

Preface

Can you see the Great Milky Way where you live? Most Americans cannot. The greatest vista known to humankind is obscured by the veil of light pollution that shrouds all but the least developed regions on Earth.

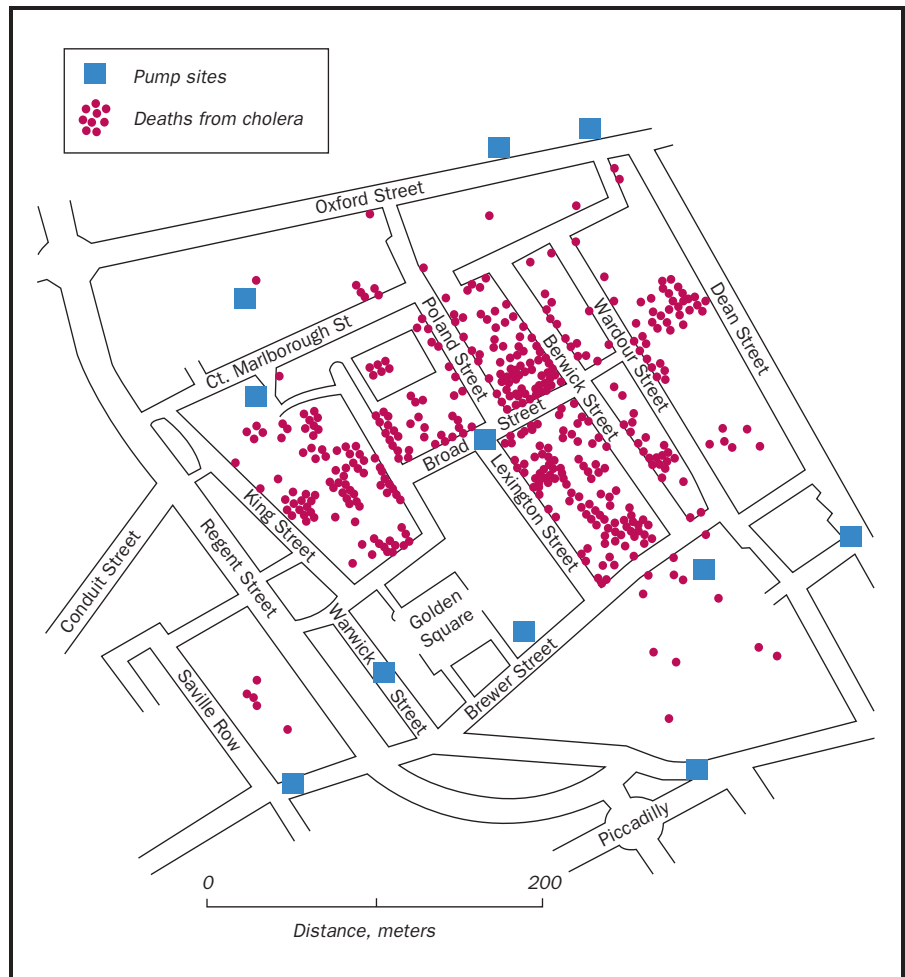
From the quality of life to life itself, there is not one person who is not affected in some way by pollution. Pollution affects our ability to swim in local waters or enjoy clear views in our national parks. More critically, pollution is responsible for waterborne diseases, birth defects, increased cancer incidence, and neurological problems ranging from loss of intelligence to madness itself. Pollution can kill instantly—over 8,000 died in just three days when methyl isocyanate leaked from the Union Carbide facility in Bhopal, India—or it can take decades for the full impact to be known. Indeed, the number of lives cut short by the radiation released when the Chernobyl nuclear reactor exploded in the Ukraine in 1986 is still being counted.

The other fundamental truth about pollution is that we have no one to blame for it but ourselves. Yes, there are natural causes of pollution, and we include an article on *Natural Disasters*, but the preponderance of pollutant threats are anthropogenic—caused by man. From lead in paint to mercury in water, PCBs in rivers to VOCs in the atmosphere, from CFCs to greenhouse gases, the sources of pollution can be traced to the decisions of industry, government and, ultimately, the individual consumer/voter.

