Unusual weather spurred Andrew's growth

Only three days before Hurricane Andrew mauled southern Florida last week, it looked as if this tropical storm might never make it to hurricane status. After crossing the Atlantic, the storm began weakening as it moved north of Puerto Rico. But then Andrew unfortunately ran into some very favorable conditions and, as meteorologists say, the bottom fell out of the storm.

"It intensified quite rapidly compared to normal hurricanes," says Kerry A. Emanuel, an atmospheric researcher at the Massachusetts Institute of Technology in Cambridge.

In a 48-hour period, Andrew's winds strengthened from 52 to 140 mph, quickly turning an average tropical storm into one of the most intense hurricanes to hit Florida this century, according to the National Hurricane Center in Coral Gables, Fla.

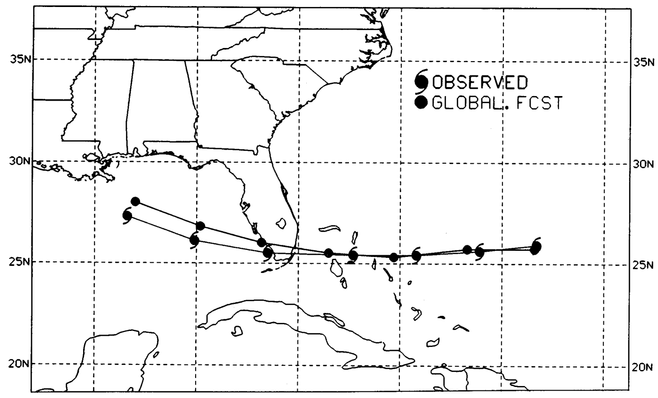
As the name implies, tropical storms start in the tropics, at latitudes between 5° and 20°. When low-pressure systems leave the African continent, the warm water and favorable winds permit a few of these systems to develop into tropical storms and then fewer still into hurricanes. North of the tropics, however, the upper winds usually blow in a different direction from the winds near the surface — a factor called wind shear, which hinders the development of hurricanes. Wind shear disrupts the tall thunderclouds that form the core of a hurricane.

Unlike most hurricanes, Andrew grew into a major hurricane outside the tropics in an area that would normally have too much wind shear. But as Andrew left the tropics, the upper-level winds were blowing — against character — toward the west, in the same direction as the lower-level trade winds. This created a situation with relatively little wind shear. At the same time, Andrew moved over warm water, which also helped the storm gather strength, says William M. Gray, a meteorologist at Colorado State University in Fort Collins.

"The environment was extremely favorable for this storm to intensify," Gray says.

Andrew's path paints a clear picture of the upper-level winds. For several days, the storm chugged almost straight westward, keeping between 26°N and 25°N, almost as if it were following a latitude line on a map. Because Andrew took such a straight course, forecasters had a relatively easy job predicting its path, says Stephen Lord, a researcher at the National Meteorological Center (NMC) in Camp Springs, Md.

When it became clear that Andrew would hit southern Florida, home to the National Hurricane Center, several hurricane specialists traveled north to the NMC to set up a backup unit in case the storm disabled the Coral Gables facility. Gusts of up to 164 mph did, in fact, blow down a radar dome and inactivate several satellite dishes on the roof of the center, but meteorologists there continued to issue forecasts with help from the NMC and other weather service offices.



Swirls show course predicted by NMC global model. Dots represent actual hurricane path. Symbols are 12 hours apart.

NMC

To make hurricane forecasts, meteorologists use a suite of statistical and dynamical models. The statistical models make predictions on the basis of past weather behavior, while the dynamical ones rely on physical laws and calculate how air circulation will evolve.

Andrew marked the first instance in which NMC meteorologists used their global weather forecasting model to help predict a hurricane's path. "We're quite pleased with the results," says Lord, who developed the technique. The global model was among the most accurate, although Lord cautions that this trial represents only one test.

For the present, he thinks the limited-area dynamical models will typically achieve greater accuracy than the global model because they have higher resolution. But as the resolution of the global model improves, it should outperform limited-area models because it can include interactions among widespread weather systems that influence hurricanes, Lord says.

