CONTRIBUTORS

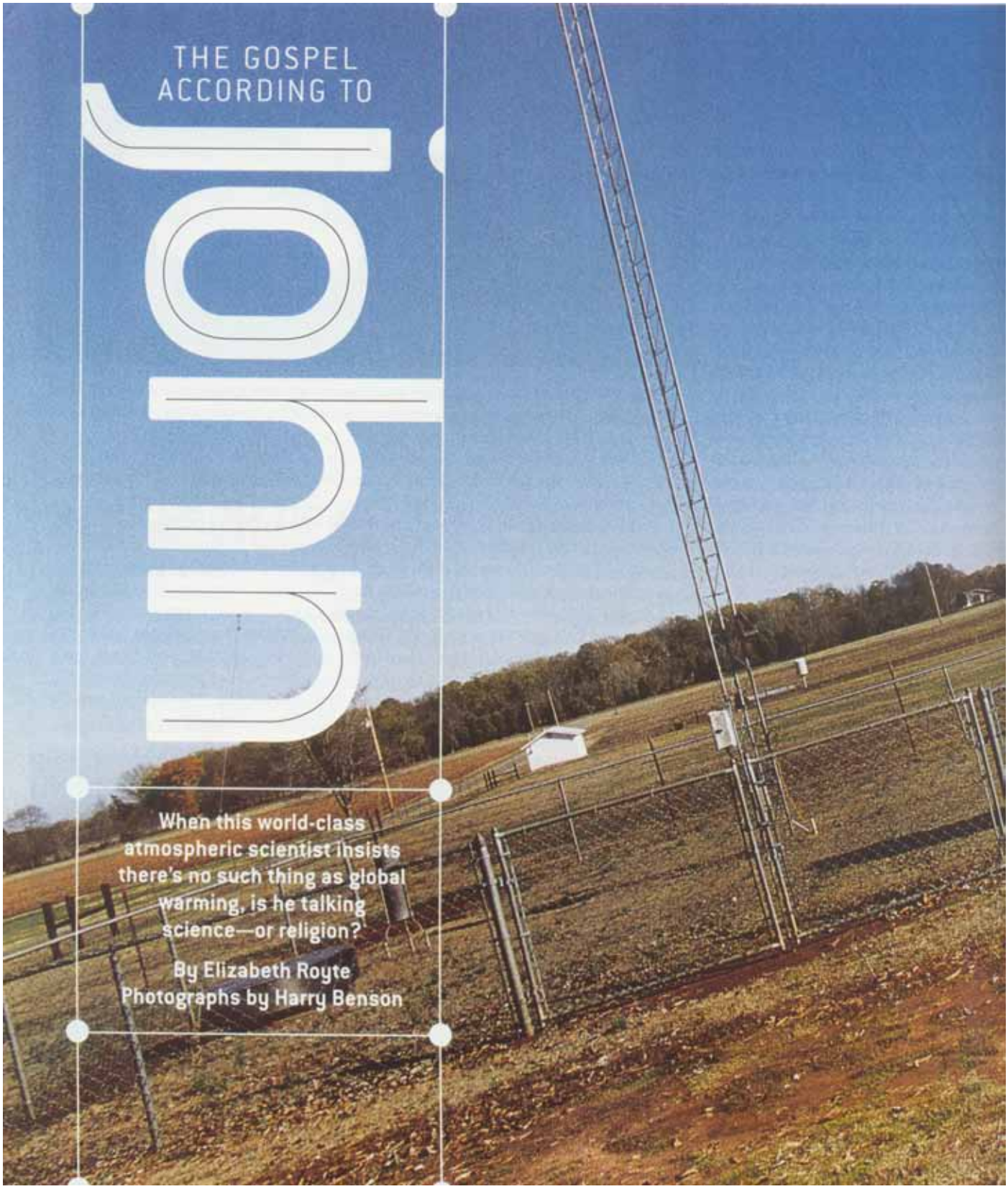
ELIZABETH ROYTE Having covered environmental news for more than a decade, Royte approached global-warming naysayer John Christy ("The Gospel According to John," page 66) with a considerable degree of skepticism. What she found was a man "irreproachable as a scientist"—and one who cares deeply about what would happen to small communities in the third world if raising the price of petroleum products was used as a strategy to help reduce greenhouse gases.

