Expedition faces Antarctic ozone hole mysteries

- Aerosol fears smooth way for cooperation
- October deadline for results

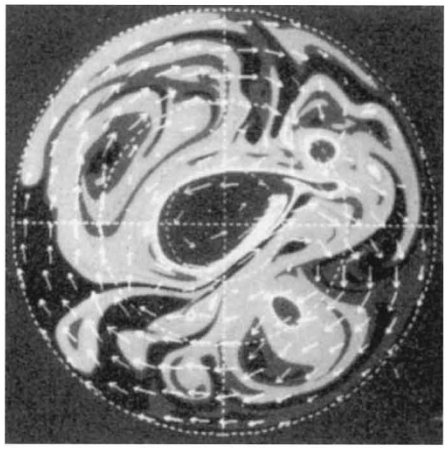
Washington

ANTARCTICA's unexplained 'ozone hole' is to be investigated in a large-scale international expedition running from mid-August to the end of September. The aim is to find out whether natural processes or man-made chemicals are to blame for the sudden depletion of ozone in the stratosphere during the Antarctic spring.

The expedition will not see many explorers trudging across the lonely Antarctic ice. It will be based in the large city of Punta Arenas in southern Chile and most observations will be made from specially instrumented high-flying aircraft, including a modified U2 spy plane capable of reaching the centre of the ozone hole 18 km above the Earth.

Quick work was needed to put the expedition together. The ozone hole was discovered just two years ago by British Antarctic Survey scientists, but the US National Aeronautics and Space Administration (NASA) has succeeded in obtaining the cooperation of the governments of Argentina, Chile, France, New Zealand and Britain, and help from other research organizations such as the Chemical Manufacturers Association. The project's urgency stems from fears that the release of man-made chlorofluorocarbons (CFCs) lies behind the dramatic appearance of the ozone hole.

Just a few weeks ago, an international convention agreed in Vienna that CFC release must be cut back lest ozone levels fall and an increasing amount of damaging ultraviolet light reach the Earth's surface.



They also serve who stand by their computers — this picture, generated using a Cray, shows results of a high-resolution numerical model of the winter stratosphere developed by M.N. Juckes and M.E. McIntyre (to appear in next week's Nature*).*

Their worries stemmed partly from Nimbus 7 satellite data showing that global atmospheric ozone levels have fallen 2–8 per cent in the past seven years. But in the Antarctic, changes are far more disturbing: over a decade, spring ozone levels have fallen 50 per cent in the whole air column and 80 per cent at the centre of the ozone hole in the lower stratosphere.

The Antarctic atmosphere is so special that there seems no likelihood that such dramatic changes will spread, but if man-made chemicals are to blame for the ozone hole then calls for tight international regulations are bound to increase. As yet, a natural explanation cannot be completely ruled out. Antarctic ozone levels always decrease in September, most probably because the stratospheric ozone absorbs radiation when the Sun reappears at the end of winter. The heated air mass may then rise and be replaced by upwelling air from the troposphere where ozone levels are much lower. Any factors that enhance these processes — even particles injected into the stratosphere by volcanic eruptions might help to absorb radiation — could in theory turn the dip in ozone concentration into a precipitous drop.

A chemical explanation already receives support from Antarctic measurements showing unusual concentrations of chlorine and nitrogen oxides. But expedition scientists are reconciling themselves to the possiblity that the cause of the ozone hole may be a complicated mix of chemical and dynamical factors. The chemistry alone will be difficult enough. While the favoured explanation is that low levels of nitrogen oxides permit chlorine oxides of industrial origin to catalyse the destruction of ozone, it seems likely that man-made bromine compounds are also involved.

The key data for the expedition will come from the aircraft. A DC-8 will make ten trips at 12 km, in the lower part of the ozone hole, and measure ozone and aerosol profiles, chlorine dioxide, bromine oxide radical, nitric acid, chlorine, nitrate, nitrogen oxide and hydrochloric acid concentrations by air sampling and remote-sensing techniques. Two flights are planned to go all the way to New Zealand and back. Complementary, shorter flights will be made by ER-2, the modified U2 spy plane, at 20 km in the centre of the ozone hole.

Although the data are unlikely to provoke a simple answer, Robert Watson, NASA programme director, has committed the expedition to producing a report of their findings by 1 October — a mere two days after ten weeks of aircraft observations ends. To make that possible, theoreticians are to be among the 160 scientists, pilots and technicians going to Punta Arenas and will try to build their models as the data arrive. Watson freely admits that, at worst, the report "might be a half-page long" but believes the project's significance to be too great to allow scientists a year to mull over their results.

Even with that deadline, the announcement will come just after the meeting at Montreal at which international guidelines on CFC use are likely to be decided. But if the Antarctic data are relevant, changes can always be made later.

Chlorine compounds are virtually indestructible in the atmosphere and, as Watson points out, even if their production were halted tomorrow, it would be a century or two before they disappeared from the stratosphere. **Alun Anderson**

Monsoon dating depends on Cray

Bangalore

THE project to achieve accurate forecasting of the arrival of the Indian monsoon season — which would be of great value to India's farmers — is falling behind schedule. And Indian scientists say the reason is the United States' refusal to supply the supercomputer they want.

The joint India–United States monsoon forecasting project is already five years old and the need for a supercomputer to deal with the enormous quantity of data that has accumulated was recognized in 1984. After a study of the programme's needs, Indian scientists at the Meteorological Department asked to purchase one of Cray's top models, the X-MP-24. The US side responded by offering the Cray X-MP-14, a slightly less sophisticated version, even though the original choice had been made after consultation with the US State Department.

Political analysts in New Delhi believe that the possibility that India might use the supercomputer for defence research, or even that the technology might reach the Soviet Union, had alerted hawks in the US State Department and the Pentagon. The State Department points out, however, that India is the first country to be offered a machine as advanced as the X-MP-14.

An Indian technical mission is now once more re-evaluating the project's needs to see if they can make do with the Cray X-MP-14. If not, they may have to consider the purchase of a Japanese or even a Soviet supercomputer, although opinions so far are that neither country produces a computer to match the Cray.

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