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WEEKLY NEWS AND CULTURE



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# PICKING UP THE PIECES

A black and white photograph of a hand held palm up, holding several pieces of mechanical debris, including gears and metal fragments. In the background, the Space Shuttle Columbia is visible in space, with stars and a bright light source behind it. The shuttle's name 'Columbia' is partially visible on its side.

Searching for  
the Space Shuttle  
Columbia.

BY BRENDAN L. SMITH

For many Americans, the explosion of the Space Shuttle Columbia was just a depressing jolt during the rush to war with Iraq. In our post-9.11 world, the deaths of seven astronauts, including Israel's first astronaut, raised paranoid fears that terrorism had reached the fringes of space.

But the Feb. 1 explosion of the Columbia in a fiery trail above New Mexico, Texas and Louisiana—and the repercussions it will have for America's space program—is even more unsettling because it cannot be blamed on something as simple as a terrorist bomb. The largest accident scene inves-

tigation in history bears witness to some basic, and faulty, decisions that NASA officials made about safety, and highlights an institutional culture that assumed a shuttle mission couldn't possibly go that horribly wrong...again.

My role in the Columbia investigation was to help search for the pieces from the shuttle, both human and machine, scattered in a four-mile-wide swath that stretched hundreds of miles across central and eastern Texas.

For myself and several other rookies on a Carson National Forest firefighting crew from Peñasco, the shuttle recovery mission in Hemphill, Texas, was our first assignment as wildland firefighters. I had spent five years reporting on wildfires

as a journalist and two years training to become a wildland firefighter, but the closest I got to any open flame during my first two-week assignment was a cigarette lighter to spark a smoke. Yet in some ways, the mission was much more important than fighting fire. Thousands of wildland firefighters from every state in America helped search for shuttle debris, sleeping in tents or on cots in incident-command posts spread across eastern Texas.

It made sense for NASA and the Federal Emergency Management Agency to use wildland firefighters for the grunt work in the shuttle debris search. The US Forest Service and US Bureau of Land Management already had

thousands of trained wildland firefighters who had passed an annual endurance test by carrying a 45-pound pack three miles within 45 minutes. With the search extending from February through April, the fire season had not started yet, so fire crews were available to help. Other New Mexico crews at the Hemphill camp during our two-week stay included Mescalero Apache, Jicarilla Apache and Zuni crews.

By the end of three months of searching, more than 84,000 pieces of shuttle debris were found, weighing almost 85,000 pounds, or



COURTESY NASA

roughly 38 percent of the Columbia. NASA officials initially expected to find no more than 20 percent of the shuttle following the fiery explosion. All of the recovered pieces were shipped to a 50,000-square-foot hangar at Kennedy Space Center in Cape Canaveral, Fla., where NASA workers painstakingly arranged them in their proper order inside an outline of the Columbia, an enormous jigsaw puzzle where more than half the pieces are still missing.

### **The search for shuttle debris was not a pleasant hike through the woods.**

Like wildland firefighting, the grid searches through overgrown forests and marshy swamps near the Louisiana border were physically challenging and potentially dangerous. During those two weeks, two men in the 20-person Peñasco 3 crew were sent home with debilitating injuries, four others succumbed to a bronchitis epidemic, and others suffered sprained ankles, poison ivy rashes, dehydration and heat exhaustion.

Two people were killed and three others seriously injured when a Bell 407 helicopter searching for shuttle debris crashed March 27 in the Angelina National Forest in eastern Texas. The Columbia had exploded almost two months earlier, but she was still claiming victims.

East of Albuquerque, firefighter crews searched approximately 1,000 acres around 7,767-foot Cedro Peak in the Cibola National Forest and recovered some small burned pieces which were sent to NASA for analysis. A telescope at Kirtland Air Force Base that took pictures of the Columbia as it streaked past Albuquerque on Feb. 1 showed a misshapen left wing with a gray trail, indicating the shuttle already may have begun to break apart.

