interest: "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest."[1] Yet, although "he intends only his own gain," he is "led by an invisible hand to promote an end which was no part of his intention. . . . By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good."[2]

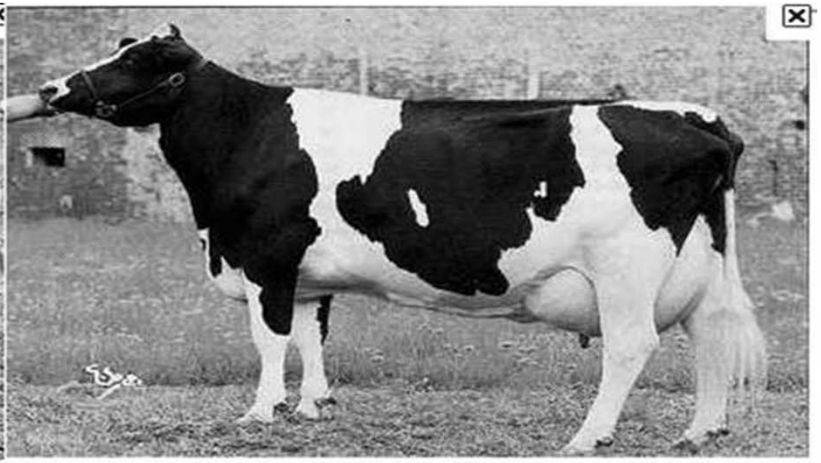
Despite its large element of truth, the invisible hand metaphor does not adequately take account of damage to the environment.

Regarding the environment, most of these are negative externalities—pollution, destruction of natural habitats, depletion of shared resources, and other unintended and often unappreciated damage to "common" resources.

(2) The Tragedy of the Commons

- The ways in which the marketplace harms public goods (such as clean air and water) by creating unintended "externalities" that is, harmful effects such as pollution that are not factored into the cost products.

Aristotle's observation that we tend to be thoughtless about things we do not own individually and which seem to be in unlimited supply.



William Foster Lloyd was also an astute observer of this phenomenon. In 1833 he described what the ecologist Garrett Hardin would later call "the tragedy of the commons."[4] Lloyd observed that cattle in the common pasture of a village were more stunted than those kept on private land.

(Retard the growth)

The common fields were themselves more worn than private pastures. His explanation began with the premise that individual farmers are understandably motivated by self-interest to enlarge their common-pasture herd by one or two cows, especially given that each act taken by itself does negligible damage. Yet, when all the farmers behave this way, in the absence of laws constraining them, the result is the tragedy of overgrazing that harms everyone.

The same kind of competitive, unmalicious but unthinking, exploitation arises with all natural resources held in common: air, land, forests, lakes, oceans, endangered species, and indeed the entire biosphere. Hence, the tragedy of the commons remains a powerful image in thinking about environmental challenges in today's era of increasing population and decreasing natural resources. Its very simplicity, however, belies the complexity of many issues concerning ecosystems and the biosphere.

Ecosystems are systems of living organisms interacting with their environment—for example, within deserts, oceans, rivers, and forests. The biosphere is the entirety of the land, water, and atmosphere in which organisms live. Ecosystems and the biosphere are themselves interconnected and do not respect national boundaries.

There is need for multifaceted and often concerted environmental responses by engineers, corporations, government, market mechanisms, local communities, and social activists.

8.1.2 Engineers: Sustainable Development

Defined as economical and technological patterns that are compatible with preserving environmental capacities to sustain future generations.

Sustainable Development (Sustainability): is the development that meets the needs of the present without compromising the ability of future generation to meet their needs.

8.1.2 Engineers: Sustainable Development

In tune with these themes, ASCE defines *sustainable development* as "a process of change in which the direction of investment, the orientation of technology, the allocation of resources, and the development and functioning of institutions [is directed] to meet present needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities, and without compromising the ability of future generations to meet their own needs and aspirations."[10]

8.1.2 Engineers: Sustainable Development

Ali Ansari, a scholar in India, suggests that there is a "standard engineering worldview—that of a mechanical universe,"





which is at odds with "organic" environmental thought.[5]

8.1.2 Engineers: Sustainable Development

We believe there is a tension, not a dichotomy, between technothink and green philosophy, as Ansari defines them. It is true that historically engineers were not as responsible concerning the environment as they should have been, but in that respect they simply reflected attitudes predominant in society. The U.S. environmental movement that emerged from the 1960s began a social transformation that has influenced engineers as much as other populations, and more than most professions. Furthermore, there is no single canonical professional attitude or philosophical "green" attitude. Individual engineers, like individuals in all professions, differ considerably in their views, including their broader holistic views about the environment. What is important is that all engineers should reflect seriously on environmental values and how they can best integrate them into understanding and solving problems.

