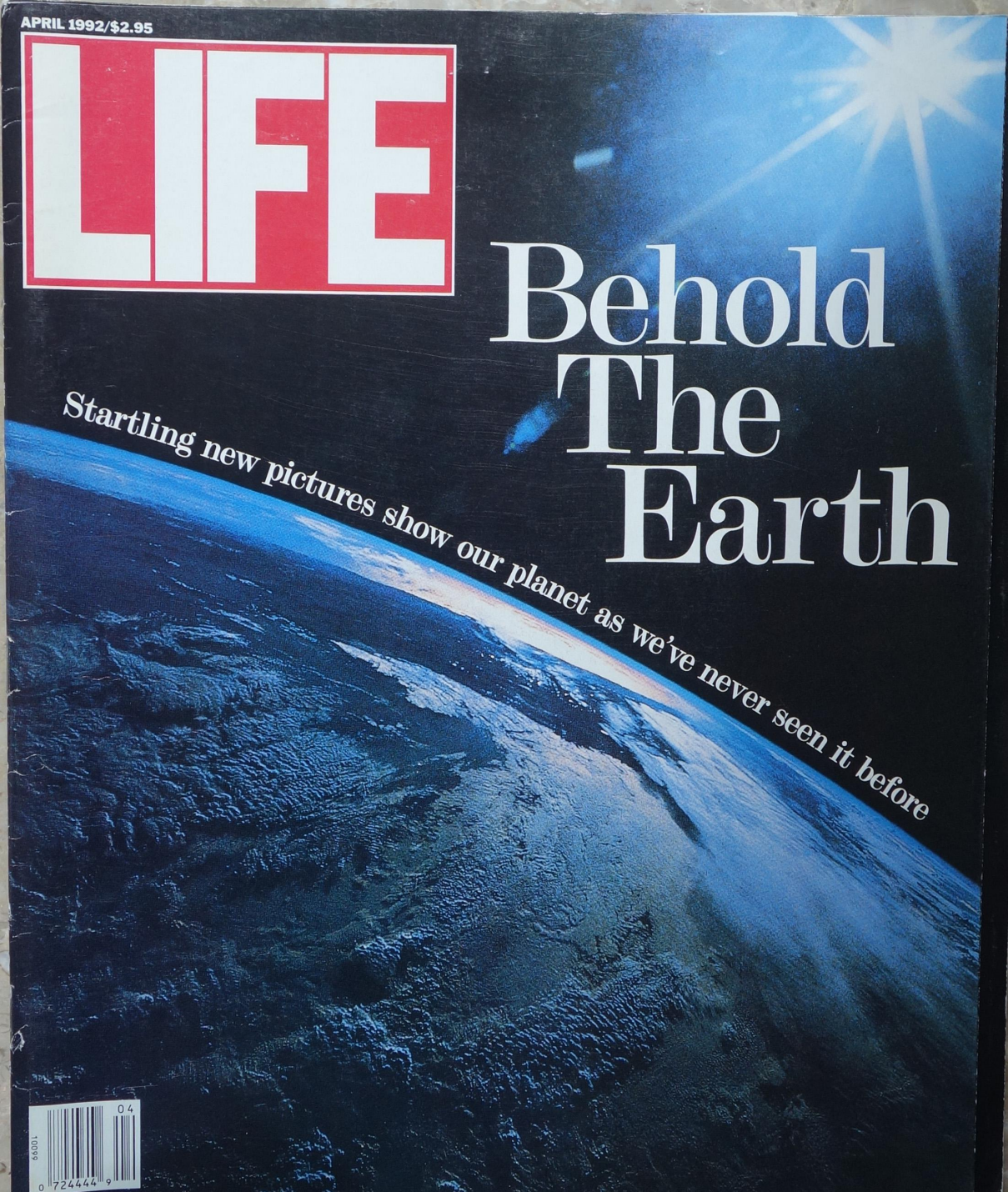
APRIL 1992/$2.95

# LIFE

# Behold The Earth

## Startling new pictures show our planet as we've never seen it before



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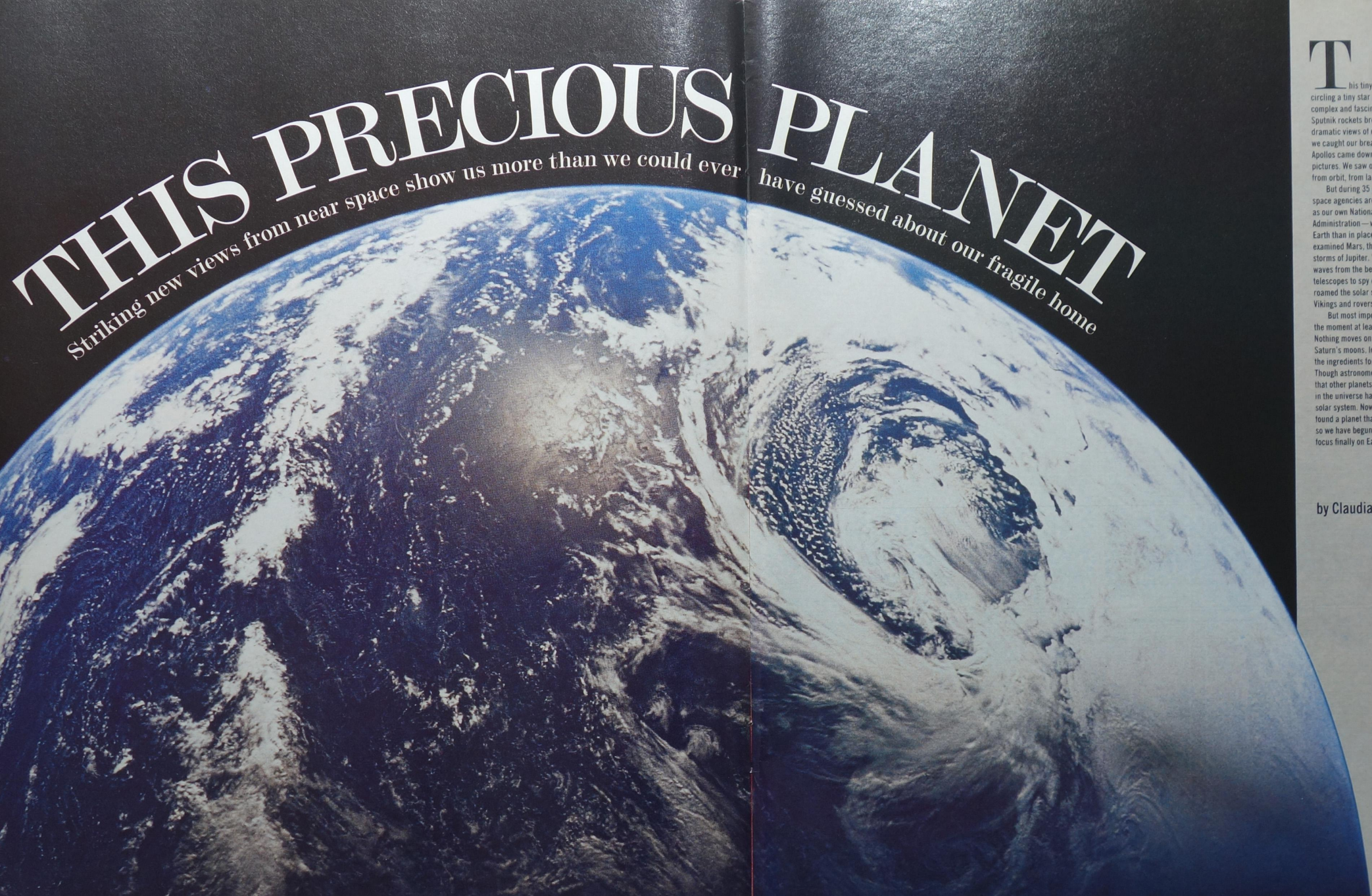
# THIS PRECIOUS PLANET

## Striking new views from near space show us more than we could ever have guessed about our fragile home



This tiny planet, one of nine circling a tiny star in the vast void, is a complex and fascinating place. When post-Sputnik rockets brought us the early dramatic views of our planet in the 1960s, we caught our breath. Apollos went up. Apollos came down. Astronauts snapped pictures. We saw ourselves from the moon, from orbit, from landing patterns.

