

The Skeptics vs. the Ozone Hole

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Introduction

On June 28, 1974, Sherry Rowland and Mario Molina, chemists at the University of California, Irvine, published the first scientific paper warning that human-generated chlorofluorocarbons (CFCs) could cause serious harm to Earth's protective ozone layer (Molina and Rowland, 1974). They calculated that if CFC production continued to increase at the going rate of 10%/year until 1990, then remain steady, CFCs would cause a global 5 to 7 percent ozone loss by 1995 and 30-50% loss by 2050.

They warned that the loss of ozone would significantly increase the amount of skin-damaging ultraviolet UV-B light reaching the surface, greatly increasing skin cancer and cataracts. The loss of stratospheric ozone could also significantly cool the stratosphere, potentially causing destructive climate change. Although no stratospheric ozone loss had been observed yet, CFCs should be banned, they said. At the time, the CFC industry was worth about \$8 billion in the U.S., employed over 600,000 people directly, and 1.4 million people indirectly (Roan, 1989).

Critics and skeptics--primarily industry spokespeople and scientists from conservative think tanks--immediately attacked the theory. Despite the fact that Molina and Rowland's theory had wide support in the scientific community, a handful of skeptics, their voices greatly amplified by the public relations machines of powerful corporations and politicians sympathetic to them, succeeded in delaying imposition of controls on CFCs for many years. However, the stunning discovery of the Antarctic ozone hole in 1985 proved the skeptics wrong. Human-generated CFCs were indeed destroying Earth's protective ozone layer. In fact, the ozone depletion was far worse than Molina and Rowland had predicted. No one had imagined that ozone depletions like the 50% losses being observed by 1987 over Antarctica were possible so soon. Despite the continued opposition of many of the skeptics, the Montreal Protocol, an international agreement to phase out ozone-destroying chemicals, was hurriedly approved in 1987 to address the threat.

Ozone depletion worsened globally throughout the 1990's, with peak ozone losses reaching 70% in Antarctica in Spring, 30% in the Arctic in Spring, 8% in Australia in summer, 10-15% in New Zealand in summer, and 3% globally year-round (WMO, 2002; Manin *et. al.*, 2001; McKenzie *et. al.*, 1999). In response, the international community adopted four amendments to the Montreal Protocol in the 1990's to promote an ever faster phase out of ozone-destroying chemicals. Finally, in the early 2000's, although we cannot yet say that stratospheric ozone depletion has reached its maximum, atmospheric levels of ozone-destroying substances in the atmosphere are now declining, and a disappearance of the Antarctic ozone hole is expected by about 2050 (WMO, 2002).

Molina and Rowland were awarded the Nobel Prize in 1995. The citation from the Nobel committee credited them with helping to deliver the Earth from a potential environmental disaster.

With the advantage of hindsight, it is revealing to review the techniques the skeptics used to mislead and distort the truth in the debate on the CFC-ozone depletion issue. Many of them have parallels in the current global warming debate. Keep in mind that some environmentalists have used similar techniques to mislead and distort the truth; several of these distortions are mentioned below.

Techniques of the Skeptics

Launch a public relations campaign disputing the evidence.

DuPont, which made 1/4 of the world's CFCs, spent millions of dollars running full-page newspaper advertisements defending CFCs in 1975, claiming there was no proof that CFCs were harming the ozone layer. The chairman of DuPont commented that the ozone depletion theory was "a science fiction tale...a load of rubbish...utter nonsense." (Chemical Week, 16 July 1975). The aerosol industry also launched a PR blitz, issuing a press release stating that the ozone destruction by CFCs was a theory, and not fact. This press release, and many other 'news stories' favorable to industry, were generated by the aerosol industry and printed by the *New York Times*, *Wall Street Journal*, *Fortune* magazine, *Business Week*, and the London *Observer* (Blysky and Blysky, 1985). The symbol of Chicken Little claiming that "The sky is falling!" was used with great effect by the PR campaign, and appeared in various newspaper headlines.

