Global Gas Hunt

FROM 1

aboard the NASA planes, said he believes the cloud of gas may have survived a 10,000-mile journey across the planet — intact.

"I would have thought it would have been dissipated or diluted," Blake said. "It certainly shows this is not as pristine an area as we thought."

Blake has earned widespread recognition as part of the research team led by F. Sherwood Rowland, who shared a Nobel prize with researcher Mario Molina last year for making the connection between chlorofluorocarbons, or CFCs, and depletion of the Earth's protective ozone layer.

Rowland's discovery in the 1970s led to a global ban on CFCs. Now, the ozone wizards at UCI are at it again, collecting samples of gas from around the planet like 19th-century naturalists collecting butterflies.

The expedition will help gather critical information about the mechanics of Earth's climate and atmosphere, essential to predicting what the world we pass on to future generations will be like.

"The climate of a planet does depend on the composition of its atmosphere," said Robert J. McNeal, manager of the tropospheric chemistry program at NASA headquarters in Washington, D.C. "This will enable one to say how much climate might change if the chemistry continues to change as we think it would."

This year, Blake and other scientists are scooping up air samples over Tahiti, Easter Island, Ecuador, New Zealand, Fiji, Hawaii and a vast stretch of Pacific Ocean, part of NASA's Pacific Exploratory Mission. One important goal is to find out what uncontaminated air looks like and how it behaves, so that future changes in the atmosphere can be calibrated.

The air samples are analyzed at UCI, yielding — bit by bit — answers to questions that contain the seeds of our worst apocalyptic nightmares: Is human industrial pollution changing the global climate? Is the ozone layer still weakening, subjecting more of us to skin cancer?

"The chemistry of the atmosphere is changing on a global scale as a consequence of human activities," said McNeal.

Of the dozen experiments aboard the DC-8, UCI's is among the three most critical. Blake's airborne team is measuring hydrocarbons — the stuff that's left over when we burn oil and other fossil fuels — and other gases.

A research group from NASA-Langley Research Center in Virginia is targeting ozone.

The third group, from the Georgia Institute of Technology, is going after oxides of nitrogen; under the influence of sunlight, these react with hydrocarbons to form ozone.

Ozone is a kind of atmospheric Jekyll and Hyde. High in the stratosphere, it forms a protective shield against cancer-causing ultraviolet radiation. But lower down, at ground level, it is a major pollutant, part of the lung-scarring haze over the Los Angeles basin.

The researchers want to know more about Jekyll.

Rowland's theories have generated controversy in some quarters. But an overwhelming majority of atmospheric scientists accept Rowland's finding that the thinning of the ozone shield, and the ozone hole over Antarctica, is a product of human use of CFCs.

This thin layer of ozone is all there is between us and skin cancer. Ultraviolet rays from the sun are absorbed by ozone. When the shield thins, the rays get through, and skin cancer rates increase.

But scientists still don't know the nitty-gritty details. How exactly does the troposphere — the part of the atmosphere we inhabit, and influence with our emissions — interact with the stratosphere, where the ozone layer resides?

How do CFCs released from, say, the leaking air-conditioning system on a junked Chevrolet Impala in Louisiana make it all the way to the stratosphere?

And how long does it take for those same CFCs to find themselves gobbling up ozone molecules over Antarctica?

Put in more scientific terms, the questions revolve around transport: how gases are transported vertically, through the atmosphere, as well as horizontally, across the face of the planet.

Finding the answer is essential to predicting what will happen to the ozone layer in the future, experts say. Scientists rely on computer models of the complex interactions of gases in the atmosphere to make such predictions. The better the real-world data fed into the models, the better the forecast.

But there are many unknowns. The flying scientists were astounded early in the mission, for example, when they detected a finger of stratospheric air poking downward, into the troposphere. Such a structure has never been observed before, and while the finding must be verified, it could have important implications for modeling the exchange of gases between the two atmospheric layers.

Gathering such information not only sheds light on the fate of the ozone layer, the scientists say, it is also vital to the other big-ticket topic in atmospheric science: global warming. Enter Mr. Hyde — tropospheric ozone.

A number of theories and observations suggest that the Earth may be shifting to a warmer climate, at least partially caused by the industrial release of greenhouse gases. Such gases trap heat in the atmosphere. Venus, for instance, has an atmosphere loaded with greenhouse gases. The surface temperature there is hot enough to melt lead.

How fast the Earth's atmosphere can cleanse itself of these gases will determine, in part, how quickly the climate changes. But there is a major problem. The cleansing capacity comes from ozone in the troposphere.

