



# ‘THE COLUMBIA IS LOST’

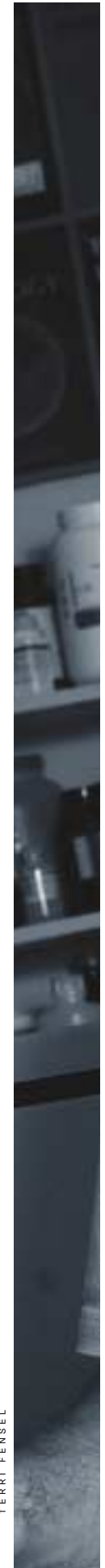
A UL Lafayette biologist is hoping for another chance to find answers to age-old questions about plants and gravity.

By Kathleen Thames

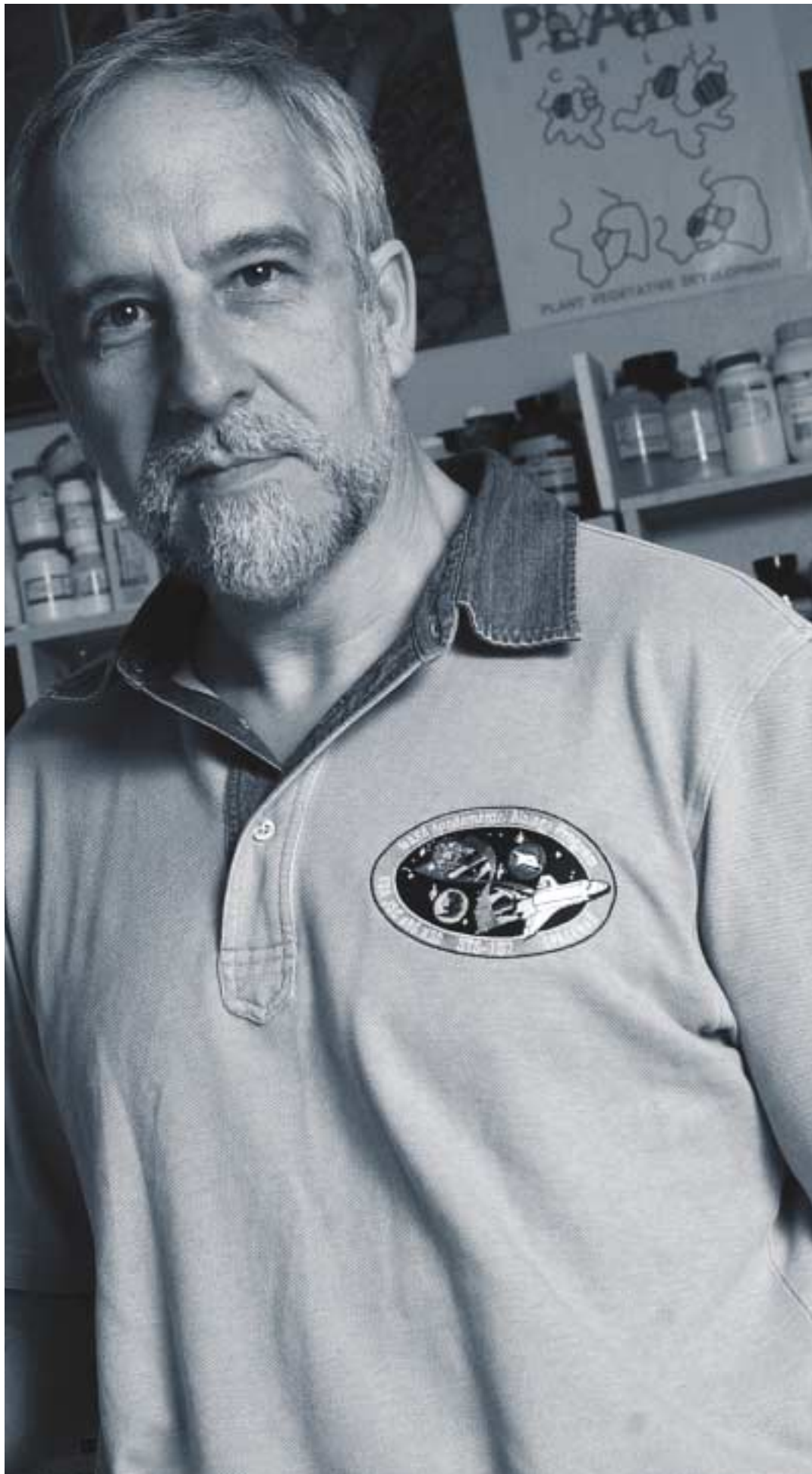
**A**bout six weeks after the Space Shuttle Columbia exploded in the sky, Dr. Karl Hasenstein received some unexpected news. Two small pieces of his experiment, which had been onboard, were recovered in Texas.

