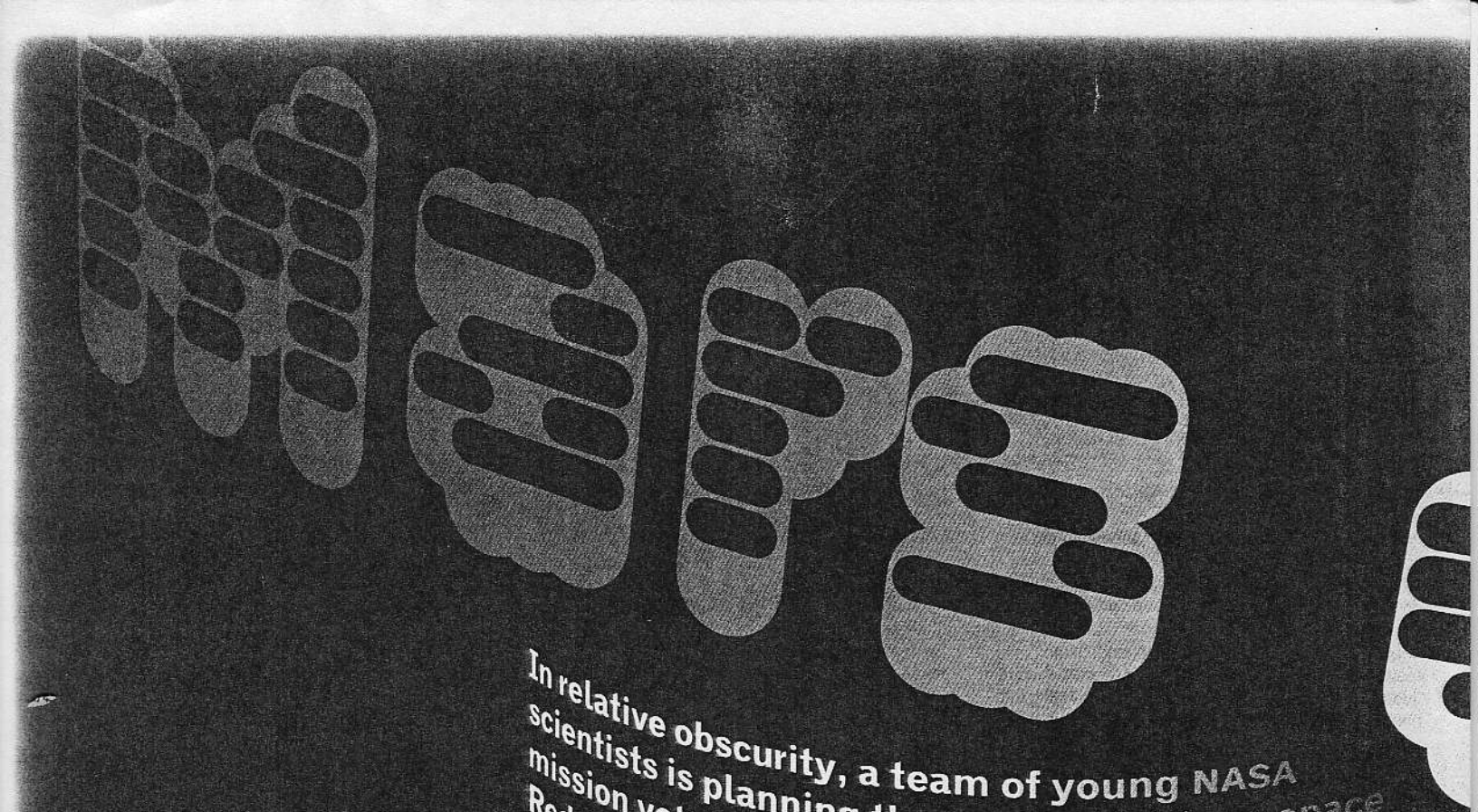


# Mars or Bust

**In relative obscurity, a team of young NASA scientists is planning the most ambitious space mission yet. But before they put Man on the Red Planet, they'll have to reinvent the astronaut first. By DAVID S. BENNAHUM**

"Have you seen the Mir video yet?" Constance Adams asks. I shake my head no.

"You've got to get it. Before you leave, you really have to."

Adams is one of a handful of "space architects" at NASA. She's part of a very small team of young scientists plotting the return of grand space exploration. They're easy to identify at Houston's Johnson Space Center, since most of them wear little white buttons pinned to their shirts reading, in big red letters, MARS OR BUST! Adams's job is to think about the psychological factors of sending six men and women on a three-year trip to the Red Planet, which NASA wants to do by 2014.

Behind her, on the other side of the parking lot, across a hundred yards of cars and asphalt, a Saturn V rocket lies on its side, broken up into five pieces. The once-awesome machine, built in the early 1970s to take men to the moon, now serves as a grand lawn ornament for the Space Center—it's the greatest garden tchotchke in the world.

Adams gets into her car, a BMW Z3 convertible—the kind that James Bond drove in *GoldenEye*—and takes down the top.