On April 9, the Peñasco 3 crew left for eastern Texas, traveling by bus and plane to an incident-command post set up in the Sabine County rodeo grounds and livestock yard three miles outside Hemphill, population 1,106. We slept in tents in the rodeo grounds, which was surrounded by trailers used by NASA, Forest

**The Columbia crew included (from left to right) mission specialist David Brown, Commander Rick D. Husband, mission specialists Laurel Blair Salton Clark, Kalpana Chawla and Michael P. Anderson, pilot William C. McCool and payload specialist Ilan Ramon, Israel's first astronaut flying his first shuttle mission.**

## PICKING UP THE PIECES

Service and Environmental Protection Agency support staff. The base camp also had a mess tent, a medical trailer, two shower trailers, a portable laundry unit and a small building where shuttle debris was stored and tagged before being shipped to Kennedy Space Center.

Hemphill is located about 10 miles west of the Sabine River, which marks the Louisiana border, so the countryside was lush, green and overgrown, alternating between thorn-filled thickets in forests of scrub pine and submerged oaks and snakes rising from black-water bayous.

We only received about an hour of training on the grid searches, which involved stretching 18 members of our crew in a 180-foot line, with 10 feet between each person. Then each person carved his own path through the woods, searching the ground and tree canopy for shuttle debris while trying to keep the line straight and evenly spaced. It doesn't sound incredibly difficult, but it became more challenging in the middle of thickets so dense I couldn't see the person 10 feet away from me. We were constantly shouting orders down the line to bump right, veer left or hold for a slower part of the line stuck in thick brush.

At times, it felt as if the forest, or Mother Nature, was not a benign influence but an encompassing enemy ready to scratch, poke, tear or trip us at every step. Our crew wore fire-resistant wildland firefighting pants and shirts, helmets, plastic safety glasses, leather gloves and boots, heavy denim arm guards and thick canvas chaps. We weren't allowed to use machetes, so I armed myself with a heavy stick and whacked or pushed through walls of

underbrush as thorns snapped off in my protective clothing. In the hot, humid weather, I had to remind myself to keep drinking water to prevent dehydration and heat exhaustion.

During almost two weeks of 12-hour days in the bush, our crew found more than a dozen pieces of the shuttle, including one circuit board that was considered a significant find. Most of the rest were small pieces of metal or fabric collected in plastic bags by NASA and EPA workers who followed behind us.

One bone that couldn't be identified immediately as animal also was collected. Most of the astronauts' remains already had been found, but some bones were still missing. We heard NASA still wanted to find several ribs and part of a spine. It spooked me a little to think I might stumble upon human remains, but searchers already had found more human bones in the woods than just those of the astronauts. NASA shuttle technician David Bakehorn, who worked in the field with our crew, said law-enforcement officials had opened three new homicide investigations because some recovered body parts did not match any of the astronauts.