“It was totally torn up, but it was definitely recognizable as our hardware,” he said, during an interview in his office in Billeaud Hall. The scraps of metal were a surprise addition to what had previously been the only legacy of his doomed research project – a small amount of data collected by NASA.

For the UL Lafayette biology professor,



TERRI FENSEL



Hasenstein's experiment aboard the Space Shuttle Columbia was designed to elicit information about plants' gravity sensing systems by asking, "What can we learn from creating a condition where gravity is not the dominant force but some other force can act on parts of the cell?" • The only place that gravity is not the dominant force is in outer space, where the centrifugal force that keeps a spacecraft in orbit cancels out the Earth's strong gravitational pull.

Mission STS-107 was a rare opportunity to gather clues that could someday help solve a mystery that has baffled scientists for centuries: How do plants know to grow up, while their roots grow down? His experiment was one of about 80 research projects from around the world that were tucked inside Columbia's belly. STS-107 was the first mission in four years to concentrate on research and education.

NASA has suspended future shuttle voyages until it can determine what caused Columbia to disintegrate "sixteen minutes from home," ending the lives of seven astronauts.

"Maybe I can make a good argument for the future. I don't know what's going to happen, but I hope NASA will consider flying a similar mission," Hasenstein said.

The astronauts' deaths overshadowed any disappointment about aborted experiments. For Hasenstein, the tragic loss of life was professional and personal, since he had gotten to know most of the astronauts. In them, he had found kindred spirits, men and women driven by insatiable curiosity and the thrill of discovery.

Gravitropism, the response of plants to the pull of gravity, captured his imagination when he was a graduate student in Germany. Twenty-five years later, there is still a note of wonder in his voice when he talks about it.

Consider orchid flowers, growing at the end of long, thin stalks, he instructs. "You will notice that the position of all the individual flowers is such that they present the most striking inner petal in a horizontal fashion to make it the most perfect landing place for pollinators. They torque, they twist to achieve that position. So the plants have a very precise sense of where gravity is active and they adjust accordingly."

Scientists have a couple of theories about how plants sense and respond to gravity. One possibility: when gravity pulls the fluid contents of plants downward, pressure on the cell walls serves as a signal. Or, maybe starch grains inside plants' special cells, which are sensitive to magnetism, drift sediment down when gravity is present.

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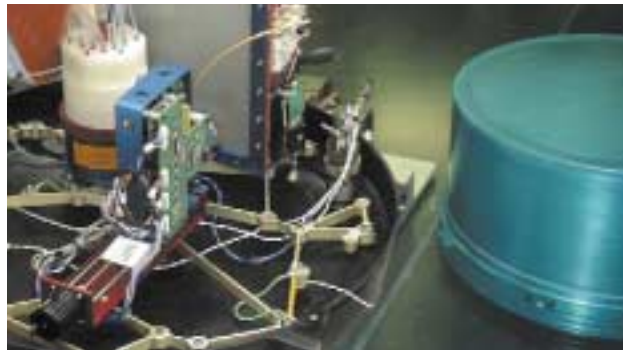
The only place that gravity is not the dominant force is in outer space, where the centrifugal force that keeps a spacecraft in orbit cancels out the Earth's strong magnetic gravitational pull.

Hasenstein's experiment was about the size of a microwave and weighed a little less than NASA's maximum allowance of 70 pounds. The chamber was kept dark so light would not be an influence. The reason for the unusual weight were sets of magnets that were the core of

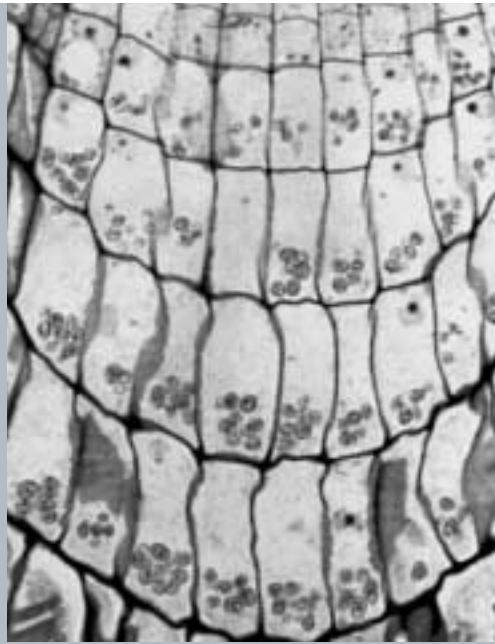
his experiment. In the absence of gravity, high gradient magnetic fields would act on the starch grains inside special cells but not affect their fluid contents.