HARRY BENSON Although he has chronicled the Beatles and photographed every president from Eisenhower to Clinton, Benson still finds shooting scientists, including atmospheric researcher John Christy ("The Gospel According to John," page 66) a bit of an ordeal. "To shoot a person who has all the interesting stuff going on inside his dome—it's never easy," says Benson. "Finally I took him to a cotton field in Alabama and put him next to his meteorological equipment, where he seemed most at home."

JARON LANIER As a technologist, Jaron Lanier is lead scientist for the National Tele-immersion Initiative, a coalition of universities studying advanced applications for Internet2. As a musician, he performs with artists as diverse as Philip Glass, Ornette Coleman, and Sean Lennon; he also composes and records his work on instruments both real and virtual. Drawing on his knowledge of these two worlds, he seems well situated to cast a sharp eye over the Napster controversy that has raged for the last year ("A Love Song for Napster," page 36).

XPLANE Growing up an inveterate doodler, David Gray was a visual learner. "I always had a hard time with chemistry because I could never figure out how to draw it." In 1993 he founded XPLANE, his dream company, in the basement of his St. Louis apartment; today, its 22 artists illustrate everything from how nanotechnology works (for *Time* magazine) to a map of space junk (*Harper's*) to the journey of a space probe to an asteroid (*Discover*, "The End Is NEAR," page 52).

THE GOSPEL ACCORDING TO John



When this world-class atmospheric scientist insists there's no such thing as global warming, is he talking science—or religion?

By Elizabeth Royte
Photographs by Harry Benson

John Christy and his wife, Babs, met as missionaries in Kenya and were married 25 years ago. Their children, Alison and Brian, have followed in Christy's scientific footsteps, studying math and physics, respectively.

ON AN AUTUMNAL SUNDAY MORNING IN SUBURBAN Huntsville, Alabama, the sun streams through the second-floor windows of a Baptist church classroom. Eight men and women sit in folding chairs, eyes focused on John Christy, the leader of their Bible-study group. Dressed in khaki pants and a short-sleeved shirt, Christy flips through the pages of Genesis. He's talking about Adam and Eve, about the difference between God and his creation. "All God created is precious," he says. "And humans are the most precious part of creation."

The others nod. They know Christy as a dedicated member of the church and a mellow-toned bass in its choir. Some of them know he's a scientist, and some may even know that he puts more faith in evolution as an explanatory theory than in creationism. But only those closest to Christy know the extent to which his science and his religion are intertwined—and how much his double life has helped shape the most heated scientific debate of the past 20 years.

A professor of atmospheric science at the University of Alabama in Huntsville, Christy is a member of the Intergovernmental Panel on Climate Change (IPCC) established by the United Nations 12 years ago. As such, he is one of the world's preeminent experts on atmospheric conditions, one whose research informs our basic understanding of climate change. Yet Christy is also something of a maverick. Years ago he cast doubt on the idea that global warming is caused by humans—or that the phenomenon exists at all—and he has only grown more skeptical as most other atmospheric scientists have grown more certain.

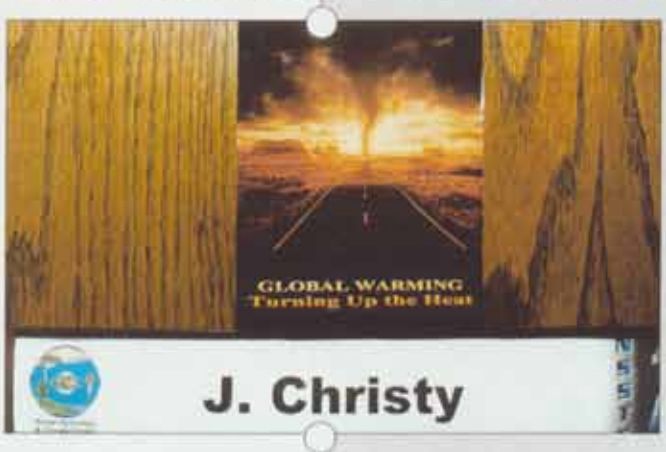
This fall, as the IPCC was preparing to announce, in stronger terms than ever before, that Earth is warming at an unprecedented rate and that people are the cause, Christy was declaring exactly the opposite. "The usual predictions show escalating atmospheric temperatures, and we're just not seeing that rise," he says. "This indicates that the cause of recent surface warming may be due to factors other than human activities."