Such biased news reporting is hardly unusual in American journalism; several studies have shown that press releases are the basis for 40 - 50% of the content of U.S. newspapers (Lee and Solomon, 1990; Blysky and Blysky, 1985). The material appears to be written by the paper's own journalists, but is hardly changed from the press release.

Predict dire economic consequences, and ignore the cost benefits.

The CEO of Pennwalt, the third largest CFC manufacturer in the U.S., talked of "economic chaos" if CFC use was to be phased out (Cogan, 1988). DuPont, the largest CFC manufacturer, warned that the costs in the U.S. alone could exceed \$135 billion, and that "entire industries could fold" (Glas, 1989). The Association of European Chemical Companies warned that CFC regulation might lead to "redesign and re-equipping of large sectors of vital industry..., smaller firms going out of business... and an effect on inflation and unemployment, nationally and internationally" (Stockholm Environment Institute, 1999).

However, the economic reality has been less dire. As the United Nations Environment Programme (UNEP) Economic Options Committee stated in 1994: "Ozone-depleting substance replacement has been more rapid, less expensive, and more innovative than had been anticipated at the beginning of the substitution process. The alternative technologies already adopted have been effective and inexpensive enough that consumers have not yet felt any noticeable impacts (except for an increase in automobile air conditioning service costs)" (UNEP, 1994). A group of over two dozen industry experts estimated the total CFC phase-out cost in industrialized countries at \$37 billion to business and industry, and \$3 billion to consumers (Vogelsberg, 1997). A study done for [Environment Canada](#) presented to a UN meeting in 1997, estimated a total CFC phase-out cost of \$235 billion through the year 2060, but economic benefits totaling \$459 billion. These savings came from decreased UV light exposure to aquatic ecosystems, plants, forests, crops, plastics, paints and other outdoor building materials, and did not include the savings due to decreased health care costs. The report concluded that because of the Montreal Protocol, there would be 19.1 million fewer cases of non-melanoma skin cancer, 1.5 million fewer cases of melanoma, 129 million fewer cases of cataracts, and 330,000 fewer skin cancer deaths worldwide.

Find and pay a respected scientist to argue persuasively against the threat.

CFC industry companies hired the world's largest public relations firm, Hill & Knowlton, who organized a month-long U.S. speaking tour in 1975 for noted British scientist Richard Scorer, a former editor of the International Journal of Air Pollution and author of several books on pollution. Scorer blasted Molina and Rowland, calling them "doomsayers", and remarking, "The only thing that has been accumulated so far is a number of theories." Molina's response was, "The gentleman is good at attacking. But he has never published any scientific papers on the subject." (Roan, 1985).

Use non-peer reviewed scientific publications or industry-funded scientists who don't publish original peer-reviewed scientific work to support your point of view.

Articles published in traditional scientific journals undergo a process essential to good science--peer-review. The peer-review process starts when a prospective author submits their work to a journal. The editor of the journal reviews the article, and sends copies to three scientists who are experts in the field. These anonymous reviewers send their comments on errors that need correcting, omissions that need addressing, etc, back to the journal editor, who then asks the author to submit a revised article addressing the concerns of the reviewers. After making revisions, the author submits the article back to the journal editor, who can then accept the article, reject it, or send it back for another round of review. The rigors of peer-review are such that a large percentage of submitted articles never get published in the scientific literature.

In 1995, the year Molina and Rowland were awarded the Nobel Prize in Chemistry for their discovery of the CFC-ozone depletion link, the House Science Subcommittee on Energy and the Environment began a series of hearings to revisit the issue of ozone depletion, where the issue of peer-review was brought up. During the hearings, Representative John Doolittle, a California Republican, stated, "My own belief, is that the question is still very much open to debate...Theories or speculation about this are not sufficient. We need science, not pseudo-science."