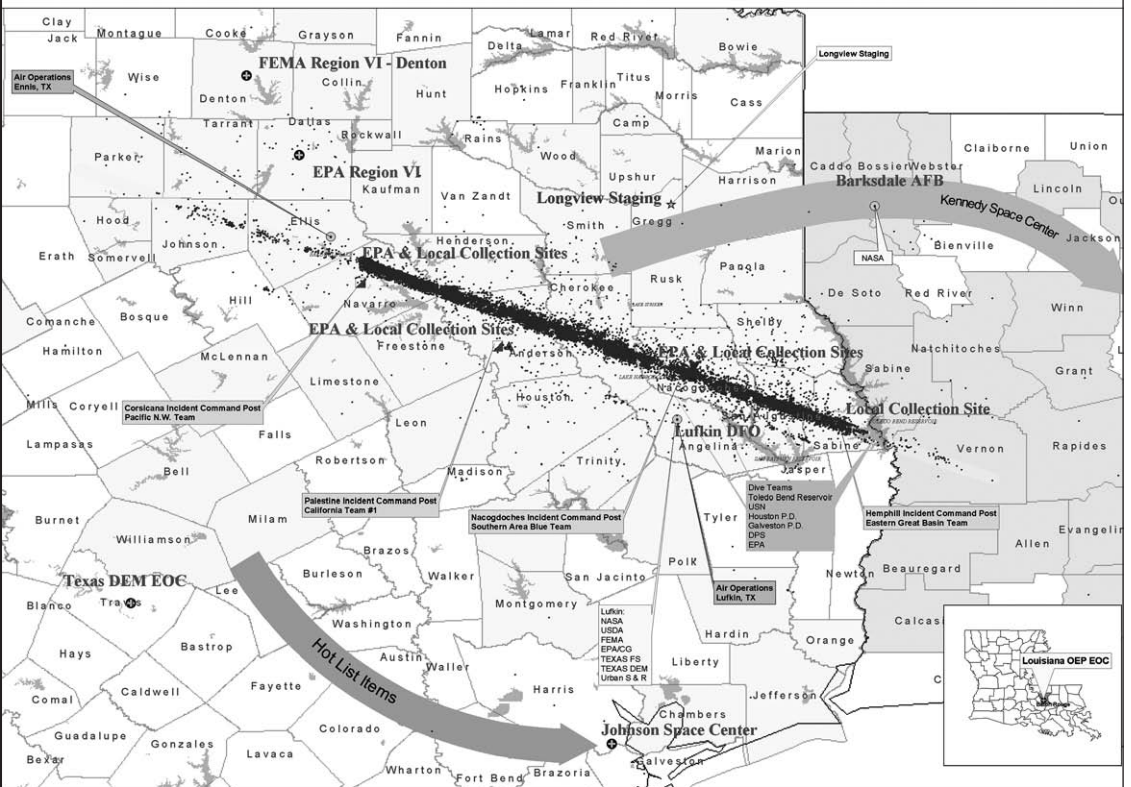
**The Peñasco 3 crew was a real mix of characters, ranging from teenagers to middle-aged men, most of whom had grown up in or near Peñasco, an isolated village on the high road to Taos, bordered by the Carson National Forest and Sangre de Cristo Mountains.**

Our crew included 16 Hispanic men, three Anglo men and one Anglo woman. Some crew members had never been to Texas before or flown in an airplane. In

This map shows the huge area over which debris from the Columbia explosion was spread and the collection points for anything NASA recovered.

### Columbia Shuttle Recovery Operations

(April 1, 2003)



#### Map Key

- |                          |                              |
|--------------------------|------------------------------|
| <b>Facility Function</b> | <b>Material Search Area</b>  |
| ▲ Collection             | ▭ Designated Counties for TX |
| ○ Field Facility         | ▭ Designated Parishes for LA |
| ⊙ Headquarters           | ▭ Relieved Debris Sites      |





economically depressed Taos County, working as a wildland firefighter is still one of the best-paying jobs available and a seasonal job relied on by men who also work as construction workers, wood haulers or ski instructors.

Crew member Raphael “Ralph” Aguilar—who lost his three upper front teeth when his jaw hit another man’s brass knuckles in



David Bakehorn (center) briefs the crew.

Questa—had a habit of telling crazy stories that later proved to be true. Aguilar already had completed a prior two-week shuttle recovery assignment, and he told me a dead infant or fetus was found in a portable toilet at the Corsicana command post. I thought this was another crazy story, but The Associated Press confirmed that Corsicana police began questioning about 300 women in the camp after the body was found in early March by a worker cleaning the toilets. The body appeared to be a third-trimester female fetus, but an autopsy was inconclusive about whether the baby was born alive or dead.

Our crew was like one big dysfunctional family. We yelled at each other in the woods each day but all was forgiven in camp where we laughed and joked in the evening. Mario “Mongo” Romero, tall with a gap-toothed smile and large eyes swimming behind thick glasses, had traveled to 25 states over the past nine years working on wildfires. At his very first assignment at the Grand Canyon, he got the nickname Mongo, after the huge, slow-witted character in *Blazing Saddles* who gets blown up with a candy-gram delivered by the black sheriff.

