CHAPTER 1

THE BEGINNING OF A LIFELONG INVOLVEMENT WITH POLLUTION: A MAJOR THREAT TO SUSTAINABILITY

Early Encounters with Polluted Ecosystems

The Schuylkill River that borders Conshohocken, Pennsylvania, was badly polluted as early as the 1930s from coalmines upstream and a number of industries. I was well aware, as one with a lifelong interest in fishing, that I could catch only carp and catfish in the river but the fish were big. Occasionally, I caught some fish other than these, but even the carp and catfish often had surface lesions. Nearby, within a 5-10 minute bicycle ride or a 15-minute walk from my house, was a disused stone quarry that had filled with water. Although the sides were extremely steep and the biological productivity must have been minuscule, I caught plenty of sunfish and an occasional bass. These fish were healthy, robust, and alert fish; a professional scientist was not needed to see the difference between polluted and unpolluted water.

Although the river near my home was polluted, I was well aware that some stretches of the river, both above and below Conshohocken, were less polluted. These areas were beyond the daily reach of a boy using a bicycle or walking as the two major forms of transportation, unless a lot of time was spent in traveling. Even so, I could roam relatively wild places on land and enjoy decent forests, meadows, and the like. In those days, when significant green space still existed between Conshohocken and Philadelphia, people who lived in an industrial town had access to relatively natural systems without having to travel by automobile to a more distant area. Later, of course, when I became old enough to drive a car (or even when I was younger and could persuade an older acquaintance to drive me somewhere), I could trout fish on Wissahickon Creek, which was, ironically, within the Philadelphia city limits. Wissahickon Creek was then stocked, but some trout were carryovers. Valley Forge was not too far away either, and, at that time, trout and chubs were still living in the little creek that flowed through the park. Most places that I enjoyed as a child are now either gone or are under intense pressure, which has caused substantive change in them ecologically.

I mention these details because, although in my childhood I recognized pollution, I still felt that industry and natural systems could coexist because uninhabited places remained that were relatively untouched. Even later, when I purchased property in a wooded area across the river from Conshohocken, foxes, herons, deer, pheasants, and other wildlife were present. Many areas that I had enjoyed as a boy were changed beyond recognition by then, but patches of relatively untouched natural systems existed, mostly in private hands.

Motivation

My first full-time job was in the Hamilton Paper Company at Miquon, Pennsylvania, where I stood at the end of a machine that produced very high quality paper and removed sheets that were defective and tossed them into a large wheeled bin behind me. Very shortly, I worked my way up to oiler, not because of any particular innate ability, although I was fairly large and moderately strong for a teenager, but because the accident rate was fairly high. At that time, the mill was in continuous operation because it was expensive to shut it down and start it up again. Three rotating shifts worked daily. As a consequence, one week I worked from midnight until 8:00 a.m.; one week had normal working hours; and the other was essentially from late afternoon until midnight. Every third Sunday as the shifts swung around, I worked 16 hours straight. The mill was very hot (dispensers with salt tablets were located at strategic intervals) and very noisy. I virtually had no social life because my free time varied each week and working those long hours was fairly tiring. As a consequence, I spent most spare time fishing and reading and, of course, saved exceptional amounts of money that proved useful for a college education.

Working in a paper mill was an extremely valuable experience. It gave me an understanding of the industrial workforce and management personnel that I otherwise would never have acquired.

Equally important, I saw, as a consumer, the system from which the products I purchased emerged. Finally, this experience enabled me to work regularly with industries later in my career on solving environmental problems because I had observed some of the difficulties they face. Almost certainly, however, this experience was the imperative to do something useful (resulting from my childhood background) and influenced me to include industry as part of the larger ecological system rather than avoiding industry's influence and studying pristine ecosystems, as did many of my colleagues.

At the outset of my career, I focused primarily on point source discharges (that is, the end of an industrial or municipal waste discharge pipe when it entered a river). Unless the pipes were widely spaced and relatively harmless, an aggregate effect became obvious. Further, most pollution abatement conferences I attended were organized by engineers who were concerned with the effectiveness of waste treatment systems. At that time, I was convinced that, if point source discharges were properly dealt with individually and kept within the assimilative capacity of the ecosystem into which they were discharging, environmental pollution effects could be minimized.

