Joe Farman

(1930–2013)

Discoverer of the ozone hole.

Joe Farman led a team of scientists to make one of the most important geophysical discoveries of the twentieth century. In 1985, the group from the British Antarctic Survey discovered a hole in the ozone layer — the atmospheric shield that absorbs ultraviolet rays. Their seminal article in *Nature* helped to convince scientists, the public, politicians and even the chemical industry that synthetic chemicals had driven a 40% decline in ozone levels over Antarctica in less than a decade.

Farman, who died in Cambridge, UK, on 11 May, was born in Norfolk in 1930. As a student at King Edward VI's Grammar School in Norwich, he won a scholarship to Corpus Christi College at the University of Cambridge, where he studied natural sciences. After graduating in 1953, he worked on guided missiles for three years at de Havilland Propellers, a British company. He then joined the Falkland Islands Dependencies Survey, which later became the British Antarctic Survey, the national Antarctic research operation.

Farman worked for the survey, first in Edinburgh and then in Cambridge, until 1990. Initially, he was responsible for providing a range of basic geophysical measurements, including ozone and radiation levels, for the International Geophysical Year that lasted from July 1957 to December 1958. This project aimed, among other goals, to open up the Antarctic continent for scientific research.

In the early 1980s, Farman and his group recorded anomalously low levels of ozone in the stratosphere above Halley Bay in Antarctica. The fact that atmospheric ozone could be depleted by halogen species, such as fluorine and chlorine, had been postulated a decade earlier by atmospheric chemists F. Sherwood Rowland and Mario Molina. But according to their theory, the biggest losses should have occurred some 40 kilometres above Earth's surface. Farman and his colleagues had revealed a rapid depletion of ozone levels in an unexpected place and at an unexpected time of year — springtime temperatures above Antarctica are so low that any photochemical reactions were predicted to be exceptionally slow. Furthermore, satellite data from NASA apparently showed no such decline in ozone.

Farman's first reaction was to check and recheck the Dobson instruments — the devices used to calculate the thickness of the ozone layer by measuring the amount of ultraviolet radiation penetrating the atmosphere. But along with his colleagues Brian Gardiner and Jonathan Shanklin, he could find no error. Meteorological data from Halley Bay also ruled out the possibility that some unforeseen weather phenomenon was to blame.

To solve the puzzle, Farman had to turn to chemistry. The group's paper (J. C. Farman *et al. Nature* **315,** 207–210; 1985) bravely identified the breakdown products of chlorofluorocarbons (CFCs) as the cause of the ozone loss.

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Their strong statement was more remarkable in the light of Farman's innate caution.

As well as driving a sea change in attitudes towards the ozone problem, the group's discovery helped to bring about the Montreal Protocol, a 1987 international treaty to protect the ozone layer and to phase out CFCs and other ozone-depleting gases. Kofi Annan, former Secretary General of the United Nations, has described the protocol as "perhaps the single most successful international agreement to date".

When Farman reached retirement age in 1990, he started working as a volunteer consultant for the European Ozone Research Coordinating Unit, which was relocated from the Cambridge offices of the British Antarctic Survey to the University of Cambridge's chemistry department in 1995. While the two of us (J.P. and N.H.) each took a turn at heading the unit, Farman, although unpaid, came in nearly every day.

Farman's scientific life was characterized by a painstaking attention to detail. He believed in the primacy of data and the need for decades-long records in geophysics. For him, theory came a distant second to measurements, and computer models were distinctly suspect. We often saw him colouring in meteorological or satellite ozone maps, which allowed him to think about what the data were showing in a way that producing a computer plot would not have done. And of course, he delighted in finding occasional errors in computer-generated plots from NASA or the UK Met Office.

Joe was rigorous, critical of everything and dogged. And he absolutely hated being wrong. When writing reports, such as the series of Stratospheric Ozone Review Group reports for the UK Department of the Environment in the late 1980s and early 1990s, Joe wanted to test every statement to destruction. He was both a frustrating colleague and a joy to work with.

Joe did not naturally seek the limelight, so it was remarkable that after the publication of the ozone-hole paper, he entered the policy arena so keenly and effectively. He did so at a time when the United Kingdom, with the personal backing of then Prime Minister Margaret Thatcher, was taking a leading role in the international negotiations that in 1990 resulted in the London Amendment to the Montreal Protocol. This amendment has been successful in bringing significant reductions in CFC emissions.

Whether Joe talked to industry representatives or to journalists, it was always important to him to educate them about the science. In fact, it was his scientific integrity that gave him such credibility as a public advocate in the development of the Montreal Protocol.

Joe was a wonderful friend and colleague — generous with advice and ideas about science, but also about wine, English rugby, gardening, cross-country skiing and the conducting of Hector Berlioz's music, all delivered with his surreal good humour (he loved *The Goon Show*). He was awarded several prizes and honorary degrees, and took great pleasure, in particular, in the fellowship and then honorary fellowship conferred on him by his old college at Cambridge. He is survived by Paula, his wife of 42 years.

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