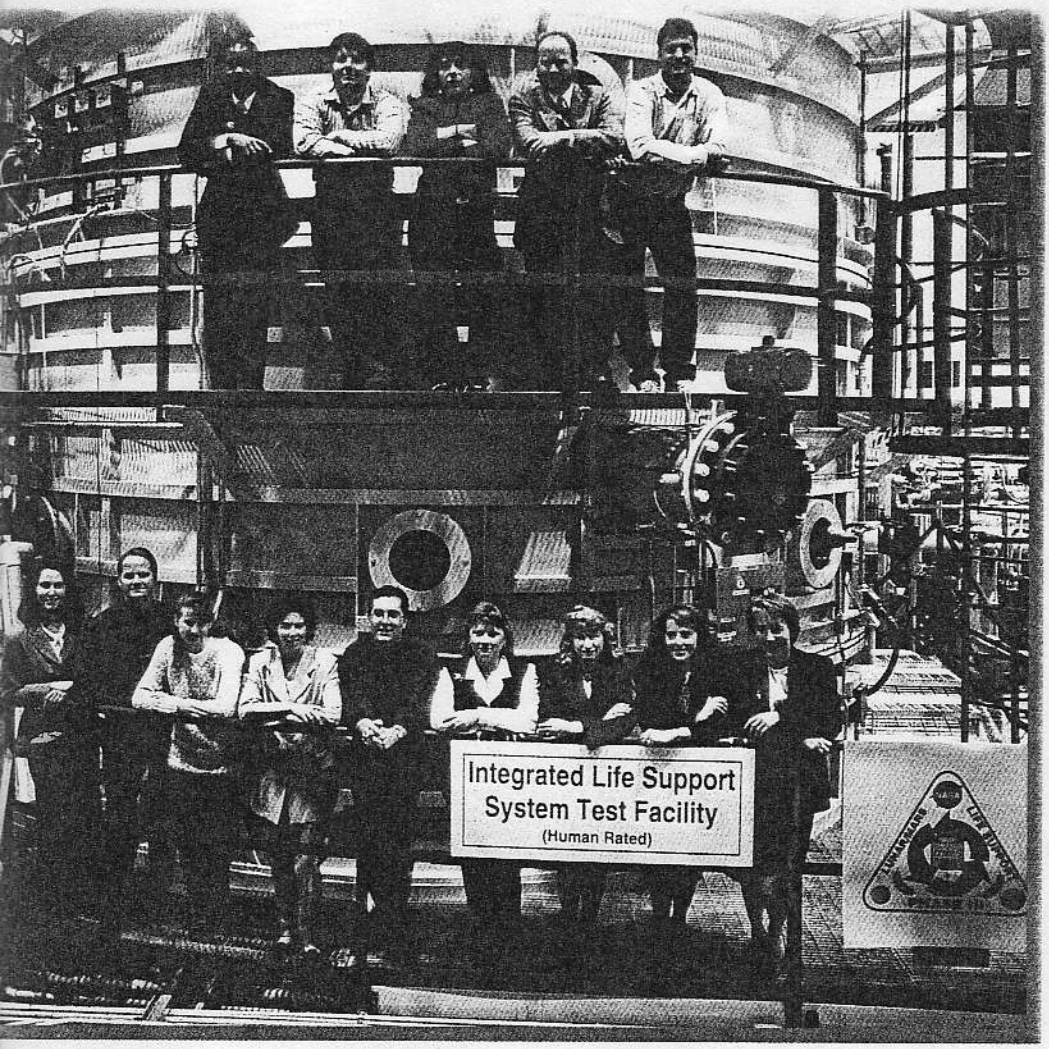
"Fuck, it's hot," she says, as a great bubble of super-heated Texan air wafts out. The Saturn V shimmers through the heat, the closest it now comes to moving.

"If you want to know what we have to deal with," she says, flipping the ignition, "watch that tape."

Last spring, the space shuttle came to Mir and picked up Jerry Linenger. The American astronaut had spent 131 days in the Russian space station, battling fires, low oxygen, and the loss of his quarters in the Spektr module. Before Linenger boarded the Space Shuttle, mission control urged him to make a video. They wanted to see the interiors. Linenger, acting as host, produced an impromptu tour, in the style of Martha Stewart, taking mission control on a live walk-through. It's not every day you see an astronaut floating through a space station, describing how it's decorated.

Linenger, bobbing about, looking fit and healthy in tan pants and a white polo shirt, praises a Russian table covered in Velcro, because objects stick nicely to its surface. Hanging on the wall, there is a watercolor of a boy fishing; Linenger says it's one of his favorite things in the station. He floats by a tiny oven, which abuts the exercise treadmill, an obviously unpleasant proximity between food and sweat. He shows us the toilet and shower. He points out little spherical globules of water, from condensation on a ventilation hose, that are impossible to clean up. The silver balls are mesmerizing as they gracefully glide through the air. Linenger stops in front of his sleep area, which is in a corner, wedged against the wall. Once a day, he straps into a sleeping bag and dozes there, rarely sleeping more than five hours. Linenger stops by a tiny porthole, a circle of plastic that gives us a glimpse of the emptiness outside. He takes us into the Mir's "attic" where all the space vehicle's trash is stored in great heaps of plastic bags. Throughout, the place looks like some magnificent intestine, grown to gargantuan size, people squirming and floating about the curved, ridged walls. It's unquestionably a claustrophobic and cramped place to be. And that's why the tape is so popular. It gives a visceral understanding of how, for most of us, being up there would be horrible enough to bring on anxiety at best, madness at worst.