In many respects, engineers are singularly well-placed to make environmental contributions. They can encourage and nudge corporations in the direction of greater environmental concern, finding ways to make that concern economically feasible. At the very least, they can help ensure that corporations obey applicable laws. In all these endeavors, they benefit from a supportive code of ethics stating the shared responsibilities of the profession.

Increasingly, engineering codes of ethics explicitly refer to environmental responsibilities under the heading of "sustainable development."[7] In the United States, a first important step occurred in 1977 when the American Society of Civil Engineers (ASCE) introduced into its code the statement "Engineers should be committed to improving the environment to enhance the quality of life." "Should" indicates the desirability of doing so, although (in contrast to "shall") it does not indicate something mandatory or enforceable. Still, the mere mention of the environment was a breakthrough. Two decades later, in 1997, ASCE's fundamental canon has changed from recommendations ("should") to requirements ("shall"): "Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development.

8.1.3 Corporations: Environmental Leadership

In the present climate, it is good business for a corporation to be perceived by the public as environmentally responsible, indeed as a leader in finding creative solutions. This is true of corporations of all sizes.

General Electric (GE) is a good example of a large corporation that took initiative in recent years, convinced that in today's business climate ecology is good economics.[12] Under a program called Ecomagination, GE drew together, expanded, and built on its businesses that were environmentally friendly, compared to current competitors. New investments were made, such as purchasing for $358 million the wind-turbine business of Enron (during its bankruptcy). It also intensified its research and development in biofuels and other renewable energy resources. In addition, it was one of the corporations that showed leadership in 2007 by urging the federal government to take action on climate change.

8.1.4 Government: Technology Assessment, Incentives, Taxes

Government laws and regulations are understandably the lightning rod in environmental controversies.

In the United States, landmark environmental legislation at the national level in the United States began in 1969 with passage of the National Environmental Policy Act, which requires environmental impact statements for federally funded projects affecting the environment. Other key legislation quickly followed, including the Occupational Safety and Health Act (1970), the Clean Air Act (1970), the Clean Water Act (1972), and the Toxic Substances Control Act (1976). These and subsequent legislative acts involved heated controversy at several stages: in passing laws, in developing and managing enforcement procedures, and in modifying laws to take account of unforeseen problems.

8.1.5 Communities: Preventing Natural Disasters

- There is four sets of measures communities can take to avert or mitigate disasters:
  1) Defensive measure
  2) Strengthening the lifelines for essential utilities
  3) Encompasses special-purpose defensive structures
  4) Safe exit in the form roads and passages.
- Turkey Earthquake 1999
- Awareness campaign in California 2003

8.1.6 Market Mechanisms: Internalizing Costs

- The cost of products and services is made to include indirect costs such as the effect of pollution (ex. car battery disposal).

8.1.6 Market Mechanisms: Internalizing Costs

Democratic controls take many forms beyond passing laws. One such option is internalizing costs of harm to the environment. When we are told how efficient and cheap many of our products and processes are—from agriculture to the manufacture of plastics—the figures usually include only the direct costs of labor, raw materials, and the use of facilities. If we are quoted a dollar figure, it is at best an approximation of the price. The true cost would have to include many indirect factors such as the effects of pollution, the depletion of energy and raw materials, disposal, and social costs. If these, or an approximation of them, were internalized (added to the price) then those for whose benefit the environmental degradation had occurred could be charged directly for corrective actions.

A working example is the tax imposed by governments in Europe on products and packaging that impose a burden on public garbage disposal or recycling facilities. The manufacturer prepays the tax and certifies so on the product or wrapper.

8.1.7 Social Activists

Social Activists

Social Activists

Social Activists

Finally, social activism occurs at many levels, the micro as well as macro. In 2002, Bernard Amadei founded Engineers Without Borders, a philanthropic organization with a core commitment to

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Sheikh Dr. Abdulaziz AlNuaimi

Member of the ruling family of the Emirate of Ajman in the United Arab Emirates, Environmental Advisor to the Ajman Government, UAE

