

Mario Molina (1943–) information sheet



Mario Molina

(Picture reproduced courtesy of Nobel Foundation.)

As a boy, Mario Molina was strongly influenced by his aunt, a chemist in the sugar industry, who later became a teacher. She used to encourage him to carry out chemistry experiments at home in a converted bathroom. From a young age Mario's ambition was to be a research scientist, even though it was not a trendy job for a young Mexican.

Why investigate CFCs and the atmosphere?

Molina went to university and studied chemistry at degree level. He then took a research degree (a PhD) in 1972, at the University of California, Berkeley. Molina then went to Irvine to work with a man called Sherwood Rowland, who had recently heard that the British scientist James Lovelock had discovered some of the refrigerant trichlorofluoromethane (called CFC-11) in the atmosphere of the Northern and Southern hemisphere. He was curious to find out more, and wanted to know the answer to a simple question, 'what happens to CFCs in the environment and were there any consequences?'

Rowland managed to persuade his sponsors to fund the project and Molina started investigating CFCs in October 1973, even though his knowledge of atmospheric chemistry was limited.

Molina got to work, carrying out calculations and he soon started to build up a very worrying picture of the atmosphere. If he was right, it was not good news; if he was wrong he would look stupid. What should he do next?

Molina's theory

CFC's were so inert that there was nothing for them to react with in the atmosphere. So air currents carried them up into the stratosphere, where energy from ultraviolet (UV) radiation would break off a chlorine atom, called a radical. The radical would then start a chain reaction with ozone that would eventually destroy the ozone layer. At the then current CFC atmospheric release rate, Molina calculated that between 7 and 13%

of the ozone would soon be destroyed. This could cause problems since it was known that the ozone layer protected the Earth from harmful UV radiation.

Action

Towards the end of December 1973, Molina discussed his theory with Rowland. At first they both tried to find a mistake in the calculations, but they could not. So just after Christmas 1973, the two scientists went to visit some atmospheric chemists for a second opinion. It was known that nitrogen oxides could destroy ozone and other investigations to do with the release of hydrogen chloride from volcanoes and the ammonium perchlorate fuel planned for the space shuttle were being carried out. No one had yet investigated CFCs; the rough estimates suggested they were perhaps a factor of 100 more significant than the fuel from the space shuttle as a potential source of stratospheric chlorine.

Telling the world

After Molina made his initial discovery, he knew that if he were right, then the Earth would be in serious trouble. CFC molecules can stay in the atmosphere for about 130 years. As a scientist he felt that he had a responsibility to tell the world, and to do something about the ever-growing CFC industry.

Even though there was no experimental evidence, Rowland and Molina published the CFC–ozone theory in the scientific journal *Nature* in June 1974.

Response

Initially there was no response from the scientific world. Concerned that their voices may go unheard, Rowland and Molina discussed their theory for the first time in public, at the American Chemical Society meeting in Atlantic City, in September 1974. This time 'possible ozone depletion' hit the headlines, Molina and Rowland recommended a complete ban on the future release of CFCs to the environment. This triggered an enormous response from governments, industry, the public and environmental groups such as Greenpeace and has subsequently led to measures to reduce and eventually eliminate their use.