Contrarians are never in short supply where global warming is concerned. But Christy is unique for both the quality of his science and the depth of his moral fervor. First, he backs up his hypotheses with rigorously vetted data from satellites and weather stations around the globe. Second, his opposition to emissions controls is rooted in compassion: As a Baptist missionary in Africa 27 years ago, Christy witnessed how

the energy policies of large nations can devastate small communities dependent on fossil fuels.

Today, inspired for a moment by the lesson from Genesis, he can't resist an aside to his students. "Now, some extreme environmentalists, they say that a whale is more important than your child. These people," he says, leaning forward over a low table, blue eyes twinkling, "they want us to live in the Stone Age." He shakes off the crazy thought and returns to Adam and Eve.

FROM HIS EARLIEST YEARS, CHRISTY TRAINED HIS EYES ON the sky: "I was a weather weenie," he says. He remembers watching storms gather above the Sierras from his family's house in Fresno, California. When rain fell, he climbed onto the roof to take measurements. In the 1960s, he recorded 75 different weather variables, including four daily readings of wind speed and direction, cloud type, and barometric pressure, all using a homemade weather station. He analyzed the observations statistically and wrote a computer program in Fortran that could make three-day forecasts based on the data.



A poster on John Christy's office door pokes fun at the apocalyptic tone of many global warming predictions.

Christy was also active in the Baptist church from an early age. His parents were devout, and he attended religious retreats and taught Bible school to the children of tourists in the Sierras. Through high school and college, Christy leaned toward the ministry, but a professor advised him to study what he loved. In 1973, at the age of 22, with a fresh B.A. in math and a low draft number, Christy opted out of the Vietnam War by joining a Baptist mission in the Kenyan village of Nyeri, in the highlands outside Nairobi.

Christy went to Kenya to teach high-school science, but he soon found that he was powerless to offer villagers the economic help they really needed. The Arab oil embargo had sent energy prices soaring. "I saw the number of nighttime accidents go up because a rumor spread that turning off your headlights conserved gas," Christy remembers. He also watched as sick villagers got sicker because they couldn't afford to take taxis to the hospital. He knew of one school that closed because its Texas patrons, strapped for cash, couldn't send their monthly checks.

That experience forever shaped his views on energy policy. "Disrupting the lives of those whose existence is too often literally hanging by a thread causes the kind of suffering that the average policy maker or activist never sees," he told the House Small Business Committee in 1998. "I have seen it. It is real, and it is devastating." Christy's wife, Alice Babbette Joslin, saw it too. She met him while in Kenya, where she was also a teacher and missionary, and after two years they returned to the United States and were married. Christy went on to earn his master of divinity at Golden Gate Baptist Theological Seminary in Mill Valley, California. Then he moved to South Dakota, started a church, and endured four frigid winters, one of them the coldest in a decade and the second coldest in a century.

All the while, the gods of weather were calling too. Like the Johnny Appleseed of weather weenies, Christy scattered rain gauges wherever he went, and in 1982 he finally resumed his childhood passion. He earned his master's and Ph.D. degrees in atmospheric sciences from the University of Illinois. He taught at Illinois's Parkland College, then settled at the University of Alabama in Huntsville, where he is director of the Earth System Science Center. Outside his neat brick house, a rain gauge rises at the edge of a sloping driveway. The neighbors thought it an odd place to set up a basketball net.

