



Heartland Science



Ohio's Legacy of Discovery & Innovation



Environmental Resources

From Animal Extinction to Ozone

Rowland: Friend of the Environment

F. Sherwood Rowland, a native of Delaware, Ohio, shared the 1995 Nobel Prize in Chemistry for his critical role in discovering the global environmental threat of a now-banned family of industrial chemicals. "The three researchers have contributed to our salvation from a global environmental problem that could have catastrophic consequences," said the Royal Swedish Academy of Sciences, which awards the chemistry prizes.



They focused public and scientific attention on the "ozone layer," the Achilles heel of the biosphere, and the depleted area of that protective chemical now known as the "ozone hole." In addition, the research helped to establish atmospheric chemistry as a major field of research, sparking hundreds of new studies on the thin layer of gases that allows life to exist on Earth.

Everyone knows that Earth's atmosphere contains oxygen -- O_2 -- a molecule consisting of two atoms of the element bonded together. That's the oxygen that people and other animals breathe, and plants release in photosynthesis. The atmosphere also contains tiny amounts of another gas made from oxygen. That's ozone -- O_3 -- that has three oxygen atoms. Most of it exists in a layer whose center is about 12 miles above Earth's surface. If all the ozone in the atmosphere were spread over Earth's surface, the layer would be only 3 mm thick.



Ozone may be distant and rare, but it plays a key role in allowing life to exist on Earth. Ozone forms a protective shield in the upper atmosphere that absorbs most of the sun's dangerous ultraviolet (UV) radiation before it reaches the surface. UV is the reason why too much exposure to sunlight can cause sunburn. UV radiation has other bad effects on living things. Without a protective ozone layer in the atmosphere, modern animals and plants could not exist.

Rowland and atmospheric chemistry pioneers Paul Crutzen and Mario Molina discovered how ozone forms and decomposes through chemical processes in the atmosphere. They also showed how sensitive the ozone layer is to gases that modern society produces as part of important commercial and industrial processes.

In 1974, Rowland, of the University of California at Irvine, and Molina published a landmark study in the journal *Nature* showing that chlorofluorocarbon (CFC) gases, or "freons" were destroying the ozone shield. Billions of pounds of CFCs then were used to force the contents out of aerosol spray bottles; in air conditioners and other cooling systems; to make plastic foams; and in scores of other applications.

Their conclusion made scientists' jaws drop in amazement, and stirred widespread disbelief among people who made CFCs and products that depended on them. That's because everyone thought CFCs were chemically inert, and totally harmless. In addition, CFCs were used in essential products, and there were no easily available alternatives. Rowland and Molina showed that the CFCs in a can of hair spray or underarm deodorant could gradually travel to the ozone layer. Intense ultraviolet light then broke CFCs apart, leaving chlorine atoms that took part in chemical reactions that destroyed ozone.

In addition to the science, Rowland became a vocal advocate for a CFC ban. The research led to the Montreal Protocol, a treaty in which the world's countries agreed to a phase-out and ban further uses of CFCs.

Today's aerosol sprays, air conditioners, and many other products once dependent on CFCs, use ozone-safe ingredients. Still, the effects of decades of CFC release linger, with an ozone hole developing over Antarctica every spring. Large amounts of ozone were destroyed in that big area.

Without this brilliant, brave Ohio chemist and other pioneering atmospheric scientists, that hole could be allowing intense UV radiation to pour down on cities elsewhere, increasing the risk of skin cancer and other health problems.

Find out more...

- U.S. Environmental Protection Agency - Science of Ozone Depletion (<http://www.epa.gov/ozone/science/index.html>)