Doolittle was challenged by Lynn Rivers, a Michigan Democrat. They had the following interchange, taken from the Congressional Report, "*Hearing on Scientific Integrity and the Public Trust: The Science Behind Federal Policies and Mandates: Case Study 1 -- Stratospheric Ozone: Myth and Realities*", 104th Congress, 1st session, September 20, 1995, Report no. 31 (Gelbspan, 1998):

RIVERS: "Have you found in peer-reviewed articles or in the broader scientific discourse that people are saying this is not really a problem?"

DOOLITTLE: "I have found that there is no established consensus as what actually is the problem. I found extremely misleading representations by the government and government officials that are not founded on sound science."

RIVERS: "...[W]hat I was asking about is peer-reviewed articles [by] scientists who are...doing this work on a regular basis. Can you give me an example of some peer-reviewed publications that you consulted in formulating your opinion that there's no [sound] science?"

DOOLITTLE: "Well, you're going to hear from one of the scientists today, Dr. Fred Singer."

RIVERS: "Dr. Singer doesn't publish in peer-reviewed documents."

DOOLITTLE: "[I]'m not going to get involved in a mumbo-jumbo of peer-reviewed documents. There's a politics within the scientific community, where they're all too intimidated to speak out once someone has staked out a position...And under this Congress, we're going to get to the truth and not just the academic politics."

RIVERS: "[T]he general way to feel certain that you're getting good science is that you put your ideas out in a straightforward way in a peer-reviewed publication and you allow others who are doing the same work to make comments, to criticize, to replicate your findings. And what I'm asking you, in your search for good science, is what peer-reviewed documentation did you use to come up with your decision? What good science did you rely on?"

DOOLITTLE: "My response to you is, it is the proponents of the ban that have the burden of producing the good science. I do not have that burden."

Later during the same hearing, House majority whip Tom DeLay was asked about his position opposing a ban on ozone depleting substances. Had he consulted the latest scientific assessment in ozone depletion (WMO/UNEP, 1994) put together by a team of virtually all of the relevant researchers publishing in peer-reviewed publications on the subject? He replied that he had not, because "Well, I just haven't been presented with the study of late." He also launched into a criticism of peer-reviewed science, claiming that "the conclusion is usually written before the study is even done, in many cases." DeLay cited *Toxic Terror* by Dr. Elizabeth Whelan to support his criticism of peer-reviewed science. But according to the *Columbia Journalism Review*, Dr. Whelan praises the nutritional value of fast food in her writings, and dismisses the links between fatty diets and heart disease--but receives funding from Burger King, Oscar Meyer, Frito Lay, and Land O' Lakes (Kurtz, 1990). Unfortunately, our House Majority Leader is not the only one who relies on Dr. Whelan's "science". [PR Watch](#) notes that *USA Today* cites Whelan's American Council on Science and Health think tank as one of its most frequently-quoted sources for information on public health issues.

Dr. Fred Singer, the expert whom Representative Doolittle referred to, has testified before Congress numerous times, and is probably the most widely quoted skeptic on the ozone hole and global warming issues. Unfortunately, Dr. Singer is not a major climate scientist publishing in the peer-reviewed literature, or even an objective informed critic. Dr. Singer touts himself as having "published more than 200 peer-reviewed scientific papers over the course of his career". However, all but one of these papers were published in 1971 or before, or in fields unrelated to climate science. A search for his relevant publications where he is lead author reveals one piece of original research, a 1988 paper on "nuclear winter" (Singer, 1988). The Science Citation Index, the comprehensive scientific journal database that indexes virtually every citation a journal article gets in the peer-reviewed scientific literature, reveals that this paper, which Dr. Singer calls a "[key research publication](#)", has been cited exactly zero times, as of 2004. For comparison, Dr. Steven Schneider's 1988 publication in *Nature* on the same topic, "Simulating the climatic effects of nuclear war", has gotten 16 citations. Singer has been listed as a co-author in three peer-reviewed climate science publications since 1971, a 2-page "Technical Comment" criticizing a study showing increased UV-B light at the surface in response to ozone depletion (Michaels *et. al.*, 1994), and two 2004 papers, "Disparity of tropospheric and surface temperature trends: New evidence" (Douglass *et. al.*, 2004), and "Altitude dependence of atmospheric temperature trends: Climate models versus observation" (Douglass *et. al.*, 2004). Neither of these publications had a citation in the Science Citation Index, as of January 2005, and the 1994 paper had 19 citations. Dr. Singer's objectivity comes into question because the think tank that he founded and currently runs, [The Science and Environmental Policy Project](#), has received substantial industry funding, including contributions from Exxon, Shell, ARCO, Unocal, and Sun Oil (Gelbspan, 1998).