The Christys have two children—Alison, who recently graduated from Auburn University with a degree in applied mathematics, and Brian, who is majoring in physics at Auburn and

A SOOTY SILVER LINING

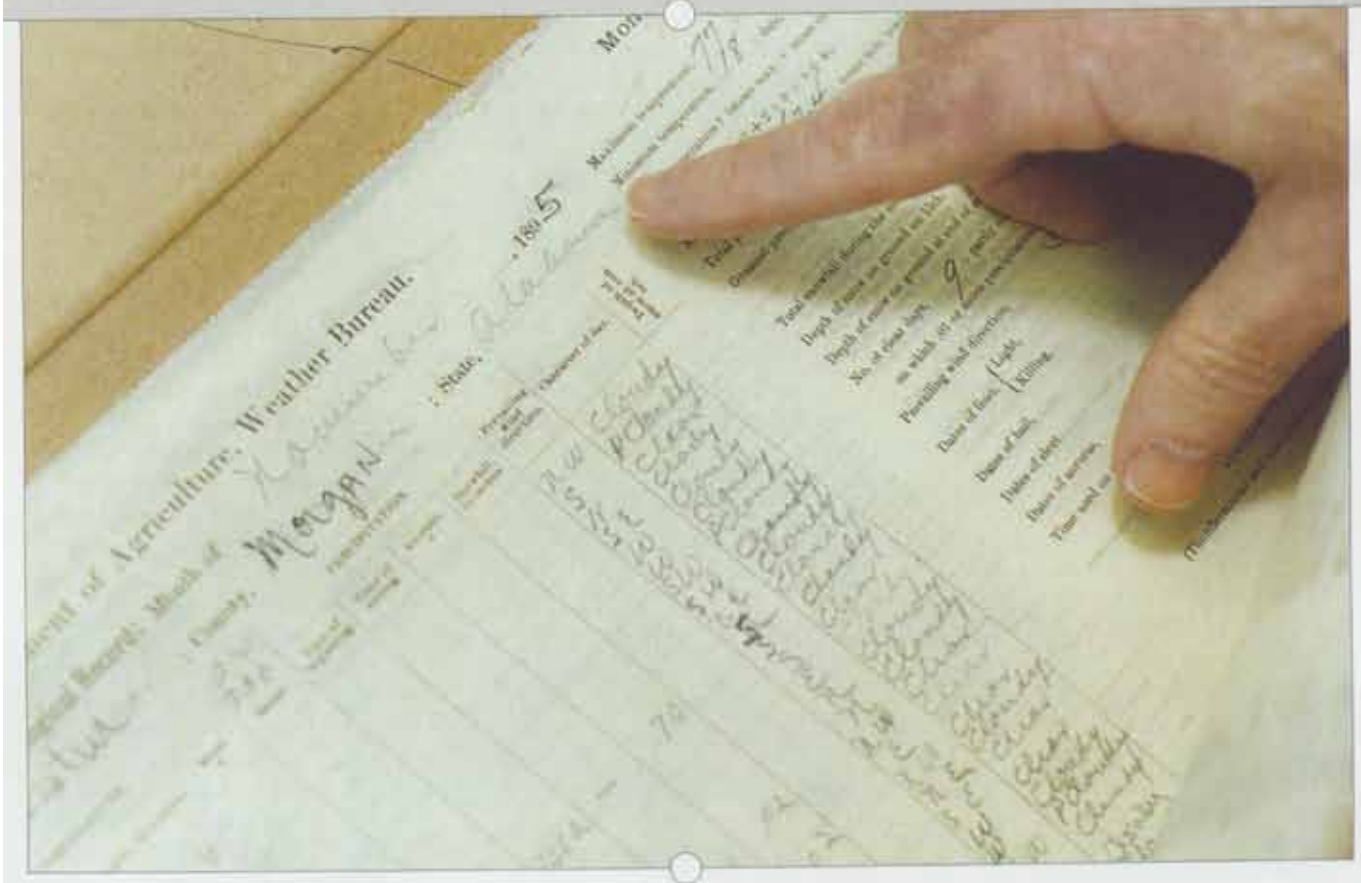
CAN WARMER GLOBAL TEMPERatures mean colder, snowier winters? It seems counterintuitive, but then so does much of the science of climate change. Take the most recent report from the Intergovernmental Panel on Climate Change. It says that the planet may be heating up faster than previously predicted, but the cause of the acceleration, ironically, is cleaner air. Reducing smokestack emissions will rid the atmosphere of some greenhouse gases, the report says, thereby lowering global temperatures over the long term. But it will also clean out sulfate particles that block the sun and cool the planet, even as they pollute it.