While forecasters have been developing skill in predicting hurricane paths, intensity forecasts have lagged behind. "We have absolutely no skill in forecasting the change in hurricane intensity," says Emanuel. *—R. Monastersky*

Comets and planets: A noble link appears

More than 30 years ago, a young chemist fascinated with the origin of life made a startling discovery. Mixing together water, ammonia, and hydrogen cyanide — three compounds believed to be carried by comets — John Oró of the University of Houston found that this hellbrew formed adenine, a fundamental component of DNA and a relative of adenosine triphosphate, the molecule that provides a key fuel for most living things. Citing his laboratory findings, Oró proposed in a 1961 NATURE article that as comets struck the planets early in the history of the solar system, these icy bodies brought with them the chemical precursors of life.

Although Oró's article became a landmark, over the years many researchers ignored the role of comets in planetary evolution because they didn't believe these objects contributed significantly to the chemical composition of the terrestrial planets. After all, they reasoned, rocky planets like Venus, Earth, and Mars probably originated as agglomerations of rocky, meteoritic bodies. And it seemed that meteorites striking the young planets might account for the concentrations of noble gases — chemically inert substances — in the atmospheres of these planets. Comets simply weren't needed.

But during the past decade, researchers uncovered a major problem with this explanation for the evolution of planetary atmospheres. They discovered that the meteorites that have fallen to Earth contain a far greater abundance of xenon, a heavy noble gas, than that found in the atmosphere of Earth and Mars. At first, scientists suggested that the missing xenon might lie hidden in underground rock or ice deposits, but no extra xenon was ever found.

Now, a team of space scientists proposes a way out of this dilemma. New laboratory experiments suggest that noble gases trapped within the icy nuclei of comets may account for the abundance of xenon in the atmospheres of Earth and Mars, as well as the unusually large amounts of argon found on Venus. Tobias Owen of the University of Hawaii in Honolulu presented the findings this week at the World Space Congress in Washington, D.C.

Two of Owen's colleagues, Akiva Bar-Nun and Idit Kleinfeld of Tel Aviv University in Israel, conducted experiments crucial to understanding the influence of comets. They found that at a certain temperature, amorphous water-ice — a laboratory stand-in for comets — trapped the noble gas argon but relatively little xenon. Such a pattern approximates, but doesn't precisely match, the relative abundance of these gases in the atmospheres of Mars and Earth, Owen notes. In

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the experiments, the abundances of gases trapped in water-ice chilled to 50 kelvins most closely approximated terrestrial conditions. That temperature has special significance, Owen says, because it corresponds to the temperature found in the region between Uranus and Neptune, where scientists believe comets first formed.

On the basis of this work, Owen suggests that the present noble gas composition on Earth, Mars, and Venus may represent the mixture of two reservoirs: trapped gas released when comets first rained down on the planets, and gas released in an entirely different pattern from rocky material inside the planets. Different planets — and different regions within those planets — draw from these two reservoirs in different proportions. For example, says Owen, material from deep within Earth's mantle, shielded from cometary bombardment, exhibits a noble gas composition more akin to that of rocky compounds such as meteorites. He adds that the higher abundance of argon on Venus indicates that the most recent series of comets striking that planet formed at temperatures below 50 kelvins, since the Tel Aviv experiments indicate that chillier water-ice traps more of the noble gases.

Owen emphasizes that his conclusions remain speculative because researchers have yet to measure the actual abundances of noble gases inside "new" comets — icy bodies that are visiting the inner solar system for the first time and haven't had a chance to warm up and expel most of the gases trapped within them. If future observations confirm the findings, he says, the recent work may provide one of the first direct links between comets and planetary evolution.

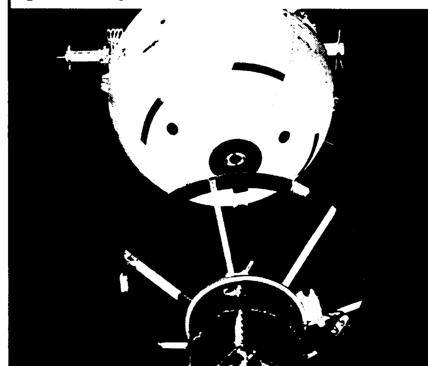
The new findings also strengthen the argument that comets played a crucial role in transporting biochemical compounds to the planets, says Oró, who spoke at this week's conference. Adds Owen: "The fact that you have to have comets coming in [to account for the noble gas abundances] means you're also bringing in carbon and nitrogen."