We had both “Big Carlos” and “Little Carlos” on our crew. Little Carlos was a small, quiet guy, while Big Carlos constantly shouted not only orders but comments and criticisms during the grid searches. Much of the profanity from the crew often was directed at Big Carlos or Mongo for yelling too much during our treks through the woods.

Elee Duran, a young guy in my five-person squad, also talked constantly, but he didn’t shout. He lectured, ranging far afield on any topic imaginable. He always was ready with a scientific explanation, especially if you hadn’t asked for one. Duran, who was called “Encyclopedia” or “The Professor,” was right only about half the time, but he presented all his facts and not-so facts with the same unwavering confidence and enthusiasm.

Aguilar was sent home early after he twisted his foot in a stump hole and couldn’t walk without crutches. Back spasms hit Chuck, a short,

On April 28, a Russian Soyuz spacecraft docked at the International Space Station, carrying one American astronaut and one Russian cosmonaut to replace a three-person crew aboard since November. The Columbia investigation has delayed many experiments and construction on the half-finished space station.

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bearded biker who liked to sing karaoke songs, and he went home as well. All four Anglo crew members, including myself, contracted bronchitis, which spread like wildfire through the tight quarters in camp. We each rested for one or two days before returning to work. I spent the day before I went to the doctor stumbling through the woods in a cold sweat, dizzy and aching while my voice faded to a gravelly whisper from shouting orders down the line.

Benny Lujan, our crew boss, was a hardass during the grid searches, but he joked with the guys after hours and smoked a cigar in the van. Everyone listened to him because he knew what he was doing. At a safety briefing one morning, Lujan told us “to think about what you’re doing out here.”

“This is nothing compared to fighting fire,” he said. “If you’re thinking about firefighting as a career and you can’t handle this, you need to think about getting another career.”

On April 16, NASA administrator Sean O’Keefe visited our camp to speak to hundreds of firefighters crowded into the Veterans of Foreign Wars hall next to the rodeo grounds where we were camping.

“This is a real, real tough situation we never would have imagined,” O’Keefe said. “This is our honor to have you all engaged in this. All of the work over these last 10 weeks has really yielded results.”

“So whenever you’re standing out there thinking, ‘What am I doing this for?’—it has a real purpose,” he said. “We’re going to get there. We’re going to figure out what happened.”

**Before the** Columbia began its reentry on Feb. 1, NASA officials already knew something could go wrong. But NASA concluded there was no serious risk to the Columbia or its crew, even though some engineers already had predicted catastrophic results in a flurry of e-mails following an incident during takeoff on Jan. 16. Tracking cameras showed a piece of hardened insulation foam

break loose from the external fuel tank and strike the leading edge of the shuttle’s left wing at an estimated speed of more than 475 mph. The wings are covered with heat-resistant thermal panels made from a reinforced carbon-carbon composite, or RCC. The panels are then connected with flexible T-seals.

After a 16-day mission of microgravity experiments, the Columbia fired its braking rockets and maneuvered for reentry. Ground controllers noticed the first minor signs of trouble, the failure of four temperature gauges for hydraulic systems on the left side of the shuttle. Then, other sensors signaled that tire temperature and pressure kept rising in the shuttle’s left-side landing gear, before those sensors shut down as well. Traveling at 18 times the speed of sound nearly 40 miles above Earth, the Columbia exploded about one minute later. The entire crew of seven astronauts was killed instantly, before they knew anything was seriously wrong.

The independent Columbia Accident Investigation Board has not yet released its final report, but its leading theory for the shuttle explosion is the damage caused to the shuttle’s left wing by the foam impact during takeoff.