Such reversals underscore how remarkably young the study of climate change is. Twenty-five years ago, atmospheric scientists fretted about global cooling. Today scientists agree that Earth's surface is warming, but they can't reach a consensus on exactly how much and why. The more scientists study the atmosphere, the more complicated it appears.

John Christy goes a step or two further than some skeptics—both in his research and in the bullish conclusions he draws from it. "The notion that only bad things happen when these emissions go into the air is not supported by scientific evidence," he says. "The planet evolved when CO_2 concentrations were many times what they are today. A carbon-dioxide-enriched atmosphere would be beneficial to all carbon-based ecosystems. Food production would go up. Numerous studies show that people will suffer fewer cold-season deaths than warm-season deaths."

Even if temperatures and sea levels continue to rise, Christy says, such changes will be slow, and humanity will have time to adapt. "All kinds of neat things are coming along. In 100 years, we'll see cleaner and more efficient gas and coal technology. We're clever people." —*E. R.*

"The critics kept popping up, like dragons," John Christy says. One by one,



An Alabama weather record from 1895 notes cloud conditions and other variables in Decatur. The information was filled in by hand meticulously, but it may contain anomalies that can throw off climate assessments.

has already presented two posters at a conference. Christy swears he didn't predetermine his offspring's career paths, but he does joke that he wouldn't talk to them until they could factor polynomials.

"There's a lot of statistics talk around here," his wife says one afternoon, after a lunch of stewed chicken, cheddared broccoli, corn, and green Jell-O. "Last Christmas, we had a present that wasn't labeled. I picked it up and said, 'What are the odds that this is for me?' Well, everyone chimed in with a very precise answer."

TO MOST PEOPLE, NUMBERS ARE HARD AND IMMUTABLE. BUT Christy knows that they're subject to interpretation—and too often misinterpretation. For years, he listened as politicians and scientists spoke of rising global temperatures. But he questioned the data behind their predictions. He knew that buildings had been erected around thermometers and that nearby forests had been cut down, driving up recorded temperatures independently of any global climate change. He knew that scientists didn't have a way to get accurate readings of temperatures above the Earth's surface, so they didn't know what was happening to the lower troposphere—the first five miles of air hovering above Earth.

To fill in that vast gap, Christy began to work with Roy Spencer, a satellite meteorologist at NASA's Marshall Space Flight Center in Huntsville, extracting data from polar-orbiting satellites. The satellites carried instruments that measure the intensity of microwave radiation emitted by oxygen. Weather forecasters had used this data in a limited way to record temperatures at 20 different levels of the atmosphere but never to get a global average for the troposphere. Figuring out how to infer tropospheric temperature from the data was Christy and Spencer's genius.

In theory, if the atmosphere heats up like a giant greenhouse, then the troposphere ought to be warming as rapidly as the Earth's surface, if not faster. According to Spencer and Christy's satellite data, however, the lower troposphere was surprisingly cool. Since 1979, it had warmed only 0.2 degree Fahrenheit, whereas the surface had warmed between 0.48 and 0.7 degrees Fahrenheit. The disparity suggested to Christy that prevailing climate models were wrong.