Inside were sets of flax seed, chosen for its rapid germination and small size. Once in orbit, the seed were watered. Two sets of seeds were near high gradient magnetic fields; a third set was in a non-gradient magnetic field. Time-lapse photographs, taken by an infrared camera, captured growth of the seedlings' roots.

If the starch grains are involved in gravisensing then



*The Generic Containment Unit housed a part of the hardware used in Dr. Karl Hasenstein's experiment. The blue cover was seated onto the black base. The mounting board was initially a solid aluminum plate, but weight constraints led to the development of a web-like structure that provided the mounting points for the remainder of the hardware.*



TOP: The tip of (flax) roots is characterized by columella cells, columns of cells that contain starch-filled grains (dark dots). These particles sediment and are thought to function as gravity sensors. MIDDLE: The ability to respond to gravity is vital for emerging roots. Roots germinated on special seed cassettes show their sense of up and down by growing straight down (lower row) or curving immediately after emerging from the seed (top row). BOTTOM: When roots grow in (simulated) weightlessness, the roots grow straight and do not curve.

the roots would curve away from the magnetic gradient. If they didn't, and the starch grains were displaced inside the cells, other mechanisms would have to explain the gravisensing in plants.

Hasenstein's experiment fit nicely in NASA's Fundamental Space Biology program, which concentrates on basic biological processes. It sponsors research into the effects of space on the evolution, development and function of living organisms, according to the space agency.

Information that the biologist's experiment would have yielded might not have provided all the answers to scientists' questions about plants' response to gravity, but it would have provided an important building block for future research.

"Once you understand how plants sense an environment, you can accommodate them at a better level," Hasenstein said. So, researchers might someday be able to increase a plant's productivity while using fewer resources, for example. Or they could make sugar cane rise upright more quickly after it has been flattened by a hurricane.

Hasenstein is fascinated with another NASA discipline, life support biology, which refers to learning how to create a self-sustaining environment. "That means everything from food to cleansing the atmosphere to producing oxygen and recycling waste and other products," he said. Without the ability to create such an environment, humans will always be tethered to Earth.

Life support biology, he said, "is kind of a long-term, fairly visionary determination to solve these problems to create the next or newest frontier. It's exciting to think about the possibilities. You can really break out of the confinements that determine our daily lives. This is why it is fascinating to me. It takes place in your head; presently it's a fantasy. It's a very creative process."

Hasenstein described the thrill of discussing this subject with other people – such as astronauts – who "think along the same lines and are just as excited about it. It's really satisfying to see there is a little bit of vision for the future that goes far beyond what we typically view."

*continued on page 33*

“This cause of exploration and discovery is not an option we choose; it is a desire written in the human heart. We are that part of creation which seeks to understand all creation. We find the best among us, send them forth into unmapped darkness, and pray they will return. They go in peace for all mankind, and all mankind is in their debt.” PRESIDENT GEORGE W. BUSH

## ‘WE KNEW SOMETHING WA

**O**n the morning of Feb. 1, 2003, Dr. Karl Hasenstein was standing near the runway where Space Shuttle Columbia would land at Kennedy Space Center, Fla.

He was one of 80 elite scientists whose experiments had been in orbit aboard the Columbia for the previous 16 days. Researchers, NASA officials and the families of the seven shuttle astronauts were there to watch the shuttle landing. A large clock was the center of attention as it counted down the minutes until the spacecraft would touch Earth again.

The group’s mood was euphoric. “There was so much excitement going into this. The launch had been so beautiful and everything had gone so flawlessly, of course. There was no sign whatsoever that anything might have happened during the launch,” he recalled in an interview in mid-March.

Hasenstein knew that when Columbia landed, it would take about three or four hours for NASA crews to retrieve his experiment and turn it over to him. He and three colleagues would then work 36-40 hours straight, gathering important data. “We had rehearsed this twice in the past, so we knew what to get ready for. We had prepared the lab and we were ready.”

A precursor to his experiment aboard the Columbia, which was testing plants’ sensitivity and response to gravity, had flown on the Space Shuttle Atlantis in 2000.

“Typically, about two minutes before the landing happens, you hear two sonic booms. I heard it the last time

Columbia landed, so I knew what to expect.” But on the morning of Feb. 1, he said quietly, “it never came.”