The Southwest Research Institute in San Antonio, Texas, has conducted foam impact tests to simulate damage to the Columbia. On June 6, a 1.7-pound piece of insulation foam was fired at 523 mph from a pressurized nitrogen gun at RCC panels connected with T-seals in a model of the Columbia’s left wing. The foam hit the wing and “created a three-inch crack extending from a visible three-quarter-inch damage area on the outside of the RCC (panel) to the RCC rib inside the wing,” the board reported. The impact also cracked a T-seal, shifted an RCC panel and chipped a carrier panel on the wing’s upper side.

Similar damage to the Columbia could have breached the shuttle’s protective thermal shell and allowed plasma to enter the spacecraft and cause it to explode. Plasma are gases, superheated up to 3,000 degrees, which surround space shuttles during reentry. The extreme temperatures recorded in Columbia’s left-side landing gear indicate plasma must have penetrated the left wheel well and possibly other areas on the left wing, the board has reported.

Insulation foam breaking loose from the external tank, and even striking the shuttle in flight, has happened many times before, ever since the very first shuttle mission in 1981 by the Columbia, said board member Air Force Maj. Gen. Kenneth Hess at a May 28 press briefing in Houston.

However, NASA technicians viewed foam loss, which sometimes required repair to damaged thermal tiles “as being a maintenance issue as opposed to a safety-of-flight issue,” Hess said.

“As a consequence, their building body of experience is that the shuttle always comes back, and we always do maintenance on it,” Hess said. “So over time, it quits being a focus of something that might be dangerous.”

At the same press briefing, board chairman retired Navy Admiral Harold Gehman Jr. said, “a considerable part of our report is going to be addressing this underlying and hard-to-pin-down attitude or climate” at NASA, which could have downplayed safety issues or discouraged employees from raising safety concerns. The report is “intended

The only survivors of the shuttle explosion were hundreds of worms found inside six sealed canisters that had been part of the Columbia’s final experiments. The canister were among debris located in Texas.



Grid searches involved stretching 18 firefighters along a 180-foot line.

to be the baseline for a very serious public policy debate on the future of the safety of the shuttle program and its role in the manned space-flight program," Gehman said.

The 13-member board held its final public hearing last month in Washington, DC, before adjourning to prepare its report, which is expected later this month. At the hearing, the board disclosed another safety flaw not only on Columbia but the three remaining space shuttles. A bolt catcher, which catches two-foot-long bolts exploded in half when the shuttle separates from its rocket boosters, did not meet design specifications and could have allowed a 40-pound bolt piece to fly loose, possibly endangering the shuttle.

Radar imagery of the Columbia taken moments after the rocket boosters separated showed an object, which could be a bolt piece, hurtling away from the shuttle. While the bolt catchers must be replaced before the next shuttle flight, the board did not conclude that a bolt piece actually struck the Columbia. The board has not changed its working theory that the Columbia exploded because of foam impact damage caused during takeoff.

In addition to addressing safety concerns, the board is expected to recommend that NASA develop plans for repairing the space shuttle while in orbit and speed up design plans for the shuttle's successor.

Some NASA officials have said they want to restart the shuttle program as early as December, in part because of the need to support the half-finished International Space Station. At a press briefing last week in Washington, DC, Gehman said NASA should be able to complete any recommendations expected from the Columbia board so that the shuttle program should "be able to return to flight in six to nine months."

That would be a remarkably fast turnaround, considering that the shuttle program was grounded for almost three years after the explosion of the Challenger during takeoff on Jan. 28, 1986. The deaths of seven astronauts aboard the Challenger was the first loss of life in America's space program since three astronauts died in the Apollo 1 launchpad fire in 1967.

The Challenger explosion was made even more terrible and poignant by the death of 37-year-old teacher Christa McAuliffe, who would have been the first civilian in space. Millions of schoolchildren across America, including McAuliffe's own students at Concord High School in Concord, NH, watched the Challenger launch on live television, cheering until a faulty O-ring on the solid fuel booster caused the shuttle to explode only 73 seconds after liftoff.