But during 35 years of exploration, space agencies around the world—as well as our own National Aeronautics and Space Administration—were less interested in Earth than in places *out there*. We examined Mars, the rings of Saturn, the storms of Jupiter. We listened to radio waves from the beyond and launched giant telescopes to spy on faraway galaxies. We roamed the solar system with Voyagers and Vikings and rovers. We saw a lot.

But most important, we saw that—for the moment at least—we are alone. Nothing moves on Mars. Titan, one of Saturn's moons, looks as if it has the ingredients for life—but it is too cold. Though astronomers say there are hints that other planets exist, nowhere else in the universe have we found another solar system. Nowhere else have we found a planet that supports life. And so we have begun to look homeward, to focus finally on Earth.

by Claudia Glenn Dowling

IMAGES FROM *EMBRACING EARTH* BY PAYSON R. STEVENS AND KEVIN W. KELLEY, WITH FOREWORD BY JAMES BURKE, TO BE PUBLISHED BY CHRONICLE BOOKS THIS FALL.

# The Computer's Eye

ANDES WATER



ANTARCTIC GLACIER



SIBERIAN CRATER

Although NASA has launched dozens of satellites to study Earth, most of its budget has gone to support exploration far from the home planet. As far back as 1976, Congress asked NASA to expand its programs aimed at Earth. But the first major effort, called the Upper Atmosphere Research Satellite, designed to study the ozone layer, wasn't ready until 1989, partly because it was extremely complicated and partly because the *Challenger* explosion threw shuttle schedules into chaos. Finally, the satellite was launched last September. Though NASA is now more devoted than ever to studying Earth, only 5 percent of its budget is earmarked for such projects.

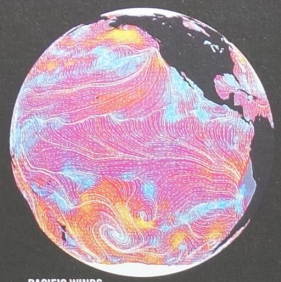
Some 20 satellites launched by seven nations now peer down at us from orbit. From space we can find aquifers under the Sahara sands or veins of uranium deposited in dry riverbeds. We can monitor the health of oceans, measure the destruction of rain forests, map mountains under the ocean. And all the information is shared among nations, which makes sense, because as sensitive as the orbiting instruments are, not one can detect the border of a country.

ANDES WATER This Landsat image from 420 miles above Earth, processed by a computer on the ground, shows watercourses in the foothills of mountains near Nazca, Peru. Rivers spring from the heights *(top left)* to feed reddish-brown fertile valleys *(top center)*. Colors are arbitrarily assigned, but vegetation is usually shown in red because more shades of red are distinguishable to the eye than any other color. Images from orbit show areas much larger than those in aerial photographs—and can be captured frequently to determine patterns of erosion and help warn of flood conditions.

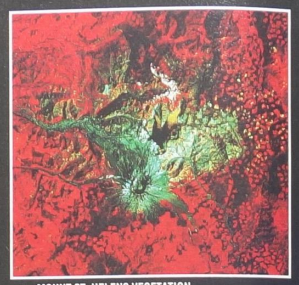
ANTARCTIC GLACIER Great climatic changes such as global warming can be detected first near the icy poles. This image of Byrd Glacier and Ross Ice Shelf, made in the 1970s, was partially overexposed. It was rescued years later by new computer software. Now scientists can compare it to more recent images and see two decades of changes in the moving ice.

SIBERIAN CRATER Some parts of our planet are so remote they are studied by satellite. More than three million years ago a meteorite hit Elgygytgyn, Siberia, forming a crater 12 miles in diameter, which eventually filled with water. The area was so inaccessible that no one realized the crater had been caused by a meteorite until the early 1970s. A French satellite, using visible and infrared light bands, created a composite image of the area that helped scientists understand the evolution of landforms.

# The Grand Design



PACIFIC WINDS



MOUNT ST. HELENS VEGETATION

MISSISSIPPI DELTA SILT

PARIS SPRAWL

ATMOSPHERIC VEIL

Whole-earthers have been telling us for decades to view this planet as a single system. Thirty years ago Rachel Carson wrote that people who kill bugs in cornfields with pesticides may also kill the birds that eat the bugs, not to mention the humans who drink the water that runs off the field. Somehow, though, scientists have become increasingly fascinated with ever more specialized studies of Earth, often ignoring hypotheses about linkages among air, soil and water. Eric Barron, director of Penn State's Earth System Science Center, puts it this way: "Oceanographers study water and ignore the atmosphere above it. When the water evaporates and forms a cloud that makes rain, it becomes the purview of a meteorologist. If that rain falls on land, it becomes civil engineering. If it percolates down, that's geology. If it affects vegetation, it's biology. If it becomes snow, it's something for a polar expert."