As soon as he published his figures in 1990, Christy was attacked in scientific journals, in the media, and as the years passed, on the Web. There were questions about satellite drift, orbital decay, instrument temperature, and other possible biases. While environmentalists accused him of destroying the planet, industry public relations officers gleefully distributed Christy's statistics on the Internet. Of the two contingents,

he and his colleague Roy Spencer slew them. Their weapon was math

Christy says, "I'm more upset with environmental advocacy groups who lie about my data, who say it's inaccurate." He says one employee of NASA's Mission to Planet Earth program, which studies climate change, told him, "I'm paying people to come at you with bricks and bats."

"The critics kept popping up, like dragons," Christy says. One by one, he and Spencer slew them. Their weapon: math. For months on end, the men identified and quantified possible sources of error, applied nonlinear-trend reconstruction algorithms, and corrected least-squares regressions. They calibrated one satellite against another and, finally, validated their corrected numbers with readings from radiosondes—weather balloons that have been collecting data worldwide since 1958. In the end, he says, the errors fell to less than a tenth of a degree for the 20-year period.

Eventually, scientific opinion turned in Spencer and Christy's favor. In 1996, the American Meteorological Society presented them with an award for "fundamentally advancing our ability to monitor climate." In 1997, the Hadley Centre for Climate Prediction and Research in England independently verified their data. "We have nine data sets and they're absolutely confirmed," Christy says. "They're dead-on."

SITTING IN HIS OFFICE TODAY, SURROUNDED BY WEATHER charts and climate bulletins, Christy looks as preternaturally neat as his data: lean and square-chinned, his hair and push-broom mustache trimmed with diamond-edged precision. He's not especially tall, but he gives the impression, when he's excited by his topic, of having rocked onto his toes. At 49, he seems at least a decade younger.

On the walls, Christy has hung computer-generated charts of his times on 5-kilometer, 10-kilometer, and marathon runs. (When he's not working or running, Christy heads for the North Carolina hills, to pan for gold with a sluice box and shovel.) On the door is an Al Gore-signed letter from the Democratic National Committee, asking, "Won't you join us?"

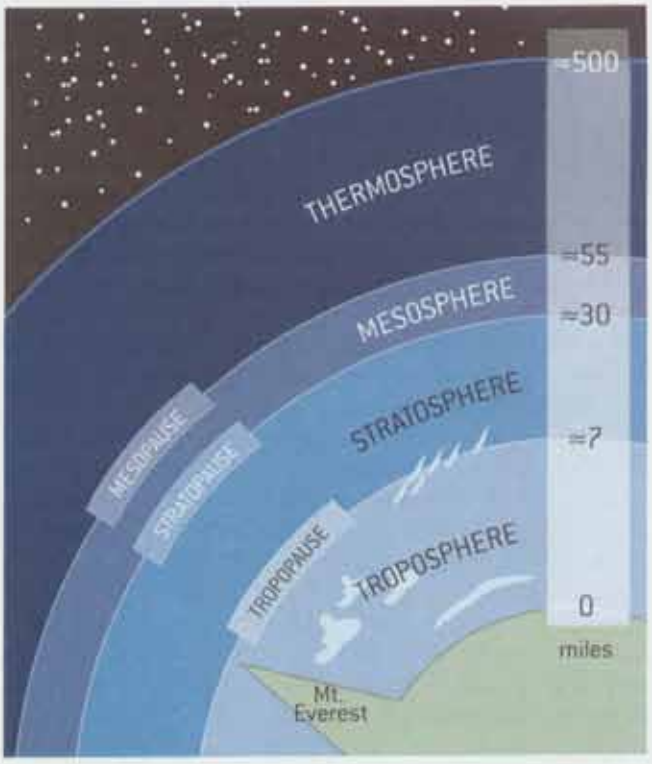
The letter is posted as a dig at Gore's belief in global warming. But it points to a bitter irony at the core of Christy's research: While his data have won praise, his conclusions have not. In a report released on January 12 last year, the National Research Council declared that the disparity between surface and troposphere temperatures is probably real, but that it's difficult to say why it exists or what it means.