Trumpet discredited scientific studies and myths supporting your point of view as scientific fact.

The skeptics primarily published in non-peer-reviewed newspapers, magazines, books,

and think tank publications. Publications that do not undergo peer-review are frequently filled with factual errors, distortions, and opinionated statements that greatly confuse the public on issues where there is no scientific uncertainty. For example, numerous critics of the ozone hole discovery (e.g., [Singer, 1989](#), Bailey, 1993; Bast *et. al.*, 1994) claimed that Professor G.M.B. Dobson had measured an ozone hole in 1956 in the Antarctic, and thus an Antarctic ozone hole was a normal natural occurrence. This myth arose from a misinterpretation of an out-of-context quotation from a review article (Dobson, 1968), where he mentioned that when springtime ozone levels over Halley Bay were first measured, he was surprised to find that they were about 150 Dobson Units below springtime levels in the Arctic. The skeptics repeatedly refer to "an ozone hole 150 Dobson Units below normal" that was discovered in 1957, when in fact the levels discovered in 1957 were normal for Antarctica. A trip to the [British Antarctic Survey's web site](#) will confirm that no such ozone hole was measured in the 1950s. Another myth the skeptics repeat states that a French scientist found an Antarctic ozone hole in 1958 (Bailey, 1993). There were measurements in 1958 that found large ozone loss in the Antarctic, but these measurement have been found to be false, due to instrument error. A study in *Science* magazine (Newman, 1994) concluded, "There is no credible evidence for an ozone hole in 1958."

To be fair, environmentalists were also guilty of using discredited myths to support their positions. For example, in 1992, *The New York Times* reported ozone depletion over southern Chile had caused "an increase in Twilight Zone-type reports of sheep and rabbits with cataracts" (Nash, 1992). The story was repeated in many places, including the July 1, 1993 showing of ABC's Prime Time Live. Al Gore's book, *Earth in the Balance*, repeated the myth, stating: "In Patagonia, hunters now report finding blind rabbits; fishermen catch blind salmon" (Gore, 1992). A group at Johns Hopkins has investigated the evidence and attributed the cases of sheep blindness to a local infection ("pink eye") (Pearce, 1993).

Point to the substantial scientific uncertainty, and the certainty of economic loss if immediate action is taken.

The science behind the estimation of ozone depletion is and was subject to a great deal of uncertainty. In early 1976, Rowland and Molina discovered that a chemical reaction involving chlorine nitrate might reduce ozone destruction from their previous estimate of 7-13% to about 7%. One editorial in the *New York Daily News* in 1976 concluded, "Now that scientists have been put in the position of crying wolf, who will listen to the new warnings?" Detractors also pointed to the fluctuating estimates of eventual global ozone depletion provided in reports by the U.S. National Academy of Sciences as justification that since the science was so uncertain, action should not be taken.

Long-term Ozone Depletion Estimates from National Academy of Sciences Reports

Year Depletion Estimate

1976 2-20% (7% most likely)

1979 16.5%

1982 5-9%

1984 2-4%

Of course, in the end, it did turn out that the estimates of ozone depletion were quite inaccurate--they were far too low! No scientist anticipated the stunning 70% losses of ozone that appeared in the Antarctic ozone hole, nor the 30% losses in ozone that appeared in the Arctic. The lesson to be learned here should be this: just because the reality is uncertain is not an excuse to delay action. The reality could be far worse than the expectation.