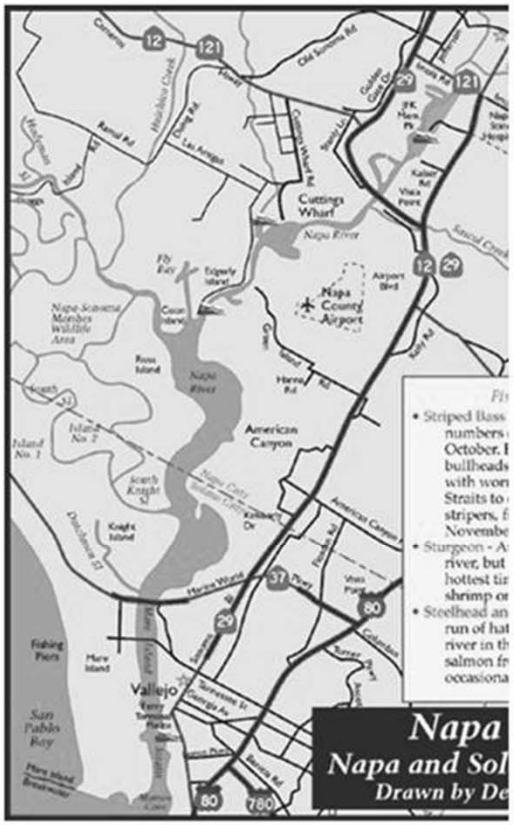
Abdul Aziz bin Ali Al Nuaimi is a member of the ruling family of the Emirate of Ajman in the United Arab Emirates and infamously known as the "Green Sheikh", is taking his message of 'holistic living' to the world. Sheikh Al Nuaimi is currently serving as environmental advisor to the Ajman Government. He earned his PhD in Cleaner Production and Industrial (Ecology) Eco-Systems. He has many international and national awards for his work.

Two Case Studies

Two Corps Cases

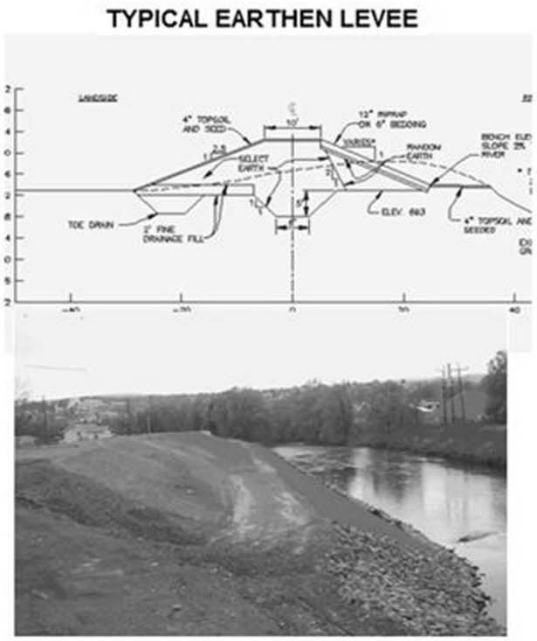
We conclude with two cases involving the U.S. Army Corps of Engineers, one a promising success and the other the worst natural disaster in U.S. history, that illustrate the need for developing reasonable compromises and consensus between local, state, and federal groups.

The promising success is work on a 55-mile waterway through the Napa Valley in California, which for decades had been a battleground between humans and nature.



Case (1)

The promising success is work on a 55-mile waterway through the Napa Valley in California, which for decades had been a battleground between humans and nature. A series of earthen levees were used to redirect and constrain the natural flow of water, and low concrete bridges spanned the river, but these makeshift controls failed to prevent periodic floods. A 1986 flood alone caused $100 million in property damage, killed three people, and forced the evacuation of 5000 others. In July 2000, groundbreaking ceremonies took place on a project to restore the waterway into a "living river," with natural floodplains, wetlands, and other natural habitat.[19] The restoration project was innovative in the way it combined ecological and economic goals. Instead of imposing further constraints on the river, the project was to restore the river to something closer to its natural state. Furthermore, although initial costs would be much higher, even after the savings from conforming to regulations about preserving wetlands and endangered species, there were counterbalancing long-term economic benefits. They included increased tourism because of more scenic countryside, elevated property values, and lower home insurance costs as a result of lessened flood risks.



Case (2)

Contrast this case with the battle against nature won decisively by Hurricane Katrina in 2005 (Figure 9–1).[21]

The causes of the disaster were multiple. They included the perfect storm that hit with the fury of 155–miles-per-hour winds and with uncanny precision. They included the relentless incursion of homes and roads into the wetlands that provided a natural buffer against hurricanes. They included utter failure of the city and region to develop and implement disaster preparedness plans, especially for the 100,000 individuals who lacked cars or other means of escape. Equally egregious and shameful failures occurred at the state and federal level, as the officials at the Federal Emergency Management Agency (FEMA) and the Department of Homeland Security, of which FEMA had become a part, were at times utterly disconnected from the tragedy they were responsible for dealing with. And the causes included shoddy engineering.

