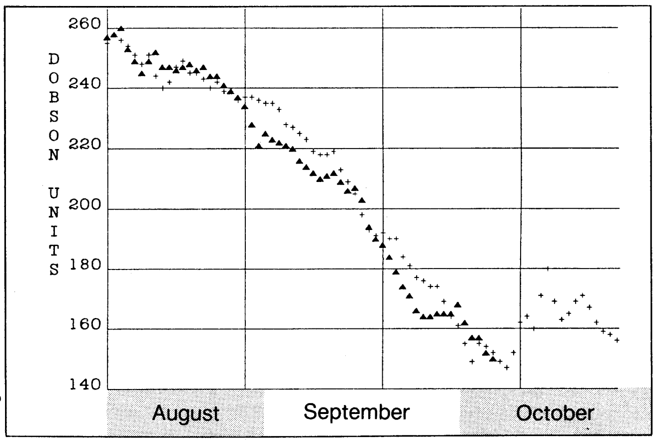
Antarctic ozone hole unexpectedly severe



Ozone losses in 1989 (triangles) match the severe depletions in 1987 (crosses). The similarities show up on a chart of average ozone concentrations in the Antarctic atmosphere for the region between the South Pole and 70° S.

Only two years after the worst ozone hole on record, nature has repeated itself. Ozone concentrations in the Antarctic stratosphere last week dropped to levels on a par with the severe depletions of 1987, contradicting some scientists' claims that the drastic ozone hole two years ago was a fluke. The ozone loss also confounds theories that predicted a relatively weak Antarctic hole for 1989.

"We weren't expecting it to be as severe as 1987. That was a surprise," says David J. Hofmann, a physicist from the University of Wyoming in Laramie who monitored the latest ozone loss with balloon-borne instruments. "This year and 1987 were close to as bad as you can get," Hofmann told SCIENCE NEWS in a telephone interview from Christchurch, New Zealand.

The term "ozone hole" describes a loss of stratospheric ozone that has occurred over Antarctica each September and October since the late 1970s. Ozone in the stratosphere protects life by absorbing damaging ultraviolet radiation from the sun. In the past four years, atmospheric scientists have accumulated significant evidence that industrially produced chlorofluorocarbons and related compounds cause the annual Antarctic ozone hole. These widely used compounds also eat away at the global ozone layer, though at a slower rate (SN: 9/2/89, p.154).

Over the Antarctic, the region of ozone loss begins at an altitude of 12 kilometers and extends to 23 km. This year, ozone almost disappeared completely from certain stratospheric layers. "We're approaching total depletion in the 16-to-18-km range. In that slab we've gone from 50 Dobson units [of ozone] at the end of August to something like 5 Dobson units," Hofmann says.

In bad years such as 1987 and 1989, the region of ozone depletion covers almost twice the area of the Antarctic continent. In 1987, the average amount of ozone in this region fell from around 250 Dobson units in winter to 147 Dobson units on Oct. 5. In 1989, the average dropped to 150 Dobson units on Oct. 3 – a level indistinguishable from the 1987 record, according to Arlin J. Krueger at the NASA Goddard Space Flight Center in Greenbelt, Md., who tracks the development of the ozone hole with instruments aboard a polar-orbiting satellite.

After 1987, some scientists suggested the conditions that year were abnormal and predicted the Antarctic would not experience such severe ozone loss for perhaps a decade or more, says Goddard's Mark R. Schoeberl. "But it looks like right now we're right back at 1987. It suggests the deep ozone hole phenomenon is more robust than has previously been thought."

In both years, the stratosphere in the midlatitudes of the Southern Hemisphere remained extremely stable during winter and early spring. The quiet conditions allowed a strong vortex of stratospheric winds to encircle the polar region, essentially isolating the Antarctic stratosphere from the air in the midlatitudes. During the months of winter darkness, stratospheric temperatures inside the vortex dropped to around -85°C, at which point nitric acid and water condensed to form cloud particles. Scientists think the particles play a critical role in the chemical reactions that destroy ozone (SN: 10/15/88, p.249).

Earlier this year, atmospheric researchers thought high-pressure systems would develop during late winter in the midlatitude stratosphere and disrupt the polar vortex, leading to a relatively mild ozone hole. They based the prediction on an apparent correlation over the last few years between midlatitude activity and stratospheric winds in the tropics.

The tropical winds circle the globe, switching direction about every 13 months. In the past, the midlatitude conditions have remained quiet when the winds traveled from west to east. When wind moved in the opposite direction, pressure systems grew in the midlatitudes and weakened the ozone hole.

During the Antarctic winter of 1988, the tropical winds shifted and started flowing toward the west. In keeping with the pattern, the ozone hole was weak. Because the winds this winter still traveled toward the west, scientists expected another mild ozone hole. But the midlatitude stratosphere defied predictions and remained stable, permitting a strong vortex to form. Scientists will now have to look more closely at the processes that control midlatitude conditions, says Schoeberl. *– R. Monastersky*

Building new proteins with odd parts

With a palette of 20 or so amino acids, cells assemble the proteins they need. Scientists can modify these proteins by substituting one naturally occurring amino acid for another. Now they are finding ways of inserting unusual amino acids into their designs in hopes of endowing proteins with otherwise unavailable chemical features. The payoffs might include new drugs, industrial enzymes or molecular tools for basic biochemical research.

Building on work by others, chemist A. Richard Chamberlin of the University of California, Irvine, and his co-workers are using an innovative technique to plug exotic amino acids into specific protein sites. They report their latest efforts in the Sept. 27 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

To make a protein, a cell transcribes segments of its DNA into messenger RNA (mRNA), which carries the code to protein-assembling organelles called ribosomes. The mRNA then directs protein assembly by sequentially attracting specific transfer RNA (tRNA) molecules, each of which carries one of the 20 natural amino acids.

To install a non-natural amino acid into a polypeptide, or protein fragment, Chamberlin's group first replaces a short DNA fragment (codon), which translates into an amino acid, with a termination codon, which normally stops protein assembly in the ribosome because it has no associated tRNA or amino acid. By attaching a synthetic variation of the amino acid tyrosine to a lab-made tRNA molecule that sticks to the termination codon, the researchers can slip the modified amino acid into a polypeptide.

In the April 14 SCIENCE, other researchers reported using a similar technique to insert amino-acid analogs into the enzyme beta-lactamase.

Chemist Sidney M. Hecht of the University of Virginia in Charlottesville, who laid much of the chemical groundwork for the new technique, says he hopes to extend it to even odder amino acids for added flexibility in protein design. *– I. Amato*