When the countdown was over, without the audible signals, “we knew something wasn’t right, but we had no clue what had happened.”

Everything had seemed routine about 20 minutes earlier, when NASA officials had taken his group by bus to the runway. NASA makes sure a shuttle’s “de-orbit burn” is successful before transporting visitors to the site. “Otherwise, the astronauts would have to go another round before landing,” Hasenstein explained.



*This photo was taken at Kennedy Space Center during the first of several crew training sessions. From left, are: Michael Anderson, astronaut; David Brown, astronaut; Willie McCool, astronaut; David Cox, payload mission manager; April Broody, project engineer; Ilan Ramon, astronaut; Dr. Karl Hasenstein, UL Lafayette biology professor; Laurel Clark, astronaut; and Rick Husband, astronaut.*

“Everyone was so cheerful, getting the cameras ready, pointing them toward the north, where the shuttle was going to land. After maybe a minute overtime, a NASA official walked out and said, ‘It’s time for you to go back to your bus.’

“He was as somber as you can possibly be and everyone knew that something was not right, but we still had no clue. The only response that I remember is that the families were hugging each other. They knew as much or as little as we

did. Then, on the way back, we heard the news from NASA that it had experienced a ‘loss of contact’ 15 minutes earlier.” The professor paused for a moment before continuing. “It was just horrible, horrible.”

Hasenstein had gotten to know the astronauts when he taught them how to conduct his experiment, which was intended to test how plants sense and respond to gravity. “It was amazing how methodical, alert, intense and dedicated

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the astronauts were to everything they were asked to do," he recalled.

After watching the Columbia launch on Jan. 16, Hasenstein returned to Lafayette for a few days to work.

"The shuttle was passing over Lafayette every morning at 6:35. On two occasions, I went outside and saw it. It's a pretty conspicuous thing because it moves fast. So you see this thing moving in the sky and it's a strange thought to know that people are working up there and they are working on *your* stuff, among other things," he said, smiling. "It was special."

Hasenstein had been drawn to what he describes as the astronauts' "passion" for discovery. That passion enabled them to risk their lives for scientific research without regret. "The astronauts are so aware of this (risk)," he said, emphatically.

Hasenstein recounted a conversation with Columbia astronaut Mike Anderson, a mission specialist. Anderson mentioned that, as a test pilot, he had landed planes a couple of times at the New Iberia, La., airport.

"He told me, 'After all this is over and the dust has settled, I'll still be flying.' So I said, 'Man, can you come to Lafayette to visit?' 'Yes, I'll give you a call,' he said, and this was someone who meant what he said. So I was hoping that he would travel here. I would have tried to make his visit as special as possible."

President George W. Bush spoke of Anderson during a memorial held at NASA three days after the Space Shuttle Columbia accident. Anderson, the president said, was a role model who, when he spoke at schools, told children "whatever you want to be in life, you're training for it now."

"He also told his minister, 'If this thing doesn't come out right, don't worry about me, I'm just going higher.' " ■

*continued from page 31*

The biology professor's gravisensing experiment was a lesson in patience. It was approved by NASA in 1994 and 1995. It was scheduled to go in orbit in 1998, but a series of delays kept it grounded. A precursor went up on Space Shuttle Atlantis in 2000 to test the water delivery system. "That was quite successful. We learned a lot from it," Hasenstein said. So, he was optimistic that the experiment on Space Shuttle Columbia would be successful, too.

Could Hasenstein's experiment be sent into outer space on an unmanned space shuttle flight? Even if that were ever an option, the experiment wouldn't be the same without astronauts to conduct it, he replied.



*The germination of roots was observed in orbit and some frames were down-linked for monitoring the experiment's progress. Twenty-eight hours after the experiment began, roots emerged and, unrestrained by gravity, grew up and down.*

"Theoretically, we could have done this experiment by remote control, but we would have had to prepare a type of computer program that would have been so much more expensive and error prone." Also, an unrelated glitch, such as a change of temperature inside the shuttle, could render the experiment useless.

Hasenstein added that astronauts' ability to observe an experiment as it progresses is invaluable. They can intervene, if necessary, to solve problems that might otherwise ruin an experiment, for instance. Also, astronauts' recounting of events and impressions is important.

"It's like learning to walk. You cannot make a robot do this for you. You have to do it on your own," he said.

So Hasenstein will continue to analyze the small amount of data that his experiment on Space Shuttle Columbia produced. And he'll make sure he's prepared, in case he ever gets another chance. ■