

AIR POLLUTION HISTORY

BANG! The Big Bang. In 1948 physicist George Gamow proposed the Big Bang theory on the origin of the universe. He believed that the universe was created in a gigantic explosion as all mass and energy were created in an instant of time. On the basis of this thesis, estimates on the age of the universe at the present time range between 7 and 20 billion years with 12 billion years often mentioned as the age of planet Earth.

Gamow further believed that the various elements present today were produced within the first few minutes after the Big Bang when near-infinitely high temperatures fused subatomic particles into the chemical elements that now constitute the universe. More recent studies suggest that hydrogen and helium would have been the primary products of the Big Bang, with heavier elements being produced later within the stars. The extremely high density within the primeval atom caused the universe to expand rapidly. As it expanded, the hydrogen and helium cooled and condensed into stars and galaxies. This explains the expansion of the universe and the physical basis of Earth.

As noted in Dr. Bravo's Introduction, one might assume that the air surrounding Earth has always been composed primarily of nitrogen and oxygen, but that is not the case. Since Earth's atmosphere was first formed, its composition undoubtedly has undergone great changes. The "normal" composition of air today is not likely the same as it was when the first primitive living cells inhabited this planet. Some scientists believe that

Earth's earliest atmosphere probably contained almost no free oxygen. The oxygen in today's atmosphere is probably the result of several million of years of photosynthesis.

Over the history of Earth, plants and animals have adapted—albeit very slowly—to changes in the environment. When environmental changes occur more rapidly than a species' ability to adapt, however, the species oftentimes either does not thrive or does not survive. Human contributions to environmental changes in recent history, e.g., global warming, have come relatively quickly compared to the natural rate of change, and Earth's and its inhabitants' natural adaptation capabilities might not be adequate to meet this challenge.

Air pollution has been around for a long time. Natural phenomena such as volcanoes, windstorms, forest fires, and decaying organic matter contribute substantial amounts of air pollutants. Plants and trees also emit organic vapors and particles. For the most part, Earth, which has a well-balanced natural "cleansing" system, is able to keep up with natural pollution.

Air pollution has bedeviled humanity since the first person discovered fire. However, humans did not significantly affect the environment until relatively recent times. This is due to two reasons: (1) the human population has been large for only a small part of recorded history, and (2) the bulk of human-made produced air pollution is intimately related to industrialization. In fact, humans did not begin to alter the environment until they began to live in communities.

From the fourteenth century until recently, the primary air pollutants have been released in industrialized areas. Unfortunately, the control of pollutants rarely takes place prior to public outcry, even though the technology for controlling pollutants may be available. Early recognition of pollutants as health hazards have not resulted in pollution reduction; traditionally, only when personal survival is at stake has effective action been taken.

During the reign of the English King Edward I (1271–1307), there was a protest by the nobility against the use of "sea" coal. In the succeeding reign of Edward II (1307–1327), a man was put to torture for filling the air with a "pestilential dust" resulting from the use of coal. Under Richard III (1377–1399), and later under Henry V (1413–1422), England took steps to regulate and restrict the use of coal. Both taxation and regulation of the movement of coal in London were employed. Other legislations, parliamentary studies, and literary comments appeared sporadically during the next 250 years. In 1661, a pamphlet was published by the Royal Command of Charles II entitled "Fumifugium; or the Inconveniences of Air and Smoke in London Dissipated; Together with Some Remedies Humbly Proposed." The paper was written by John Evelyn, one of the founding fathers of the Royal Society. Later, in 1819, a Select Committee of the British Parliament was formed to study smoke abatement. As is the case of most civic actions, by the time the committee submitted its report, the problem had subsided and no action was taken.

Air pollution was a fact of life during the first half of the twentieth century. Comments such as "good, clear soot," "it's our lifeblood," "the smell of money," "an index to local activity and enterprise," and "God bless it" were used to describe air pollution. However, society began to realize that air pollution was a "deadly" problem. The term "smog" originated in Great Britain, where it was used to describe

the over 1000 smoke-fog deaths that occurred in Glasgow, Scotland in 1909. The smoke problem in London reached its peak in December 1952; during this “air pollution episode” approximately 4000 people died, primarily of respiratory problems. In 1948, 20 people died and several hundred became ill in the industrial town of Donora, Pennsylvania. New York City, Birmingham, the entire state of Tennessee, Columbia River, St. Louis, Cincinnati, and Pittsburgh have had similar problems. Additional details of these often-referenced episodes are briefly summarized below.