With that in mind, one entry deserves special mention. *Lifestyle* is less an article than an opinion essay. Its inclusion is meant to challenge the reader's social choices, to ask you to consider how your own personal lifestyle affects the environment. Do you use bottled ketchup or individual packets? Do you ride to school in an SUV or take a bus? The fact is that just as every person on the planet is affected by pollution, so each of us directly and indirectly creates pollution. Some of us just create more of it than others.

One caution: if you are looking to these volumes for the answers to all questions about pollution and its effects on human and environmental health, you will be disappointed. There are dozens—perhaps hundreds—of toxic substances, for example, for which we do not have health-based standards, meaning we do not know what is a “safe” level of exposure. And if we know little about these contaminants individually, we know virtually nothing about the cumulative (synergistic) impact of multi-contaminant exposure. Perhaps the most important thing we have learned in the last half-century is how little

A map of London, England, showing locations of pumps and deaths from cholera during the epidemic, 1854. See Health, Human; Snow, John; Water Treatment.



we know. There is no shortage of discovery left for the next generation to undertake.

Organization of the Material

As its title would suggest, *Pollution A to Z* is organized alphabetically with 264 articles presented in two volumes. Articles are cross-referenced. Authors were aware of (and sometimes wrote) related articles and, for the fullest understanding, the reader is encouraged to explore at least one level beyond the subject first selected. This is made easier with the inclusion of cross-references at the end of many articles. You will find that articles are balanced between hard science and social science. You can research the contaminants that pollute a river, learn the health impacts of the pollution, and then trace society's response, from activism through the political process required to enact legislation to the enforcement that ultimately slows or reverses the pollution.

Each entry has been commissioned especially for this work. Our contributors are drawn primarily from the ranks of academia and government, each chosen for his or her particular experience and expertise. Who better, for instance, to write about the first Earth Day than Denis Hayes, the man who organized it. Equally important, our authors were chosen for having the



uncommon ability to make their knowledge accessible to advanced high school students and university undergraduates. We also provide a glossary in the back matter of each volume, summarizing the definitions of the terms in the margins throughout the set.

The two volumes are richly illustrated with charts, tables, maps, and line drawings. Each, along with the many photographs, was selected to amplify the text it accompanies. Historic photographs such as the one taken at noon during Donora, Pennsylvania's, killer smog are especially important; they convey far more about the state of our environment at its nadir than any words could. Finally, articles include selected lists of additional resources. The lists focus on materials that students can reasonably expect to locate, and each contains at least one Internet reference.

Acknowledgements

There are so many people to thank for their commitment, encouragement, and patience along the way. First, the editorial team at Macmillan Reference

Clean-up efforts underway at Love Canal, May 22, 1980. See Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); Environmental Movement; Gibbs, Lois; History; Laws and Regulations, United States; Mass Media; Politics. (©Bettmann/Corbis. Reproduced by permission.)



Boats approaching the oil-covered beach of Green Island, Alaska, following the 1989 *Exxon Valdez* oil spill. See Disasters: Chemical Accidents and Spills; Disasters: Oil Spills; History; Industry; Mass Media; Petroleum. (©Natalie Fobes/Corbis. Reproduced by permission.)

USA and the Gale Group. In particular, my thanks to H el ene Potter for her unflinching support, and to Marie-Claire Antoine, Michael J. McGandy, Shawn Corridor, Patti Brecht, and Frank Castronova. Their gracious patience, from the initial vision through searching for just the right authors to the endless tweaking of content, has been a much-appreciated constant. No one, of course, has been more patient than my wife, Andrea, and son, Matthew, who forgave me so many nights at the computer.

