

recovery delayed

an interview with Mario Molina



Mario Molina's name may not exactly be written in the stars, but the Mexican chemist and Nobel Prize winner is one of a select few to have a piece of the solar system called after him. An asteroid to be precise.

In this he keeps eclectic, if exalted, company. Writers Isabel Allende and Ray Bradbury have their names on their own chunks of rock, scattered between Mars and Jupiter. All the Monty Python comedy team are similarly in orbit around the sun - as are Engelbert Humperdinck (the German composer, not the pop singer), several knights of King Arthur's legendary round table, and Robbie Naish, the pioneering American windsurfer. There are, naturally, a lot of astronomers - but also a Japanese teddy bear artist.

Prof Molina also has two colleagues up there with him - Prof Paul Crutzen and Prof Sherwood Rowland, who jointly won the Nobel Prize for chemistry with him in 1995 for their work in identifying the threat to the Earth's vital ozone layer. And there's something appropriate about this. For the barren surfaces of the atmosphere-less asteroids, pitilessly exposed to the sun's ultraviolet rays, serve as a reminder of the importance of the protective layer to our planet.

Prof Molina was a 30 year old postdoctoral fellow at the University of California in Berkeley in 1973, when Sherwood Rowland - then his professor - offered him a range of options for research. The one that most intrigued him was finding out the environmental fate of the inert man-made chlorofluorocarbons (CFCs) then accumulating in the atmosphere from being used in aerosol cans, refrigeration, plastic foams and a host of other applications. At first, he says, "the research did not seem to be very interesting, nothing in the lower atmosphere appeared to affect the chemicals."

But he knew that they would eventually drift high enough to be broken down by solar radiation. And when he looked at what would then happen, he realised that each of their chlorine atoms would destroy thousands of atoms of ozone. He and Prof Rowland worked out that if CFCs continued to be released at their current rate they would, within 30 years, destroy 20 to 40 per cent of the ozone shield.

Molina was so surprised when he first did the calculations that, he told *Our Planet*: "I thought I had made a mistake". That, he adds, was also the reaction of some scientists when they published their results. The experts in the field, he says, "accepted it quite readily" but "it took quite a while to make the case to the scientific community in general"; And, he adds, "it took even more effort to bring it to the political arena".

After much debate, the danger was eventually recognised. The United States banned the use of CFCs in spray cans in 1978, and the world agreed the Vienna Convention for the Protection of the Ozone Layer in 1985. But it was not until after the discovery of the Antarctic ozone hole later that year that the international community agree to tackle CFCs globally in the 1987 Montreal Protocol, which progressively strengthened as the scientific evidence accumulated, and is phasing out CFCs and other ozone depleting substances (ODS) worldwide.

Prof Molina says the amount of ODS in the atmosphere peaked a few years ago and is "beginning to decrease slowly, which is very good news." He adds that some scientists believe they may be starting to see resulting beneficial effects on the ozone layer but he fears that, - just as things finally look as if

they are improving - there may be a serious setback, due to climate change. "With a changed atmosphere through global warming, there is a likelihood that the ozone layer will take longer to recover", he says. As climate change warms the surface of the earth and the troposphere (the lower layer of the atmosphere), it cools the stratosphere further up, enhancing the process of ozone destruction. "The colder it is" he says, "the more depletion you get". The recovery, due around 2050, could be delayed by ten to 15 years.

This, as he points out, is yet another reason to tackle global warming. And one important contribution would be to strengthen the ozone protection protocol agreed twenty years ago. By phasing out CFCs, which are also powerful greenhouse gases, the Montreal Protocol has already done more to combat climate change than the Kyoto Protocol will ever do. An authoritative study published last March - by scientists from the Netherlands Environmental Assessment Agency, the US Environmental Protection Agency and National Oceanic and Atmospheric Administration and DuPont - concluded that phasing out CFCs and other ODS will save the atmosphere the equivalent of eleven gigatonnes of carbon dioxide a year by 2010. By contrast, the Kyoto Protocol will spare it the equivalent of just two gigatonnes over what emissions would then have been if the growth of greenhouse gases had continued unabated.

Like many experts, Prof Molina wants the Montreal Protocol to go further and accelerate phasing out HCFCs and HFCs - used as transitional substitutes for the CFCs - and thus increase its effectiveness in both combating climate change and protecting the ozone layer. "The trend now is to try to speed up the transition. Some of the HCFCs are much better than others, so the hope is that at the twentieth anniversary the protocol can be fine tuned to speed up the deadline for some of them."

He adds: "Although the Montreal Protocol is still a success story we need to keep watching it very closely, and keeping working at it, because of the potential for going into reverse if countries do not comply or there is illegal production of ODS. It is very important to continue to press to ensure the Protocol's continued success. There have been suggestions that the problem is already solved, but that is not the case." Nevertheless, he says, the Protocol has set important precedents for the international effort to combat climate change, not least "to show that it can be done". But time is very short, and he hopes that tougher action on greenhouse gases will not have to wait for an unpleasant surprise like the hole over Antarctica.

"The risk is that we might reach some tipping point where the changes are no longer linear - as with the ozone hole. We are already seeing visible effects of global warming - nasty situations like hurricanes, flooding and drought. That should be enough of a warning for us: we already have enough information about climate change. It would be extremely risky to wait until something more dramatic happened. But the risk of much worse surprises will clearly increase quite severely should society continue for another decade without taking clear action.

"The perception among experts is that we have about a decade to begin some very serious changes in the way we do things and, because of the time it takes for measures to be implemented, that means we have to start planning a truly international climate agreement that would mimic the Montreal Protocol."