So some ozone is necessary in the lower atmosphere. Too much, however, and you've got the cloud over Southern California.

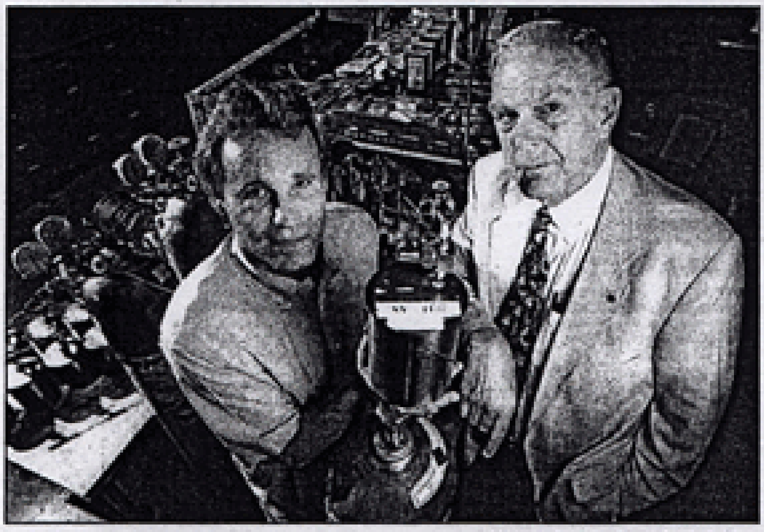
To find out whether things are out of balance in the atmosphere, scientists must first determine how much ozone is produced by human emissions, and how much is produced, or removed, naturally. Gaseous exchanges between the troposphere and the ocean, for example, remove some ozone.

Sampling the most pristine air on the planet gives scientists a baseline: what the atmosphere looks like with little or no human influence. They will then be able to compare the baseline with data from other parts of the world, and learn whether the atmosphere is on the fritz.

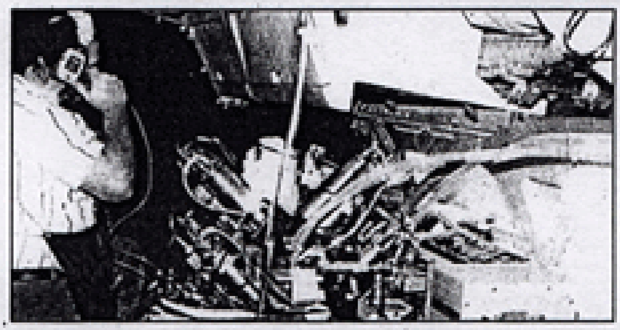
Computer models now suggest that may well be the case; but they must be fine-tuned with more atmospheric data in coming years before they produce an answer acceptable to a broad consensus of atmospheric researchers.

Meanwhile, the gas cloud of unknown origins hovers persistently over Tahiti. The deeper implications of finding the remnants of large-scale burning in what should have been the world's most pristine column of air are still a mystery. And it came as something of a shock.

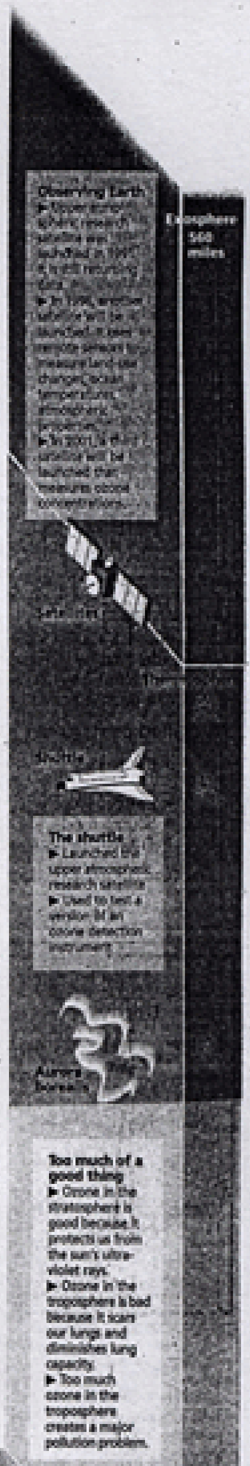
No one knows where it came from, although Australia, Africa and South America are likely candidates. In coming months meteorologists should be able to pinpoint the source.