I trace my appreciation for the environment to growing up on a small New England dairy farm. To work the land is to connect with it; the intimate relationship between air, water, land, and life is seen every aspect of life. I have left the land behind now, both figuratively—I work in the city—and literally—for relaxation, we sail. It is the sailing that now seeds me with the environment, and it is a bittersweet connection. We sail by the grace of nature, propelled by balancing the forces of wind and water. But we sail in a nature disgraced by humans. To depart the harbor, we must first breach the



trash line, a floating windrow of plastic bottles, styrofoam cups, paper trash, old tires and worse. And the return means putting the clear ocean sky behind us to head instead for the orange-brown smudge that heralds yet another urban ozone-alert day.

My son, Matthew, is thirteen as I write this. He and his generation are making their own connections with the environment. My hope is that the information presented here will in some small way help them to be better stewards than their parents were.

Richard M. Stapleton

Petroleum storage tanks,
New Haven, Connecticut.
See Industry; Petroleum.
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Topical Outline

AIR

Acid Rain
Air Pollution
Air Pollution Control Act
Asthma
Burn Barrels
CFCs (Chlorofluorocarbons)
Clean Air Act
Coal
Diesel
Disasters
Donora, Pennsylvania
Electric Power
Emissions Trading
Energy
Energy Efficiency
Fuel Cell
Fuel Economy
Global Warming
Greenhouse Gases
Halon
Household Pollutants
Incineration
Indoor Air Pollution
Methane (CH₄)
Montréal Protocol
NO_x (Nitrogen Oxides)
Ozone
Petroleum
Point Source
Radioactive Fallout
Radon
Scrubbers
Smelting
Smog
Tobacco Smoke
Ultraviolet Radiation
Vehicular Pollution
Visual Pollution

BIOGRAPHIES

Addams, Jane
Brower, David
Brundtland, Gro
Chávez, César E.
Carson, Rachel
Carver, George Washington
Colborn, Theo
Commoner, Barry
Cousteau, Jacques
Ehrlich, Paul
Gibbs, Lois
Hamilton, Alice
Hayes, Denis
Ishimure, Michiko
LaDuke, Winona
Malthus, Thomas Robert
Nader, Ralph
Nelson, Gaylord
Snow, John
Strong, Maurice
Swallow, Ellen
Todd, John

CAREERS

Careers in Environmental Protection
Economics
Enforcement
GIS (Geographic Information System)

CLEANING UP POLLUTION

Abatement
Biodegradation
Bioremediation
Comprehensive Environmental Response,
Compensation, and Liability Act (CERCLA)
Dilution
Disasters: Chemical Accidents and Spills
Incineration

Phytoremediation
Science
Scrubbers
Superfund

CULTURAL ISSUES

Consumer Pollution
Education
Environmental Movement
Green Marketing
Lifestyle
Mass Media
Popular Culture
Population
Poverty
Public Participation
Sprawl
Writers

ECONOMICS

Consumer Pollution
Cost-benefit Analysis
Economics
Emissions Trading
Energy
Enforcement
Green Chemistry
Green Marketing
Industrial Ecology
Industry
ISO 14001
Labor, Farm
Life Cycle Analysis
Limits to Growth
Pollution Shifting
Smart Growth
Sprawl
Sustainable Development
Tragedy of the Commons
World Trade Organization

EFFECTS OF POLLUTION

Acid Rain
Cryptosporidiosis
Endocrine Disruption
Fish Kills
Global Warming
Health, Human
Hypoxia
Smog

ENERGY

Antinuclear Movement
Arctic National Wildlife Refuge
Coal
Diesel
Disasters: Environmental Mining Accidents
Disasters: Oil Spills
Economics
Electric Power
Energy
Energy, Nuclear
Energy Efficiency
Fossil Fuels
Fuel Cell
Fuel Economy
Global Warming
Green Chemistry
Greenhouse Gases
Lifestyle
Light Pollution
Mining
Radioactive Waste
Renewable Energy
Vehicular Pollution
Waste to Energy