Discussion Question

1. Identify and comment on the importance of each of the environmental impacts described in the following passage: "The Swedish company IKEA, the world's largest furniture and home furnishings retailer, has adopted a global corporate policy that prohibits the use of old-growth forest wood or tropical wood in its furniture. All timber must come from sustainably managed forests. IKEA has eliminated the use of chlorine in its catalog paper, uses 100 percent recycled paper fibers, and is committed to eliminating waste in its retail stores. The 'Trash is Cash' program has transformed the thinking of retail store workers to see trash as a revenue-generating resource."[23]

- Section 8.2

Environmental and Moral Frameworks

Environmental and Moral Frameworks

Individual engineers can make a difference. Although their actions are limited—within corporations, they share responsibility with many others—they are uniquely placed to act as agents of change, as responsible experimenters. Doing so requires personal commitments that are often rooted in wider moral or religious frameworks. Here we provide an overview of some of the environmental ethics that are currently being explored, to stimulate further reflection on wider moral frameworks concerning the environment.[26]

Environmental and Moral Frameworks

- 8.2.1 Human Centered Ethics
- 8.2.2 Sentient-Centered Ethics
- 8.2.3 Biocentric Ethics
- 8.2.4 Ecocentric Ethics
- 8.2.5 Religious Prospectives

Nature Center Ethics

8.2.1 Human Centered Ethics

The view that only humans have inherent worth and that other creatures and ecosystems have at most "instrumental value" as means to promoting human interest.

- Utilitarianism
- Right Ethics
- Duty Ethics
- Virtue Ethics

8.2.1 Human Centered Ethics

All these human-centered ethics permit and indeed require a long-term view of conserving the environment, especially because the human beings who have inherent worth will include future generations. Not everything of importance within a human-centered ethics fits neatly into cost-benefit analyses with limited time horizons; much must be accounted for by means of constraints or limits that cannot necessarily be assigned dollar signs. Yet, some have argued that all versions of human-centered ethics are flawed and that we should widen the circle of things that have inherent worth, that is, value in themselves, independent of human desires and appraisals. Especially since 1979, when the journal *Environmental Ethics* was founded, philosophers have explored a wide range of *nature-centered ethics* that, for example, affirm the inherent worth of all conscious animals, of all living organisms, or of ecosystems. Let us consider each of these approaches.

8.2.2 Sentient-Centered Ethics

- The view that all sentient (conscious) animals have inherent worth.
- Sentient animals are those that feel pain and pleasure and have desires.

Sentient-Centered Ethics (Sentience is the ability to feel or perceive)

One version of nature-centered ethics recognizes all sentient animals as having inherent worth. Sentient animals are those that feel pain and pleasure and have desires. Thus, some utilitarians extend their theory (that right action maximizes goodness for all affected) to sentient animals as well as humans. Most notably, Peter Singer developed a revised act-utilitarian perspective in his influential book, *Animal Liberation*. Singer insists that moral judgments must take into account the effects of our actions on sentient animals. Failure to do so is a form of discrimination akin to racism and sexism. He labels it "speciesism": "a prejudice or attitude of bias toward the interests of members of one's own species and against those of members of other species."[29] In Singer's view, animals deserve equal consideration, in that their interests should be weighed fairly, but that does not mean equal treatment with humans (as their interests are different from human interests). Thus, in building a dam that will cause flooding to grasslands, engineers should take into account the impact on animals living there. Singer allows that sometimes animals' interests have to give way to human interests, but their interests should always be considered and weighed.

8.2.3 Biocentric Ethics

The view that all living organism have inherent worth.

A life-centered ethics regards all living organisms as having inherent worth. Albert Schweitzer (1875–1965) set forth a pioneering version of this perspective under the name of "reverence for life." He argued that our most fundamental feature is not our intellect but instead our will to live, by which he meant both a will to survive and a will to develop according to our innate tendencies. All organisms share these instinctive tendencies to survive and develop, and hence consistency requires that we affirm the inherent worth of all life.

8.2.4 Ecocentric Ethics

The view that ecosystems have inherent worth.

A frequent criticism of sentient-centered and biocentered ethics is that they are too individualistic, in that they locate inherent worth in individual organisms. Can we seriously believe that each microbe and weed has inherent worth? By contrast, ecocentered ethics locates inherent value in ecological systems. This more holistic approach was voiced by the naturalist Aldo Leopold (1887–1948), who urged that we have an obligation to promote the health of ecosystems.

More recent defenders of ecocentric ethics have included within this holistic perspective an appreciation of human relationships. That is, locating inherent worth in wider ecological systems does not cancel out or make less important what we owe to human beings.

8.2.5 Religious Prospective's

nature-centered ethics

Religious Perspectives

"And the earth We have spread out like a carpet; set thereon mountains firm and immobile; and produced therein all kinds of things in due balance" (Q.15:19).

Conclusion

- The environment is no longer the concern of an isolated minority. Engineers, corporations, federal and state laws, local community regulations, market mechanisms, and social activists are among the many influences at work.
- Given the complexity of the issues, we can expect controversy among viewpoints, and nowhere is there a greater need for ongoing dialogue and mutual respect.
- There is no longer any doubt, however, about urgency and importance of the issues confronting all of us.