Use data from a local area to support your views, and ignore the global evidence.

Many skeptics pointed out that UV-B levels as measured in some U.S. cities actually declined in the 1980s and 1990s. This is true, and has been attributed to higher levels of pollution aerosol particles, which commonly cause 20% decreases in UV-B radiation in the summer (Wenny *et. al.*, 2001). However, the relationship between ozone loss and increased UV-B light is well established. For each 1% drop in ozone levels, about 1% more UV-B reaches the Earth's lower atmosphere (WMO, 2002). Increases in UV-B of 6-14% have been measured at many mid and high-latitude sites over the past 20 years (WMO, 2002, McKenzie, 1999). At some sites about half of this increase can be attributed to ozone loss. Changes in cloud cover and surface albedo also play a part.

Disparage scientists, saying they are playing up uncertain predictions of doom in order to get research funding.

One CFC industry magazine stated in 1975, "The whole area of research grants and the competition among scientists to get them must be considered a factor in the politics of ozone" (Roan, 1985). A publication by the conservative think tank, The Cato Institute, argued that NASA's 1992 warnings of a potential ozone hole opening up over the Northern Hemisphere "were exquisitely timed to bolster the agency's budget requests" (Bailey, 1993).

Disparage environmentalists, claiming they are hyping environmental problems in order to further their ideological goals.

Dr. Fred Singer commented on environmentalists' reaction to Molina and Rowland's work linking CFCs with ozone depletion as follows: "The ecofreaks were ecstatic. At last, an industrial chemical--and produced by big bad DuPont and others of that ilk" (Singer, 1989).

Complain that it is unfair to require regulatory action in the U.S., as it would put the nation at an economic

disadvantage.

Of course, other countries complained that they were unwilling to act until the U.S., the number one manufacturer and emitter of CFCs, showed leadership on the issue and took action first.

Claim that more research is needed before action should be taken.

Between 1974 and 1987, the CFC industry and government officials continually asked for an additional three years for more research. Molina called this tactic, "the sliding three years".

Argue that it is less expensive to live with the effects.

In 1987, the Reagan Administration officials advocated a "Personal Protection Plan" as an alternative to controlling CFC emissions. Scoffers noted that if each American bought 2 bottles of sunscreen, a hat and pair of sunglasses, the bill would come to \$8 billion for the nation. They also asked how Americans would go about putting sunscreen and hats on cows and stalks of corn, since plants and animals are adversely affected by UV light, as well.

Conclusion

Unfortunately, it appears that we have not learned our lesson from the past 30 years' experience with the ozone-CFC debate. Once again, we find a theory that has wide support in the scientific community being attacked by a handful of skeptics, publishing outside of the peer-reviewed scientific literature, their voices greatly amplified by the public relations machines of powerful corporations and politicians sympathetic to them. And once again, some environmentalists have responded by presenting a distorted or imbalanced version of the facts, often colored by excessive emphasis on the low-probability scenarios of doom, that the popular press is only too eager to repeat, since prophesies of disaster sell. A balanced and truthful treatment of the Global Warming debate that focuses on presenting an unbiased version of our current scientific understanding is difficult to find.

In a 1984 interview in *The New Yorker*, Rowland concluded, "Nothing will be done about this problem until there is further evidence that a significant loss of ozone has occurred. Unfortunately, this means that if there is a disaster in the making in the stratosphere we are probably not going to avoid it." These prophetic words were proved true the very next year with the discovery of the Antarctic ozone hole. Luckily, it appears that serious damage to the planet was averted with the swift implementation of the Montreal Protocol. Let's hope that it won't take another near-disaster to motivate us to take meaningful action to address the threat of Global Warming.

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