ENVIRONMENTAL HEALTH

Acid Rain
Air Pollution
Bioaccumulation
DDT (Dichlorodiphenyl trichloroethane)
Electric Power
Endocrine Disruption
Energy
Fish Kills
Hypoxia
Oxygen Demand, Biochemical
Pesticides
Phosphates
Sedimentation
Smart Growth
Sprawl
Water Pollution
Water Pollution: Freshwater
Water Pollution: Marine

GLOBAL ISSUES

CFCs (Chlorofluorocarbons)
Disasters: Nuclear Accidents
Earth Summit
Global Warming
Greenhouse Gases
Halon
ISO 14001

Laws and Regulations, International
 Laws and Regulations, United States
 Montréal Protocol
 Ozone
 Politics
 Population
 Poverty
 Public Participation
 Public Policy Decision Making
 Sustainable Development
 Terrorism
 Ultraviolet Radiation
 War
 Waste, International Trade in
 World Trade Organization
 Zero Population Growth

GOVERNMENT AGENCIES

Agencies, Regulatory
 Cleanup
 Emergency Planning and Community Right-to-Know
 Dredging
 Environment Canada
 Environmental Crime
 GIS (Geographic Information System)
 Government
 Mexican Secretariat for Natural Resources (La Secretaría del Medio Ambiente y Recursos Naturales)
 National Oceanic and Atmospheric Administration (NOAA)
 National Park Service
 Nuclear Regulatory Commission (NRC)
 Occupational Safety and Health Administration (OSHA)
 President's Council on Environmental Quality
 U.S. Army Corps of Engineers
 U.S. Coast Guard
 U.S. Department of Agriculture
 U.S. Department of the Interior
 U.S. Environmental Protection Agency
 U.S. Food and Drug Administration (FDA)
 U.S. Geological Survey
 Workers Health Bureau

HISTORY OF POLLUTION

Disasters: Environmental Mining Accidents
 Disasters: Nuclear Accidents
 Disasters: Oil Spills
 Donora, Pennsylvania
 Earth Day
 Earth Summit
 Gauley Bridge, West Virginia

History
 Times Beach, Missouri
 Warren County, North Carolina

HUMAN HEALTH

Air Pollution
 Arsenic
 Asbestos
 Asthma
 Bioaccumulation
 Burn Barrels
 Cancer
 Cancer Alley, Louisiana
 Cryptosporidiosis
 Dioxin
 Disasters: Chemical Accidents and Spills
 Disasters: Nuclear Accidents
 Donora, Pennsylvania
 Electric Power
 Electromagnetic Fields
 Endocrine Disruption
 Energy
 Energy, Nuclear
 Groundwater
 Hazardous Waste
 Health, Human
 Heavy Metals
 Household Pollutants
 Indoor Air Pollution
 Infectious Waste
 Ishimure, Michiko
 Lead
 Mercury
 Mold Pollution
 Ozone
 Particulates
 PCBs (Polychlorinated Biphenyls)
 Persistent Bioaccumulative and Toxic Chemicals
 Persistent Organic Pollutants
 Radioactive Fallout
 Radon
 Risk
 Smog
 Times Beach, Missouri
 Tobacco Smoke
 Toxicology
 Vehicular Pollution
 Wastewater Treatment
 Water Pollution
 Water Pollution: Freshwater
 Water Pollution: Marine
 Water Treatment

LAND

Antinuclear Movement
Brownfield
Citizen Science
Citizen Suits
Dry Cleaning
Hazardous Waste
Injection Well
Landfill
Mining
Phytoremediation
Smart Growth
Smelting
Superfund
Underground Storage Tanks
Waste