More galling for Christy is the report recently released by the IPCC—a definitive 1,000-page document that Christy himself coauthored—that essentially contradicts his interpretation of the surface data. The burning of fossil fuels has "contributed substantially to the observed warming over the last 50 years," the report concludes. Moreover, it warns that temperatures could rise even higher than previously predicted—possibly 11 degrees over the next century.

Christy and IPCC members like James E. Hansen, director of NASA's Goddard Institute for Space Studies, agree that temperatures on the surface and in the troposphere don't necessarily move in lockstep and that they may need 50 years to converge. But Hansen believes—based on projections from current radiosonde readings—that the troposphere will continue to warm. The discrepancy that Christy found, he says, will disappear as climate models and measurements improve.

Christy thinks it equally likely that the Earth's surface will cool. The surface warming that alarms so many atmospheric scientists is, to Christy, well within the realm of natural variation, or measurement error. "Most of this warming occurred in the early part of the 20th century, before humans had boosted concentrations of greenhouse gases," he says. Sunspots, volcanic eruptions, El Niños, variations in aerosols, water vapor, carbon dioxide and methane from living creatures, and other unknown factors may all tweak the planet's temperature up and down, Christy says. His satellite data show that the average temperature of the United States has been slightly higher recently than in previous years, but the average temperature of the southern hemisphere has been lower. When hot and cold spells are seen from a global perspective, he concludes, they eventually even out. →

Distinct layers of air surround the planet. John Christy has found that the lower troposphere—the bottom five miles of the atmosphere—is significantly cooler than climate models predict. That suggests to him that surface temperatures will cool down in the future. But most climate experts are certain that humans are warming the planet's surface and will continue to do so. Temperatures in the lower troposphere and on the surface should converge, they say, as measurement errors, the uneven effects of aerosols, and chaotic variability decrease.



Such positions have kept Christy in the distinct minority of scientists. Most climate researchers see retreating glaciers, thinning polar-sea ice, and warmer nights as evidence of human influence. The new IPCC report acknowledges the uncertainty over tropospheric temperatures, but its more dire predictions are based on new temperature data gathered in the last few years, on improvements in computer models, and on a better understanding of how particulates affect climate. "In legitimate climate circles," says Brandon MacGillis of the National Environmental Trust, "there is no debate on the way humans have warmed the planet. It's happening."

WHATEVER THEIR VIEWS ON GLOBAL WARMING, MANY scientists believe that precautionary measures are a win-win undertaking: If they don't prevent rising temperatures, they will at least take advantage of some hard-won social and political momentum to clean up the environment. Christy has no complaint with reducing toxic emissions like methane, sulfur dioxide, and nitrous oxide. "I care about our environmental problems," he says, "if they're scientifically based and put into perspective with global environmental problems. But what I see is people in the Northeast and the West trying to control how others live." He says the environmental effects of curbing greenhouse-gas emissions "are likely to be minuscule," while the social effects could be disastrous.

Christy is a choir member and Bible-study leader at his Baptist church. He was also instrumental in getting a new science wing built at his children's former high school.

Christy is especially concerned about one oft-mentioned scheme for reducing greenhouse emissions: a carbon tax that would raise the price of fossil fuels until consumption goes down. He believes the tax would wreak havoc on poor areas by indirectly raising the prices of goods and services. "In Africa I saw a society living on the edge," he says. "You tweak one thing and it rapidly begins to disintegrate. A villager might not buy fuel, but the bicycle he wants could end up costing far too much for him to buy." He contends that the best thing for third-world countries that burn wood for fuel and heat is to build coal-fired power plants. "Cheap and accessible energy means better and longer lives. It means scientific and societal advances; it enhances health and security."

Many environmentalists would counter that the best schemes for reducing global warming would actually benefit the third world. The 1997 Kyoto Protocol, for instance, would allow countries with few CO_2 emissions to sell "emissions credits" to polluter nations like the United States. Tellingly, 30 countries have ratified the protocol, all nonindustrialized. Yet Christy, despite all his concern for the third world, still sides with the industrial nations. The United States "must remain robust," he insists, "with continued access to cheap energy." The Kyoto Protocol requires that by 2008 industrialized countries reduce their emissions to 5 percent below 1990 emissions levels, but Christy says that would cause "severe economic depressions."