Then, Carson's *Silent Spring* (1962) hit the environmental world like a bombshell! Not only were pesticides and many other chemicals exposed as persistent, but also they traveled through the ecosystem in ways not appreciated before then. Despite the many attacks on her, Carson was really quite conservative in her approach, and the errors of fact were infrequent, trivial, and irrelevant to the main theme. The book definitely helped human society toward a reappraisal of existing policies and practices. The President's Science Advisory Committee issued a report in 1963 that was a fairly thoroughgoing vindication of Carson's thesis. Since I had frequent interactions with the industrial community at that time, I immediately observed that objective, detached science often evoked severe penalties when economic interests were threatened. One chemical company is reputed to have tried to persuade Houghton Mifflin not to publish Carson's book and threatened to withdraw advertisements in publications sympathetic to her point of view. Anyone contemplating an environmental career would be well advised to study the response to *Silent Spring* and more recent events, such as endocrine disrupters and global warming, before deciding to go public with any view of the danger to the human condition.

I have always felt that creating a new model that might cause a societal paradigm shift would be the most effective long-range strategy for protecting the environment. However, if publicity is the goal, battles are sure to attract more media attention. A systematic, orderly, reasoned approach is a sure path to anonymity! A few scientists have been recognized during their lifetimes at a national meeting of their discipline. However, recognition drops dramatically once one leaves one's discipline. Great communicators—who use printed words, such as Isaac Asimov; who use television and the printed word, such as Carl Sagan; who can demonstrate a devastating wit understood by a large viewing audience, such as Paul Ehrlich on the "Johnny Carson Show" and its contemporary equivalents; who can communicate the beauty, splendor, personal joy, and wonder about science to a vast array of people, such as Edward O. Wilson—are a tremendous inspiration to anyone interested in how the world works and mankind's place in it. Very, very few have caused major paradigm shifts or are remembered for them.

Darwin's *The Origin of Species* is arguably the most notable for a paradigm shift in the biological world and, of course, Carson's *Silent Spring* for the environment. Causing a major paradigm shift often inflicts severe penalties on the originator. Darwin hesitated publishing for years, anticipating quite well the consequences; his ideas are still attacked vigorously today. Distracters who perceived *Silent Spring* as having severe adverse economic effects attacked Carson personally, often viciously.

Most scientists sneak up on a problem incrementally, rather than making a great leap forward, such as the one represented by the double helix, which won the Nobel Prize for Watson and Crick. Except for anyone with similar interests, trends in thought patterns represented by a sequence of publications are likely to go unrecognized, particularly with the compartmentalization of disciplines by journal, department, annual meetings, tribal language, and the like. Hawken (1993) noted that scientists often argue interminably about particular leaves on a tree without referring to the tree with any notable frequency. Such an accusation was partly the result of

publication requirements of particular journals and the rarity with which broad overview articles are published. The general public is unlikely to have a clue as to what a particular, individual scientist is doing unless, as was the case with Theo Colborn, the path leads to a finding that shocks both the scientific community and human society (e.g., Colborn and Clement, 1992). Not surprisingly, Colborn has paid, and is still paying, a severe price as attacks on her views go well beyond normal scientific questioning characteristic of the peer-review process.

Perhaps this scrutiny is all well and good! The word *scholar* is not often used at present in an age of specialization. However, G. Evelyn Hutchinson indeed truly deserved recognition as a person of broad interests—interests that he integrated so beautifully that what appeared impossible seemed almost platitudinous. In his later years, he noted that young academicians knew he was a famous person, but were not quite sure what he had done. Although he and I had quite different backgrounds and I sometimes had difficulty communicating with him, his tutelage of the limnological survey crew at the Academy of Natural Sciences of Philadelphia changed my entire academic career. The association with a person of such talents must suffice for most scientists; it was certainly enough for me.

I am astonished that the major paradigm of my generation is exponential growth on a finite planet. Huge numbers of people contend that affluence is a "right" acquired when born. Civility and responsibility have dramatically diminished, and such abominations as "road rage" are of increasing social concern, as is violence in schools and society as a whole. In the United States, arguably the world's leading nation in technology, technology is worshipped, but the education that produced the science and technology is denigrated. Literate people are called names such as “nerd” or worse. I have always been optimistic about what could be done to leave a habitable planet for future generations, but I am in a state of barely controlled panic about what human society will do. However, a strident approach is even less effective than the systematic and orderly presentation of evidence. Perhaps consequences are the best, albeit the most expensive, paradigm shifters. Historic evidence shows that the universe does not accept ignorance as an excuse for inappropriate action.