LAWS AND REGULATIONS

Air Pollution Control Act
Clean Air Act
Clean Water Act
Comprehensive Environmental Response,
Compensation, and Liability Act (CERCLA)
Disasters: Environmental Mining Accidents
Disasters: Natural
Emergency Planning and Community Right-to-
Know
Environmental Crime
Ethics
Federal Insecticide, Fungicide, and Rodenticide
Act
Laws and Regulations, International
Laws and Regulations, United States
Marine Protection, Research, and Sanctuaries
Act
Mining Law of 1872
National Environmental Policy Act (NEPA)
National Pollutant Discharge Elimination
System (NPDES)
National Resource Damage Assessment
Noise Control Act of 1972
Ocean Dumping Ban Act
Precautionary Principle
Resource Conservation and Recovery Act
Rivers and Harbors Appropriations Act
Soil Pollution
Solid Waste
Sprawl
Superfund
Times Beach, Missouri
Toxic Substances Control Act (TSCA)
Unintended Consequences

LEGAL PROCESS

Arbitration
Citizen Suits
Emergency Planning and Community Right-to-
Know
Consensus Building
Enforcement
Environmental Crime
Environmental Impact Statement
Environmental Justice
Government
Laws and Regulations, United States
Litigation
Mediation
Natural Resource Damage Assessment
Regulatory Negotiation
Right to Know
Toxic Release Inventory
Whistleblowing

MAJOR POLLUTION EVENTS

Disasters: Chemical Accidents and Spills
Disasters: Environmental Mining Accidents
Disasters: Natural
Disasters: Nuclear Accidents
Disasters: Oil Spills

NON-POINT SOURCE POLLUTION

Agriculture
Cryptosporidiosis
Household Pollutants
Pesticides

PETROLEUM

Arctic National Wildlife Refuge
Diesel
Disasters: Oil Spills
Petroleum
Plastic
Underground Storage Tanks

POINT SOURCE POLLUTION

Acid Rain
Catalytic Converter
Coal
Diesel
Electric Power
Fossil Fuels

POLITICAL PROCESS

Arbitration

Consensus Building
 Earth Day
 Education
 Environmental Justice
 Environmental Movement
 Environmental Racism
 GIS (Geographic Information System)
 Government
 Green Party
 Information, Access to
 Legislative Process
 Litigation
 Mediation
 National Environmental Policy Act (NEPA)
 New Left
 Nongovernmental Organizations (NGOs)
 Politics
 Progressive Movement
 Property Rights Movement
 Public Interest Research Groups
 Public Participation
 Public Policy Decision Making
 Regulatory Negotiation
 Right to Know
 Unintended Consequences
 Whistleblowing
 Wise-Use Movement

POLLUTANTS

Adaptive Management
 Arsenic
 Asbestos
 Carbon Dioxide
 Carbon Monoxide
 CFCs (Chlorofluorocarbons)
 Coal
 DDT (Dichlorodiphenyl trichloroethane)
 Dioxin
 Fossil Fuels
 Greenhouse Gases
 Halon
 Heavy Metals
 Household Pollutants
 Infectious Waste
 Lead
 Mercury
 Methane (CH₄)
 NO_x (Nitrogen Oxides)
 Nonaqueous Phase Liquids (NAPLs)
 Particulates
 PCBs (Polychlorinated Biphenyls)
 Persistent Bioaccumulative and Toxic Chemicals (PBTs)
 Persistent Organic Pollutants (POPs)
 Phosphates

Sulfur Dioxide
 VOCs (Volatile Organic Compounds)

POLLUTION PREVENTION

Beneficial Use
 Bottle Deposit Laws
 Catalytic Converter
 Composting
 Energy Efficiency
 Enforcement
 Environmental Impact Statement
 Green Chemistry
 Industrial Ecology
 Integrated Pest Management
 Life Cycle Analysis
 Pollution Prevention
 Pollution Shifting
 Recycling
 Renewable Energy
 Reuse
 Science
 Systems Science
 Technology, Pollution Prevention
 Toxic Release Inventory
 Waste
 Waste Reduction
 Waste to Energy

RADIATION

Disasters: Nuclear Accidents
 Electromagnetic Fields
 Energy, Nuclear
 Radioactive Fallout
 Radioactive Waste
 Radon
 Yucca Mountain

