news SCAN

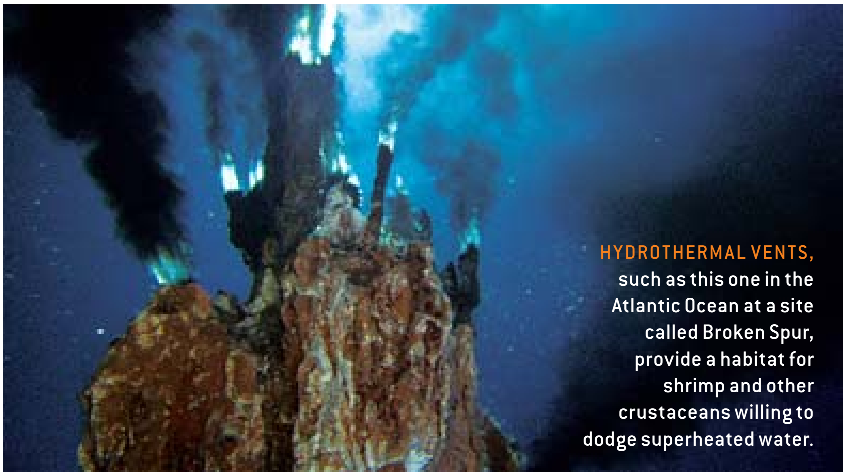
OCEANS

Into the Abyss

SCIENCE MEETS ENTERTAINMENT AT THE BOTTOM OF THE SEA BY CHRISTINA REED

"Mission Control. Mission Control. Mir 1—Beginning our descent. Over."
"Roger that, Mir 1."

The date is August 7, 2003, and I am inside the Russian *Mir 1* submersible in the Atlantic Ocean. With me are cameraman Vince Pace and pilot Anatoly Sagalevitch, and our bodies rapidly heat up the two-meter-wide sphere to 30 degrees Celsius. Fortunately, the sub quickly cools in the 30 minutes it takes to reach our destination: the "Lost City of Atlantis," where geologic formations resemble ancient ruins.



HYDROTHERMAL VENTS, such as this one in the Atlantic Ocean at a site called Broken Spur, provide a habitat for shrimp and other crustaceans willing to dodge superheated water.

Lost City was one of 10 hydrothermal vent sites that became filming locations for James Cameron's 3-D IMAX movie *Aliens of the Deep,* released January 28. The project involved two month-long expeditions, two oceans, two ships, two Russian *Mir* submersibles capable of 6,000-meter depths, two acrylic-domed *Deep Rover* submersibles capable of 1,000-meter depths, 14 scientists (a.k.a. "the talent"), 40 dives, and a slew of crew members for both ships and the production itself.

As the science coordinator, I worked as the liaison between the production crew and the scientists. For every researcher we brought out to sea, a team of scientists waited back on shore for samples, pictures and data. In a way, this was similar to other expeditions I have worked on, both as an oceanographer and as a journalist. Only this time, the ship had been converted into a floating movie set, complete with lights, camera, sound and action.

Integrating production needs with scientific ones provided a challenging dynamic. Unlike research expeditions, where investigators have upward of a year to prepare, with the film expedition I was calling scientists in June to see if they could join us in July. Over time, the scientific agenda grew to match the production agenda. I could tell because the researchers had almost as much equipment as the production crew itself.

The National Science Foundation provided Maya Tolstoy of the Lamont-Doherty Earth Observatory with 12 ocean-bottom seismometers that were heavy enough to require a forklift to move. Dijanna Figueroa, a graduate student at the University of California at Santa Barbara, brought her adviser, Jim Childress, an assistant, and the pressure housing, computers and two-meter-tall gas canisters needed to establish a biological lab at sea. They want to understand the metabolic processes of organisms around vents. Space scientists came along, too: Pamela ("Pan") Conrad and Lonne Lane of the Jet Propulsion Laboratory in Pasadena, Calif., want to perfect instruments that can detect organic chemicals and so potentially identify alien life on other worlds. They had a chance to test them on the mysterious creatures of the deep.

The life in these extreme environments is thriving because of the geology. In *Mir 1,* we traverse the bottom until we approach a cliff's edge and find a fragile outgrowth of yellowish-white carbonate minerals: examples of hydrothermal venting on 1.5-million-year-old oceanic crust. Unlike hydrothermal vents at spreading ridges, where the seawater spews to the surface heated by a magma chamber below the crust, Lost City seeps its vent fluid because of a chemical reaction occurring between the mineral olivine in the mantle rock and the seawater.