The globalization of the world economy, the rapid emergence of persistent chemicals with adverse biological effects, the enormous consumption of energy, the burgeoning growth of the human population, the growth of affluence despite continued large-scale poverty, and the mass emigration from countries that are extremely poor or destabilized by war to such countries as the United States, Canada, and Australia may destabilize over decades even the most robust and stable societies. The amount of information available overwhelms even those of us who have devoted our entire professional careers to environmental problem solving; the volume of information surely is beyond the grasp of the average person in academe not focusing on environmental problems and is even more intimidating for the average citizen. Even those of us who have a reasonably comprehensive grasp of the major environmental trends still have trouble communicating them.

References

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APPENDIX 1*

PERSONNEL OF BIOLOGICAL SURVEY
Director: H. Radclyffe Roberts
Limnologist in Charge: Ruth Patrick

Scientists

Algologists		
John L. Blum, Professor of Botany, Cassin College		June 15–Sept. 15
John H. Wallace, University of Pennsylvania		June 1 –Sept. 15
Bacteriologists		
Donald Reihard, Jr., Pennsylvania State College	(half time)	June 15–Dec. 31
Raymond L. Smith, Pennsylvania State College	(half time)	June 15–Sept. 15
Entomologist		
John W. H. Rehn, Cornell University		June 15–Sept. 15
Invertebrate Zoologists		
Thomas Dolan, 4th, Cornell University		June 10–Dec. 31
Herbert W. Levi, University of Wisconsin		June 10–Sept. 15
Charles B. Wurtz, University of Pennsylvania		June 1–Dec. 31
Protozoologists		
John Cairns, Jr., University of Pennsylvania		June 10–Dec. 31
Dr. Mary Gojdics, Professor of Zoology, Beret College		June 15–Sept. 10
Vertebrate Zoologist		
James A. Jones, University of Minnesota		June 14–Sept. 15
Water Chemist		
John M. Ward, Rutgers University		June 4–Sept. 15
	(part time)	Sept. 15–Dec. 31

Scientific Consultants

Algologists
Dr. Francis Drouet, Curator of Cryptogamic Botany, Chicago Museum of Natural History
Dr. Gerald W. Prescott, Professor of Botany, State University of Michigan

Bacteriologist
Dr. Robert W. Stone, Pennsylvania State College

Chemists
Mr. Joseph Demann, Atlantic Refining Company
Dr. Roy Weston, Atlantic Refining Company

Entomologists
Dr. Philip P. Calvert, Research Fellow, Academy of Natural Sciences of Philadelphia
Dr. Herbert H. Ross, University of Illinois
Dr. Henry K. Townes, U. S. Department of Agriculture
Dr. Jay R. Travers, University of Massachusetts

Botanist

Dr. Norman C. Fassett, Professor of Botany, University of Wisconsin

Geologist

Dr. Jack B. Graham, District Geologist of the U. S. Geological Survey

Invertebrate Zoologists

Mr. Leonard M. Bennetch, Research Associate, Academy of Natural Sciences of Philadelphia
Dr. Libby Hyman, American Museum of Natural History
Dr. J. Percy Moore, Research Fellow, Academy of Natural Sciences of Philadelphia
Dr. Henry A. Pilsbry, Academy of Natural Sciences of Philadelphia

Limnologists

Dr. Arthur D. Hasler, University of Wisconsin
Dr. G. Evelyn Hutchinson, Yale University

Mycologist

Dr. Fred K. Sparrow, University of Michigan

Statistician

Dr. Ralph O. Erickson, University of Pennsylvania

Vertebrate Zoologists

Mr. Henry Fowler, Curator of Fish, Academy of Natural Sciences of Philadelphia
Dr. Ernest A. Lachner, Pennsylvania State College

Technicians and Assistants

Stuart S. Bamforth, Laboratory Assistant		June 15–Sept. 15
	(part time)	Sept. 15–Dec. 31
Hazel D. Barner, Laboratory Assistant		June 10–Sept. 15
	(part time)	Sept. 15–Dec. 31
James F. Bergseng, Field Assistant		June 15–Dec. 31
Edward Haldeman, Laboratory Assistant	(part time)	Sept. 15–Dec. 31
Robert L. Kane, Field Assistant		June 15–Sept. 15
Mariana F. Spangler, Secretary		Oct. 15–Dec. 31
Dorothy L. Wright, Laboratory Assistant		June 1–Dec. 31

*Taken from Appendix 5 (pp. 340-341) in Patrick, R. 1949. A proposed biological measure of stream conditions based on a survey of Conestoga Basin, Lancaster County, Pennsylvania. Proceedings of the Academy Natural Sciences Philadelphia 101:271-341.