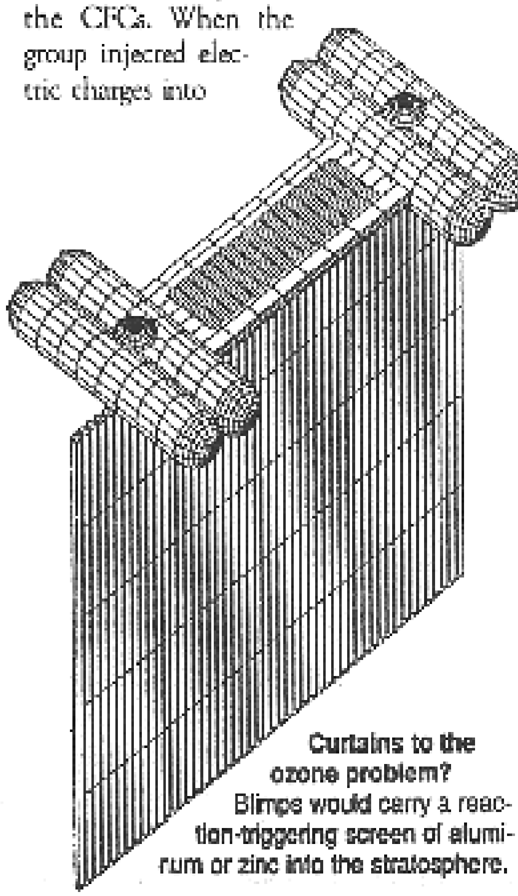
A High-Flying Fix for Ozone Loss

Alfred Wong knows he's in danger of overreaching when he talks about extending his lab-scale chemical reaction to the scale of the globe. But the University of California, Los Angeles, plasma physicist thinks the chemical transformation he has seen in a chamber of gases has implications too important for the global atmosphere to keep silent, in spite of a blast of criticism from atmospheric scientists. Wong's bold claim: Twenty or so panels of zinc or aluminum, each at least the size of a football field, carried aloft by balloons, could sustain a global version of the laboratory process—and provide a quick fix for stratospheric ozone loss.

That implication is buried in a paper in the 9 May *Physical Review Letters*, where Wong and his colleagues describe a scheme for inactivating the chlorine atoms, unleashed by manmade chlorofluorocarbons (CFCs), that destroy ozone in the stratosphere. The paper mainly describes laboratory results, but Wong's grander claim was the subject of a UCLA press release—and ensuing coverage by television networks and print media, including the Associated Press and *Newsweek*. "It was very well received," noted a spokesman in the UCLA press office.

By the press perhaps, but not by atmospheric scientists, who cite daunting technical problems. "It is a very clever idea, but it gets messy," says Earle Williams, who studies atmospheric electrical phenomena at the Massachusetts Institute of Technology (MIT).

Atmospheric chemists have little quarrel with the findings Wong's group described in the paper. In a coffin-sized chamber, the group monitored a simplified stratospheric brew including CFCs and low levels of ozone molecules, which were constantly created by ultraviolet light but were depleted by the CFCs. When the group injected electric charges into the chamber, ozone levels increased sharply. The researchers concluded that, by converting reactive chlorine atoms to virtually inert chloride ions, the charges had stymied the ozone-destroying process.



ALFRED WONG

Curtains to the ozone problem? Blimps would carry a reaction-triggering screen of aluminum or zinc into the stratosphere.

In their paper, Wong and his colleagues limited themselves to raising the possibility that the process could be scaled up, without saying how. But in an interview, Wong spelled out his scheme. Into the Arctic and Antarctic stratospheres, where the worst ozone depletion takes place, he would fly 10 to 20 balloon-borne platforms carrying sheets, wires, or curtains of a metal whose electrons can easily be dislodged by ultraviolet light. As in the laboratory, Wong believes some of the charges would find their way to the reactive chlorine atoms, converting them into inactive chloride ions that could then be collected by other, positively charged surfaces. Wong says he has been working with an engineering firm to draw up plans for the platforms, which would cost $25 million each. The total of $500 million for the full fleet would be a bargain—if it restored the ozone layer.

Some prominent atmospheric scientists don't dismiss the idea of global remediation. "If you have a serious problem [like ozone depletion]...you have to think about remediation," notes F. Sherwood Rowland of the University of California, Irvine, who with Mario Molina, now of MIT, first described the ozone-destroying chemistry of CFCs in 1973. Ralph Cicerone, a colleague of Rowland's at Irvine, agrees that there could be a place for large-scale "geo-engineering."

But Cicerone knows from experience how easily promising schemes for tinkering with stratospheric chemistry can go bust. Three years ago, he and his colleagues proposed in Science that judicious injections of small hydrocarbon molecules such as propane—delivered by a fleet of high-flying tanker airplanes—could shift the complex chemical balance in the stratosphere away from ozone destruction. More recently, however, they reanalyzed the chemistry of this "cure" and found that it would almost certainly exacerbate ozone depletion. Cicerone, along with Rowland and other atmospheric chemists *Science* contacted, believes Wong would be similarly blind-sided.

For one thing, notes Cicerone, Wong and his colleagues had to inject 20 times as many charges into the chamber as there were chlorine species to deactivate. Other molecules must have sopped up the charges, a process Cicerone says "would be an enormous problem" in the real atmosphere. Even if the charges did reach the chlorine and inactivate it, adds Molina, the resulting chloride ions could combine into chlorine molecules; solar radiation could then blast the molecules apart into a brand-new pair of ozone-eating chlorine atoms. "My bottom line," says Cicerone, "is that you could do this [cause ozone recovery] in a few cubic meters of air in a laboratory, but you cannot scale it up" to the real stratosphere.

Wong admits that "a lot more needs to be done" to make his scheme workable—but he stands by it. He is convinced that enough of the charges would have the intended effect to warrant testing the technique in the real world. "I have come up with a concept and proved it in principle," he contends doggedly. But to Rowland, planetary engineers like Wong still have a long way to go. "So far," he says, "no one who has talked about remediation has come anywhere close to having a process that can actually do it."

–Ivan Amato