— R. Cowen

Bolt jammed tether's reel

Investigators have attacked the nuts and bolts of the problems encountered during deployment of the Tethered Satellite System (SN: 8/15/92, p.101) and found a bolt at fault.

Last-minute modifications to the satellite's tether-reel assembly included the addition of a quarter-inch-diameter securing bolt, which apparently jammed the mechanism in-flight, a board of international investigators reported last week.



NASA

The tethered satellite moves away from its boom during initial deployment.

The board's preliminary analysis indicates that this bolt prevented the free movement of a device called the level wind mechanism, which feeds out tether much as a fishing reel feeds out line. This is believed to have caused the tether to jam first at 179 meters and again at 256 meters.

Although shuttle astronauts managed to clear both snags, this problem would have prevented the full deployment of the satellite even without the other failures that occurred during the mission, the board said.

Investigators continue to examine all of the major problems encountered during the mission, including an initial failure to deploy the satellite and the final tether snag, which developed at the far end of the deployment boom. □

Blood-vessel growth genes stop making sense

Using a new genetic technology called antisense, researchers have completely shut down the operation of a gene that can cause the walls of arteries to thicken, reducing blood flow to a trickle. The scientists hope their strategy will one day benefit patients undergoing balloon angioplasty, a vessel-widening procedure that sometimes backfires, prompting the growth of cells within arterial walls.

The research team, led by Robert D. Rosenberg of the Massachusetts Institute of Technology in Cambridge, used antisense to prevent arterial thickening among rats whose neck arteries had been reamed by balloon angioplasty. Rosenberg, who also holds a post at the Harvard Medical School's Beth Israel Hospital in Boston, and his colleagues report their results in the Sept. 3 NATURE.

Each year, roughly 260,000 people in the United States undergo balloon angioplasty. Surgeons snake a catheter tipped with an uninflated balloon through the fat-clogged arteries of atherosclerosis patients. By inflating the balloon, the surgeons compress the deposits, widening the arteries.

However, balloon angioplasty has an undesired effect on an estimated one-third of those who receive the therapy. In these patients, the friction of the inflating balloon spurs smooth-muscle cells lining the arteries to grow and divide, causing the arteries to narrow again.

Earlier this year, Rosenberg's team and a separate research group reported that smooth-muscle cells grown in laboratory culture switch on a gene named c-myb before they begin dividing. This "proto-oncogene" spurs normal cell growth and differentiation in a wide range of tissues. When it becomes damaged through mutation, it can cause the uncontrolled growth characteristic of cancer.

Rosenberg and his co-workers set out to determine whether they could prevent arterial thickening by inactivating this growth-promoting gene. They applied a gel containing short oligonucleotides — the chemical building blocks of genetic material — to the neck arteries of angioplasty-treated rats. These "antisense oligonucleotides" were designed to bind to and block the "sense" of a chemical message called RNA, which genes use to direct a cell to make proteins. By specifically blocking the RNA of the c-myb gene, Rosenberg's team hoped to prevent it from prompting the inappropriate growth of smooth-muscle cells in the rats' arteries.

The researchers found that the arteries of rats treated with the antisense therapy contained no detectable levels of c-myb RNA, while the arteries of rats treated with a control compound had high levels of the substance. Moreover, the arteries of the antisense-treated rats showed virtually no muscle-cell growth after two weeks, whereas those of the control rats thickened considerably.

Rosenberg says he is "enthusiastic but cautious" about the prospects of using a similar approach in humans who undergo balloon angioplasty. He has applied for a U.S. patent on the technique, and is helping to form a company to commercialize the therapy.

"This is a very flexible approach to turning off [artery-thickening] genes," Rosenberg asserts. "[The c-myb gene] is one target, but there could be many other targets." He hopes to begin human clinical trials of antisense compounds within two years.

Volkhard Lindner, a vascular biologist at the University of Washington in Seattle, calls antisense "an interesting concept" for preventing arterial thickening after balloon angioplasty. But he cautions that Rosenberg's team has not proved that the antisense compound specifically blocks c-myb without interfering with other genes. He also suggests that the group may have jumped the gun by looking for arterial thickening among the rats after waiting only two weeks. Such thickening sometimes takes six weeks to develop, Lindner says. *— C. Ezzell*