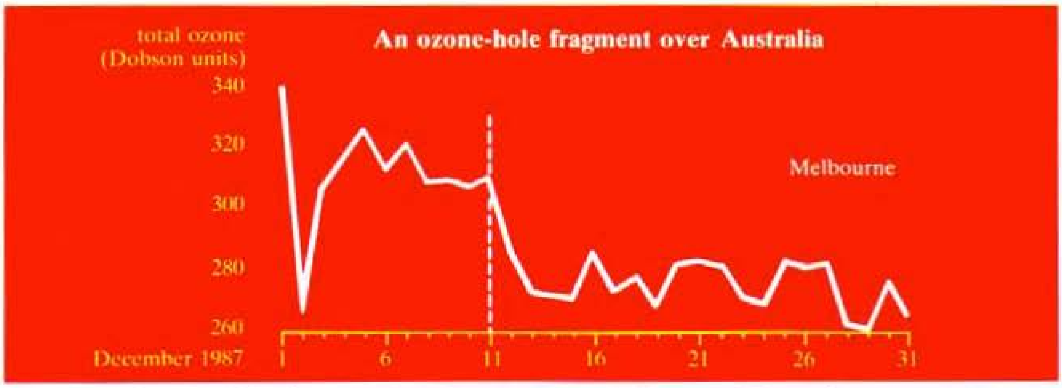
Ozone hole: a new twist

The ozone hole that appeared over Antarctica in the spring of 1988 was the smallest since 1982. Nobody is sure why, and scientists are left with a lot of questions still needing answers.



After December 11, 1987, the ozone level over Melbourne decreased due to break-up of the Antarctic ozone hole. Similar falls were seen in Perth, Hobart, and New Zealand at about the same time.

Dr Paul Fraser of the CSIRO Division of Atmospheric Research, a long-time ozone-hole watcher, attended a 'scientific review of the depletion of the ozone layer' convened by the United Nations Environment Program in The Hague during October 1988. He provides the following salient information.

Close monitoring of the 1988 hole showed that ozone levels reached a minimum about mid September and, rather than continuing to decline as in previous years, stayed constant at 175–180 Dobson units. In 1987, levels as low as 110 DU were recorded.

In another turn of the cards, instruments detected unusually high ozone levels — 500 DU and above — in surrounding regions (in recent years, levels just outside the hole have been about 425 DU; these peak levels are usually found south of Australia near 60°S). The total amount of ozone in the Southern Hemisphere during September and October was the highest recorded since satellite observations began in 1979.

The Antarctic vortex that creates the 'containment vessel' for the ozone-depleting reactions seemed to be warmer, less stable, and more elliptical last year. Data indicated much stronger eddies outside the vortex, and this suggests increased transport of ozone from tropical regions, where the gas is produced.

One suggestion is that these northerly winds might have penetrated the vortex and dispersed the chlorine-bearing chemical compounds trapped inside before sunlight could initiate the sequence of ozone-destroying reactions.

Actually, a smaller 1988 ozone hole was predicted by NASA's Ozone Trends Panel (of which Dr Fraser is a member), based on a distinct 2-year cycle superimposed on a trend towards deeper holes. However, the actual weakening was beyond what the Panel expected, and it has rekindled arguments about which mechanisms are at work in formation of the hole.

Despite the anomalous 1988 hole, the meeting in The Hague agreed that the Montreal Protocol for Substances that Deplete the Ozone Layer will have to be strengthened. It concluded that further cuts in chlorofluorocarbon release, perhaps of 85% or more, will be necessary to prevent further growth in stratospheric chlorine levels and a deepening of the hole.

The current Protocol, now ratified and in force from January 1 this year, has placed controls on 90% of global CFC production. However, as it stands, it will still permit stratospheric chlorine levels to rise to double what they are now. Atmospheric researchers expect that, until those levels are reduced to those typical of the early 1970s, the Antarctic ozone hole will remain and, to some (unknown) extent, deepen. No firm evidence has emerged to date of an ozone hole over the Arctic; a large field experiment is planned for early this year to investigate the possibility.

Experts in atmospheric science (including Dr Fraser) are working on reviews upon which the Protocol signatories can base a revision of their agreement. The earliest a revised Protocol can come into force is mid 1990. However, the good news is that most countries, including Australia, are already doing better in terms of CFC consumption reductions than the existing Protocol requires.

Repair of the Antarctic hole will require virtually a complete phase-out of CFCs and careful consideration of the permissible release of other less-harmful, but not harmless, chlorine-containing chemicals such as methyl chloroform (CH_3CCl_3) and carbon tetrachloride (CCl_4). In addition, some scientists are suggesting that the global warming resulting from the build-up of 'greenhouse gases' in the lower atmosphere, which will result in a cooler upper atmosphere, may aggravate the ozone-hole problem by enhancing the formation of the ice crystals on which the ozone-depleting reactions take place.

Coming back to the world of today, some interesting recently reported data relating to the record 1987 ozone hole indicate that, as it broke up, it caused temporary reductions in ozone levels of 10–20% over parts of southern Australia and New Zealand. Ozone-monitoring instruments operated by the Australian Bureau of Meteorology and New Zealand's DSIR showed a drop of 10–20% over Perth, Melbourne, Hobart, and Otago for a couple of days in December.

According to Mr Roger Atkinson, of the Bureau, the total ozone level over Melbourne for December 1987 — 288 DU — was the lowest recorded for the last 10 years.

Sensors on the ground, borne by balloon, and on satellites revealed that a 'finger' of air from the Antarctic ozone hole broke off and moved over southern Australia and New Zealand after December 11.

Other data analysed by Dr Alan Plumb, lately of CSIRO and now working in America, also confirm that the brief drop in ozone levels over Australasia was connected directly to the break-up of the Antarctic ozone hole.

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Reevaluation of the Australian total ozone data record. R.J. Atkinson and J.R. Easson. *Proceedings, Quadrennial Ozone Symposium, Gottingen, F.R.G., 1988.*

Chlorine blamed for growing 'ozone hole'. A. Bell. *Ecos* No. 56, 1988, 3–6.