As the first sub in the water, we pick a rendezvous site and relay our *x, y* coordinates based on acoustic signals from transponders positioned earlier on the seafloor—no

WHEN FUN PAYS FOR SCIENCE

As the production of James Cameron's *Aliens of the Deep* unfolded, a symbiosis between the scientists and those in the entertainment industry developed. For the Russian scientists onboard the science vessel *Keldysh*, such a relationship is now standard bread-and-butter financial planning for their ship time. Besides procuring the *Keldysh*'s submersibles for Cameron's other productions—*Titanic, Ghosts of the Abyss* and *Expedition: Bismarck*—the Russian researchers allow adventure-travel firms Space Adventures and Deep Ocean Expeditions to book tourist dives to the bottom of the sea.

GPS down here. One by one, the other subs appear—first *Mir 2* and then *Deep Rover 1* and 2. With their acrylic domes, the rovers look like aquariums for people.

All too quickly, five hours go by—about when our 16-volt battery dies: "*Deep Rover 2. Mir 1. Jim, we have to leave. Our 16-volt is out. Call Mission Control. Let them know we're ascending. Over.*"

"*Roger that. See you at the surface.*"

Christina Reed, now back in Washington, D.C., was the science coordinator for Aliens of the Deep.

COSMOLOGY

String Revival

ARE COSMIC STRINGS BEHIND UNUSUAL LENSING EFFECTS? BY GOVERT SCHILLING

Like haute couture, cosmology has its own fads, fashions and fallacies. Gone are the heydays of galaxy surveys and quasar discoveries; now searches for the universe's first stars and for the nature of dark energy are all the rage. But like miniskirts and bell-bottoms, some castoffs experience a resurgence. In particular, cosmic strings, which fell out of favor in the late 1990s, are making a comeback thanks to observations that may have actually detected them.

Cosmic strings are hypothetical one-dimensional defects in the fabric of spacetime. Cosmologists once thought these kinky concoctions, weighing as much as one Earth mass per meter, could have caused galaxy clusters to clump. But recent measurements of the cosmic microwave background radiation, the remnant glow of the big bang, convincingly ruled out this scenario. Cosmic strings became old-fashioned almost overnight.

A U.S.-Ukrainian team of astronomers led by Rudolph E. Schild of the Harvard-Smithsonian Center for Astrophysics now claims that the mysterious behavior of a double quasar near the Big Dipper can best be explained by an intervening loop of cosmic string. The image of the quasar is being split in two by the gravity of a massive galaxy in the line of sight. Light from image B takes longer to reach Earth than that from image A, so brightness variations in B lag 417 days behind the same fluctuations in A.

In the mid-1990s, however, the two images winked synchronously—the brightnesses of both rose and fell together several times over a year. In the August 2004 *Astronomy and Astrophysics,* Schild and his colleagues show that all possible explanations for this behavior fail, except for gravitational lensing by a small loop of cosmic string close to our own Milky Way galaxy. The moving cosmic string would have acted as an additional gravitational lens, affecting both quasar images simultaneously. "It is difficult to propose a less exotic model," they conclude.

Meanwhile a Russian-Italian team found a much stronger cosmic string candidate in the constellation Corvus: a galaxy split into two uncannily similar and completely undistorted images. A normal gravitational lens produces images with different brightnesses and shapes. Intriguingly, many other gravitational lens candidates extend across the surrounding area, as if a piece of cosmic string is stretched out in the foreground. "The more we work on it, the more we think we've found a genuine cosmic string," says team member Giuseppe Longo of Federico II University in Naples.

Britain's Astronomer Royal Martin J. Rees of the University of Cambridge warns that "extraordinary claims demand extraordinary evidence, and we certainly don't yet have this from the current observations." That may change soon. Longo and his colleagues have applied for observing time on large ground telescopes and on the Hubble Space Telescope to study their mystery object in Corvus in much more detail. "If we find a very sharp edge in the image right between the two galaxies," Longo remarks, "that would constitute definitive proof."

Govert Schilling writes about astronomy from Amersfoort, the Netherlands.

COSMIC STRINGS FROM SUPERSTRINGS

Cosmic strings are no longer needed to explain the large-scale structure of the universe. But "this is certainly not to say they don't exist," says Thomas W. B. Kibble of Imperial College London, who founded cosmic string theory in 1976. In fact, recent versions of superstring theory, which describes subatomic particles as vibrating loops of string and is the leading candidate for a physical theory of everything, strongly suggest (if not demand) the existence of cosmic strings, according to Kibble. Though not fully convinced by the evidence gathered so far, he says, "I think there's quite a serious chance that cosmic strings are around and will turn up someday."