LEONARD ORTIZ/The Orange County Register

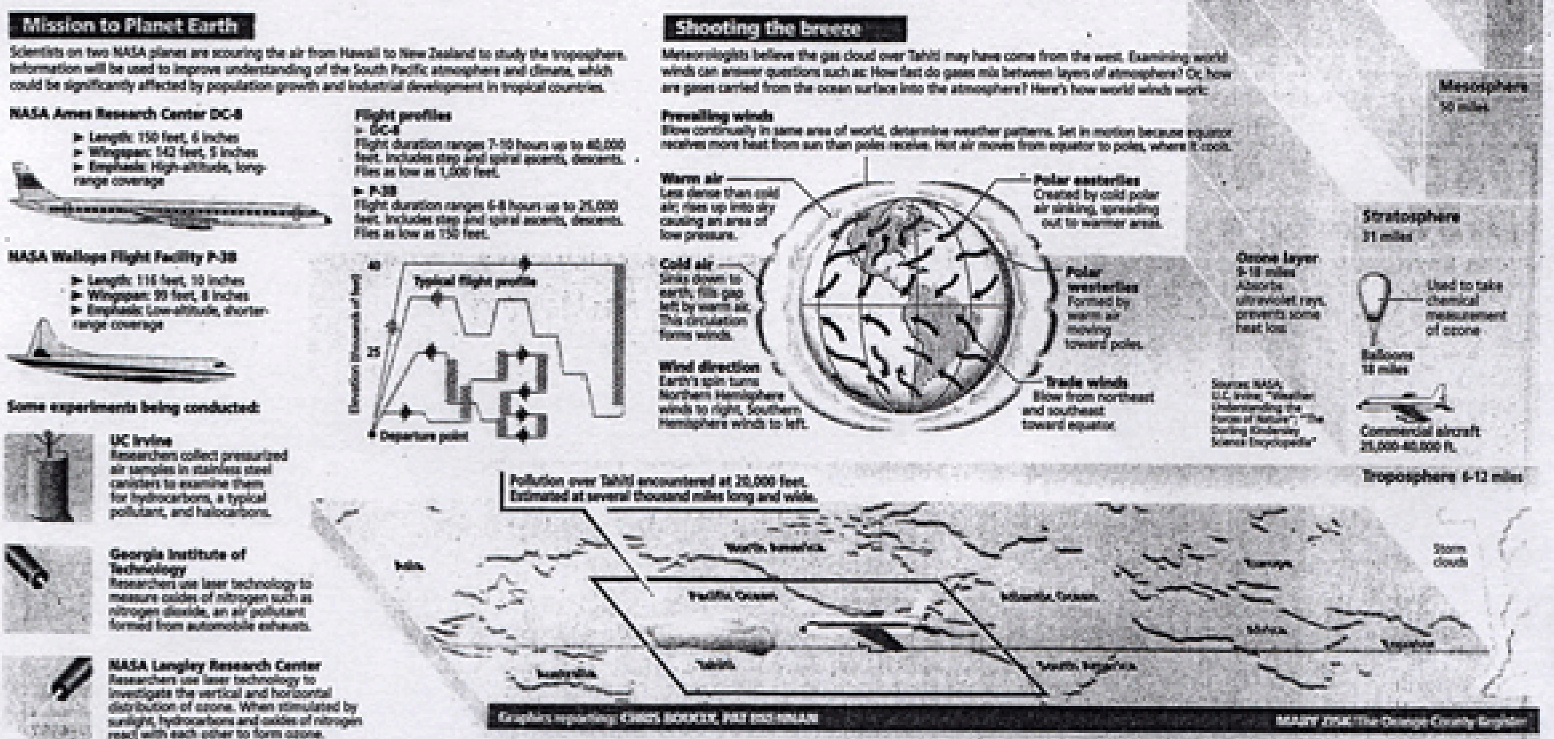


Don Blake and F. Sherwood Rowland, from left in photo above, are scientists from the University of California, Irvine, collecting atmospheric gas samples worldwide to gauge the effects on climate. Equipment aboard NASA planes for the study includes the laser system at left.



THE AIR UP THERE

Researchers trying to measure the impact of human activity on the troposphere stumbled across a mass of polluted air floating near Tahiti, where the atmosphere is supposed to be pristine. The cloud has the chemical signature of burning vegetation and scientists want to find out where it came from. Possibilities include blazing Brazilian rainforests and African or Australian grasslands.



Sources: NASA; U.C. Irvine; "Weather: Understanding the Forces of Nature"; "The Dorling Kindersley Science Encyclopedia"

Graphics reporting: … The Orange County Register