SCIENCE

Carson, Rachel
 Carver, George Washington
 Citizen Science
 Colborn, Theo
 Cousteau, Jacques
 GIS (Geographic Information System)
 Green Revolution
 Politics
 Risk
 Science
 Systems Science
 Technology, Pollution Prevention
 Toxicology
 Union of Concerned Scientists

SOCIAL ACTION

Activism
Consensus Building
Earth Day
Earth First!
Ecoterrorism
Education
Environmental Impact Statement
Environmental Justice
Environmental Movements
Environmental Racism
Ethics
GIS (Geographic Information System)
Gauley Bridge, West Virginia
Green Party
Greenpeace
Information, Access to
Labor, Farm
Legislative Process
Lifestyle
Mass Media
National Toxics Campaign
New Left
Nongovernmental Organizations (NGOs)
Popular Culture
Poverty
Precautionary Principle
Progressive Movement
Property Rights Movement
Public Interest Research Groups (PIRGs)
Public Participation
Public Policy Decision Making
Settlement House Movement
Toxic Release Inventory
Union of Concerned Scientists
Warren County, North Carolina
Wise-Use Movement
Writers
Zero Population Growth

SOURCES OF POLLUTION

Agriculture
Consumer Pollution
Disasters: Chemical Accidents and Spills
Disasters: Environmental Mining Accidents
Disasters: Natural
Disasters: Nuclear Accidents
Disasters: Oil Spills
Dry Cleaning
Electric Power
Electromagnetic Fields
Energy, Nuclear
Incineration
Industry

Lifestyle
Mining
Nonpoint Source Pollution
Pesticides
Petroleum
Point Source
Smelting
Terrorism
Vehicular Pollution

TREATIES AND CONFERENCES

Agenda 21
CFCs (Chlorofluorocarbons)
Earth Summit
Environmental Crime
Ethics
Global Warming
Greenhouse Gases
Halon
Montréal Protocol
NAFTA (North American Free Trade Agreement)
Precautionary Principle
Treaties and Conferences

TYPES OF POLLUTION

Air Pollution
Light Pollution
Medical Waste
Mold Pollution
Noise Pollution
Plastic
Radioactive Waste
Soil Pollution
Space Pollution
Thermal Pollution
Vehicular Pollution
Visual Pollution
War
Water Pollution
Water Pollution: Freshwater
Water Pollution: Marine

VEHICULAR POLLUTION

Catalytic Converter
Diesel
Energy Efficiency
Fuel Cell
Fuel Economy
Ozone
Petroleum
Smog
Vehicular Pollution

WASTE

Beneficial Use
 Biosolids
 Burn Barrels
 Hazardous Waste
 Injection Well
 Landfill
 Medical Waste
 Ocean Dumping
 Plastic
 Pollution Shifting
 Recycling
 Reuse
 Solid Waste
 Superfund
 Waste
 Waste Reduction
 Waste to Energy
 Waste, International Trade in
 Waste, Transportation of
 Yucca Mountain

WATER

Acid Rain
 Agriculture
 Biosolids
 Clean Water Act
 Cryptosporidiosis
 Disasters: Oil Spills

Dredging
 Dry Cleaning
 Energy
 Fish Kills
 Groundwater
 Hypoxia
 Infectious Waste
 Injection Well
 Marine Protection, Research, and Sanctuaries
 Act
 Mixing Zone
 National Pollutant Discharge Elimination
 System (NPDES)
 Nonpoint Source Pollution
 Ocean Dumping
 Ocean Dumping Ban Act
 Oxygen Demand, Biochemical
 PCBs (Polychlorinated Biphenyls)
 Petroleum
 Phosphates
 Point Source
 Sedimentation
 Superfund
 Thermal Pollution
 Underground Storage Tank
 Wastewater Treatment
 Water Pollution
 Water Pollution: Freshwater
 Water Pollution: Marine
 Water Treatment