I still remember watching that horrific footage as a 14-year-old high-school freshman in North Carolina. One second there was the shuttle roaring toward

space and the next second it was gone, swallowed by a twisting cloud of white smoke with flaming pieces of debris hurtling down toward the Atlantic Ocean. It was the first time I saw people die on live television, and teachers struggled to explain what had happened to their dismayed students.

On April 22, we spent our last day in the bush trudging through the rain-soaked forest, as lightning flashed and sizzled across the sky. Later that night, Dave Bakehorn, the NASA shuttle technician who worked with our crew, showed up at the Hemphill camp with 10 pizzas, sodas, ice-cream sandwiches and a couple of cartons of Marlboros—a going-away meal he bought with his own money for the Peñasco 3 crew.

Bakehorn, a biker with a bushy beard and ponytail, worked at Kennedy Space Center, but he had volunteered to help with the shuttle debris search.

"I enjoyed working with you guys," Bakehorn said. "There's a lot of respect, a lot of love there."

"You guys did all the hard work. I just followed you around," he said. "I'll never think of a (wild)fire the same way again."

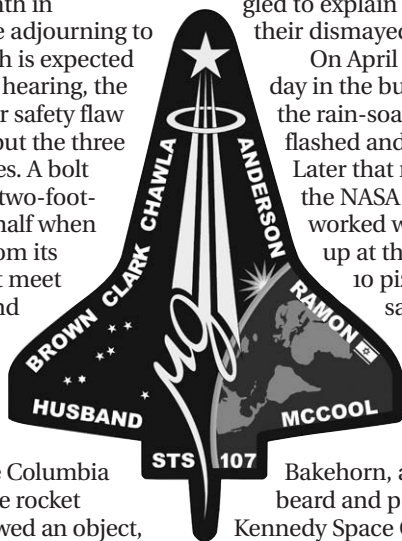
Standing in shorts and a sleeveless T-shirt, Bakehorn posed for pictures with our crew after we finished our big meal together. We gave him some souvenirs, including a sweatshirt, a ball cap with the Zuni sun symbol and an axe with a leather sheath that Benny had used in the bush.

"God bless you guys," Bakehorn said. "You've done a wonderful thing for your country."

**The loss of the Columbia already is a distant memory for many Americans.** Maybe the deaths of seven astronauts doesn't seem like big news after thousands died on 9.11 and dozens keep dying in bombings in Israel. But in a cynical time desperately short of heroes, it would be a shame to forget the five men and two women who died aboard the Columbia. They were doing a dangerous and difficult job, not for fame or fortune, but because they wanted to be astronauts. It's a dream we all had as kids while gazing at the stars, but only a few grew up and got to look down on Earth from the infinite void of space.

If anyone has reason to be bitter toward NASA about the Columbia explosion, it is the wives, husbands and children of the Columbia crew. But in an open letter just six days after the disaster, the families looked past their grief and said they "cannot stress enough how blessed and honored we feel to be counted as members of the NASA family."

"We proudly support the noble goals and objectives of NASA, and we will continue to support NASA in its finest and its darkest hours," the families wrote. "It is our deepest hope that you also will continue to share in our belief and support of NASA's dreams." **SFR**



Named for famous sailing ships, the three remaining space shuttles in NASA's fleet are the Atlantis, Discovery and Endeavour. Named after a sailing ship based in Boston that explored the Columbia River in 1792, the Columbia was America's first space shuttle, proving with its first mission 22 years ago that a winged, reusable spaceship could orbit the Earth and return unscathed.

On June 10, the US Interior Department named a 13,980-foot peak in Colorado's Sangre de Cristo Mountains the Columbia Point to honor the Columbia and her crew. The peak is located near a northwest peak of similar height named Challenger Point.

Anyone interested in contributing to funds set up to help the families of the Columbia crew may do so by visiting [www.columbia-shuttelfund.com](http://www.columbia-shuttelfund.com).