Now, two problems that affect every part of Earth—global warming and holes in the ozone layer—are forcing scientists to think macro, toward one complete ecological system. Help comes from the encompassing views offered by satellites. Computers help, too, but Earth's ecology is so complex that all the computers in the world couldn't contain sufficient information to analyze it.

ATMOSPHERIC VEIL The thin red-and-blue band seen in the space shuttle photograph is all the atmosphere Earth has to protect it from the extreme heat, cold and radiation of space, as well as the billions of meteorites that bombard it every day. Though the atmosphere is several hundred miles thick, the *breathable* part is only three miles thick at most, a mere pencil line on the horizon.

PACIFIC WINDS Satellites can track ocean wind patterns impossible for ships and buoys to measure. In this computer illustration, winds increase as colors change from blue-pink to yellow-orange.

MOUNT ST. HELENS VEGETATION This satellite image shows plants making a resurgence years after the volcano blew off a cubic mile of its summit. Plant life is red, mud and lava flows are green.

MISSISSIPPI DELTA SILT The largest river system in North America constantly changes the Gulf of Mexico by spewing billions of pounds of sediment into it every year, affecting fish life, water temperatures, currents and climate.

PARIS SPRAWL Population growth—the greatest influence on Earth's systems—is easily monitored by satellite. The capital of France has been spreading out from the Seine River since the Middle Ages. More than nine million people live in the purple areas.

# The Fragile Future

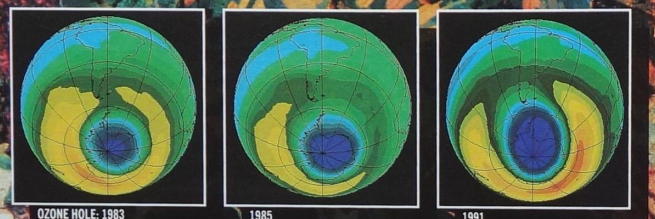
From a distance—from space—we can look back on ourselves and see the soot rising from the factories to fill our thin membrane of an atmosphere, detect the human and industrial wastes flowing into our oceans that disrupt the food chain, and track the clear-cutting of trees that has already manicured Europe and the United States. We can see an earth lacerated by sores.

ACID RAIN Two blue plumes of smoke *(right of center)* issuing from power plants in Czechoslovakia are visible even from hundreds of miles above. Such pollution, from the burning of fossil fuels, has already damaged forests. In this image, the dying trees form a diagonal orange swath across the center of the picture. Still healthy woodlands across the border of Germany *(top left)* appear as black-red.

OZONE HOLE Graphic representations of the destruction of ozone by chemicals used in refrigerants, propellants and solvents—chlorofluorocarbons—have galvanized the international community. These pictures of the enlarging hole (seen as dark blue) in the protective layer over Antarctica were bad enough. But when research released this year showed that the levels of ozone-destroying chemicals over the populated northern hemisphere were even higher than they had been in Antarctica, the Senate pressed President Bush to speed up the phaseout of chlorofluorocarbons. This month in Geneva, Switzerland, an international conference will propose new dates for a worldwide ban.

SULFUR DIOXIDE The cloud of chemicals and dust that floated from the 1991 eruption of Mount Pinatubo in the Philippines had a dramatic effect on the climate of the world. One positive effect may have been a slowdown in global warming. The cloud reflected sunlight back out of the atmosphere and kept the temperature as much as a degree cooler than predicted. However, volcanic chlorides may speed up ozone loss.

Finally, we have a global view. Can we find a global solution? An international conference is expected to sign a global warming treaty at June's Earth Summit meeting in Rio de Janeiro. Such agreements among the nations of the world will be even more important with each passing year, as we see more clearly the damage we have done. ▭



OZONE HOLE: 1983 1985 1991

VOLCANIC SULFUR DIOXIDE: WEEK 4

WEEK 6

WEEK 12

ACID RAIN IN GERMANY AND CZECHOSLOVAKIA