1. On Friday December 5, 1952, static weather conditions turned the air of London, England into a deadly menace. A prolonged temperature inversion held in the city’s air close to the ground and an anticyclonic high pressure system prevented the formation of winds that would have dispersed the pollutants that were accumulating heavily at ground level. For 5 days the greater London area was blanketed in airborne pollution. Few realized it at the time, but there were 4000 more deaths than normal for a 5-day period, hospital admissions were 48% higher, and sickness claims to the national health insurance system were 108% above the average, and 84% of those who died had preexisting heart or lung diseases. Hospital admissions for respiratory illness increased 3-fold, and deaths due to chronic respiratory disease increased 10-fold.
2. The same static atmospheric conditions in London caused a similar incident in Donora, Pennsylvania in 1948. A town of only 14,000, it had 15–20 more deaths than normal during the episode. More than 6000 of its residents were adversely affected, 10% of them seriously. Among those with preexisting illnesses, 88% of the asthmatics, 77% of those with heart diseases, and 79% of those with chronic bronchitis and emphysema, were adversely affected. Allowing for the difference in population, Donora paid a much higher price for air pollution than did London.
3. New York City has experienced similar periods of atmospheric stagnation on numerous occasions since the mid-1940s. During one such episode in 1953, the city reported more than 200 deaths above normal.
4. Birmingham, Alabama is another high-exposure area whose residents have frequently exhibited a greater than average incidence of respiratory irritation symptoms such as coughing, burning throats or lungs, and shortness of breath. EPA monitoring studies indicated that nonsmokers in these two cities developed respiratory symptoms 2 or 3 times more frequently than did nonsmokers in cleaner communities.
5. In the early 1900s, gases from short stacks at two copper smelters near the Georgia border of Tennessee caused widespread damage to vegetation in the surrounding countryside. When taller stacks were built, damage extended 30 miles into the forests of Georgia. An interstate suit resulted, which was finally carried to the United States Supreme Court. The problem was eventually solved by means of a byproduct sulfur dioxide recovery plant.
6. Two decades later, a similar case involved the lead and zinc smelter of the Consolidated Mining and Smelting Company of Canada at Trail, BC (British

Columbia). The smelter was located on the west bank of the Columbia River, 11 miles north of the international boundary between Canada and the United States. When extensive damage to vegetation occurred on the U.S. side of the border, a damage suit was filed and finally settled by an international tribunal. In this case, after damages were assessed, the problem was solved partly by sulfur recovery and partly by operating the smelter according to a plan based on meteorological considerations.

Unfortunately, the climatic conditions and human activities that combine to form critical buildups of pollutants are by no means uncommon in the United States. They occur periodically in various parts of the country and will continue to threaten public health as long as air pollutants are emitted into the atmosphere in amounts sufficient to accumulate to dangerous levels.

Approximately 200 million tons of waste gases are released into the air annually. Regarding sources, slightly over half of the pollution comes from the internal-combustion engines of cars and other motor vehicles. Roughly 25% comes from fuel burned at stationary sources such as power-generating plants, and another 15% is emitted from industrial processes.

The average person breathes 35lb of the air containing these discharges each day—6 times as much as the food and drink normally consumed in the same period of time. While low levels of air pollution can be detrimental or even deadly to the health of some people, extremely high levels can be detrimental to large numbers of people. Dangerously high concentrations of air pollutants can occur during *air pollution episodes* described above and *air pollution accidents* such as those that occurred in Flixborough (England), Seveso (Italy), Three Mile Island, Chernobyl, Bhopal, etc. (Details on these accidents are available in the text/reference book by A. M. Flynn and L. Theodore, *Health, Safety and Accident Management in the Chemical Process Industries*, CRC Press/Taylor & Francis, Boca Raton, FL, 2002.) These episodes and accidents continue to occur in various parts of the world, and are well documented.

Perhaps the federal government of the United States could have done more earlier to protect the land and resources as well as public health. But for most of the nineteenth century, the government was still a weak presence in most areas of the country. There was, moreover, no body of laws with which the government could assert its authority. By the end of that century there was a growing body of information about the harm being done and some new ideas on how to set things straight. Yet, there was no acceptable ethic that would impel people to treat the land, air, and water with wisdom and care.

As the nineteenth century was drawing to a close, three very special individuals made their entrance on the national stage. Gifford Pinchot, John Muir, and Theodore Roosevelt were to write the first pages of modern environmental history in the U.S., which in turn led to the birth of the modern environmental movement early in the twentieth century. The federal government ultimately entered into the environmental and conservation business in a significant and somewhat dramatic fashion when Teddy Roosevelt's second cousin Franklin entered the White House in 1933. It was his political ideology, as much as his love of nature, that led Roosevelt to include major conservation projects in his New Deal reforms. The Civilian Conservation

Corps, the Soil Conservation Service, and the Tennessee Valley Authority were among the many New Deal programs created to serve both the environment and the people.

At this point in time, muscle, animal, and steam power had been replaced by electricity, internal-combustion engines, and nuclear reactors. During this period, industry was consuming natural resources at an incredible rate. All of these events began to escalate at a dangerous rate after World War II. In 1962, a marine biologist named Rachel Carson, author of *Silent Spring* (Houghton-Mifflin, 1962), a best-selling book about ocean life, opened the eyes of the world to the dangers of ignoring the environment. It was perhaps at this point that America began calling in earnest for environmental reform and constraints on environmental degradation. Finally, in the 1970s, Congress began turning out environmental laws that addressed these issues. It all began in 1970 with the birth of the Environmental Protection Agency.

[For additional literature regarding early history and the environmental movement, the interested reader is referred to the book by Philip Shabecoff, titled *A Fierce Green Fire* (Farrar-Strauss-Giroux, 1993). This outstanding book is a “must” for anyone whose work is related to or is interested in the environment.]