To keep politics from appearing to bias his science, Christy refuses support from industry groups. He works strictly with funding from NASA, the National Oceanic and Atmospheric Administration, the Department of Energy, the Department of Transportation, and the state of Alabama. But he is driven by a fundamental, religious belief that human life is "precious above all else," and his doubts about global warming can almost seem like an outgrowth of his distaste for any centralized government action. Asked what he would do if his data did show the troposphere warming in lockstep with the Earth's surface, he seemed genuinely at a loss. "I guess I'd still be skeptical about forecasts of catastrophe," he said. "That's my nature."

In the meantime, his skepticism has earned him more attention than anything he has ever done. Beginning in the mid-1990s, he visited Washington, D.C., at the behest of congressional committees, to present scientific testimony. He appeared on television and gave radio and newspaper interviews. "It was fun," he says. "I was the first person in my family to go to college, and I never imagined that because I know about climate and Fortran I'd be giving advice to the U.S. government."

Does a thirst for publicity—for being the star underdog—help drive Christy's predictions? "I recognize that feedback process, and I try to avoid it," he says. "I'm not going to ignore data. Most people at the bureaucratic level synthesize the work of others. But I write code, I look at numbers, I read and review papers. I would hope I'm objective, but I'm human." He pauses, then adds, "And the opportunity to do this is a thrill."

ON A WARM MONDAY MORNING, CHRISTY TAKES A RARE FIELD trip, driving west from Huntsville to weather station Decatur 5SE. He wants to look at the setup, to see what factors might be influencing readings. It's rural here, just 20 minutes outside Huntsville, and cotton fields stretch to the horizon.

Standing next to a collection of instruments—two thermometers, one anemometer, and rain and humidity gauges—

Christy says. "Cheap and accessible energy means better and longer lives"

As a state climatologist, Christy checks readings at weather stations throughout Alabama. He's used to the work: He built a weather station as a child and measured 75 observations a day.

Christy does a 360-degree turn. "We're surrounded by fields, but there's no natural forest cover here," he says, "so we'll get warmer daytime temperatures in the summer and cooler temperatures in the winter."

On a shelf back in Christy's office sits a box of state weather records dating from 1893. While many researchers consult the temperatures noted on the dog-eared pages, few have bothered to read the handwritten notes in the record. Christy's main concern is the records' consistency through time. The notes tell him that a station has moved 20 feet east, that a new observer was trained, that no one came to work on the weekend, that blacktop now surrounds the gauges. Such information creates anomalies that break up a homogeneous set of numbers.

If surface temperatures appear to be warming, Christy says, consider the context. "Creeping urbanization has a significant effect on the appearance of a warming Earth," he says. Cities are always warmer than the global average, particularly at night. Surface measurements are also unevenly distributed. There are more gauges in the northern hemisphere than the southern; we don't have reliable climate data for remote desert, ocean, and rain-forest areas. "This variance is the bane of our field," he says.

Christy climbs back into a university van and heads for another weather station 10 minutes away. Belle Mina 2N casts its shadow over hay fields. Three feet above the rain tower, outfitted with the latest in thermistors, sits a galvanized bucket, eight inches in diameter, topped with a funnel. "That's your basic rain gauge," Christy says. "Precipitation falls, and you stick a thin wooden ruler into the bucket to measure it. It always works." The contrast between low-tech and high is striking. In his office, Christy grooms and massages numbers downloaded from orbiting satellites; in the field, he's got volunteers poking measuring sticks into buckets. Of 10,000 such weather stations spread around the planet, a global data set is made.

TWO WEEKS AFTER HIS VISIT TO DECATUR 5SE AND BELLE MINA 2N, Christy goes to Asheville, North Carolina, for a workshop on improving balloon data. A day after his return, he's got big news. "We just had the earliest frost on record in Huntsville," he crows over the telephone. "It was 29 degrees on Monday night." He doesn't say so, but one gets the feeling he's glad.