Most of us can't stand being in a car with another person for more than six hours. The proposed Mars crew of four to eight will have to live together in a space the size of a one-bedroom apartment, traveling for six months across some of the most boring vistas in the universe (millions and millions of miles of black space, little stars, and the occasional micrometeor). When they get to Mars, they'll move into another tiny habitat already on the planet's surface, sent ahead of them. They won't get much of a view here either. They'll have to bury their home underground, to insulate themselves from radiation on the Martian surface. It will be a basement apartment. Four hundred




*The ALSTF team outside the Can, where astronauts are testing the effects of prolonged isolation.*

days later, if all goes well, they'll get back in their ship, and spend six months returning home. During those three years away from Earth, they won't be able to relax with a drink or a cigarette, and sex, while possible, will be fraught with the danger of jealousy and interpersonal tension (see page 92). If they get into a fight, there'll be nowhere to go.

Understanding what happens to people when they live in space for a long time is not something NASA knows much about. NASA is a short-mission specialty shop whose popular image comes from can-do engineering narratives like Apollo 13, where three astronauts on a quick trip through space, running low on oxygen, their ship damaged from an explosion, gamely repair the vessel with a fantastically ingenious bricolage of pens and metal wire and bits of plastic stuck together just right. Much of that ethic persists. The space shuttle has never flown for more than 17 days at a time.

No one knows whether NASA can make the transition to long-duration space travel. But starting in 2000 it will try, housing people in an experimental pod called the Advanced Life Support Test Facility (ALSTF) to test what might happen if they were to live for months and years off the Earth. Constance Adams will design the interiors. With living quarters about the size of a yacht, and housed at the Space Center, the ALSTF will be home to crews of four people for 120 days in 2000, 240 in 2002, and 425 in 2003. They will be sealed off from the outside world, behind steel walls, pretending to be on another planet. There will be no more than one small window, and no opportunity to go outside. For them to stay there for more than a year, without going for the escape hatch and running off onto the green lawns that are just a minute away, the interiors will have to provide much of the stimulation they'll be missing outside.

The ALSTF will test the idea that a crew can live in symbiosis with its habitat. Like Biosphere 2, the ill-fated experiment that tried to re-create a miniature Earth within a building, the ALSTF will use nature, in the form of wheat plants and algae, to produce food and clean air for the crew. But where Biosphere was grand in scope (and a bit kitschy), attempting to mimic entire biomes, such as forests and oceans, NASA is tightly focused on one goal: sustaining human life. It's more like a womb than a pseudoplanet. In 2004, NASA, assuming Congress agrees, will make a "go/no-go" decision on whether to prepare for a 2014 launch to Mars. If the life-support system in the ALSTF works and the people don't crack, NASA will have a good reason to believe that sending a half dozen people to Mars and bringing them back alive won't be absurdly dangerous—just merely dangerous.

The metaphor of the house as a womb becomes challengingly literal," Constance Adams tells me, as she carefully takes a black Magic Marker and traces the outline of a wall on translucent drafting paper. "You can get so into it that it's frightening. It's frightening to be in the womb." She looks up at me, scowling. "Most of us would rather go mountain biking." She laughs at her joke, and goes back to drawing. She's sitting at a metal desk in her office on the second floor of Building 15. Through the broad windows, there's a view of the Space Center's neatly trimmed lawns. Adams can be pithy and wry. Thirtyish, with long black hair, pale olive skin, and a yen for stylish suits, she doesn't fit into the traditional mold of khakis, crew cuts, and engineering degrees that predominates at the Space Center. Instead, she exudes opulent exoticism. Adams is originally from New Orleans (her full name is Constance Marguerite Augustine deJean deBousquet deJumecourt Adams), and she describes herself as the descendant of bastards and second sons of the French aristocracy. Fluent in French and German; schooled in Marx and Weber; inspired by communal, eco-friendly theories of social organization, she is a suprisingly countercultural presence to find at NASA. In the Age of Apollo, which gave us Tang and Velcro, ideas of sustainable ecology in space were seen as far-out science fiction. Previous generations of space designers might have devised complex plans for stowing thousands of "meals ready to eat" on a Mars mission, each empty dish thrown out into space, or onto the surface of Mars. Adams thinks a mission to Mars will inspire new forms of habitation on Earth, producing a space dividend for the 21st century. Instead of fizzy orange water, we'll get cities that live in balance with the surrounding environment, absorbing pollution, producing clean water and food.

Adams is under pressure to complete initial sketches of the habitat for an architectural review, what she calls a "pinup session," two days from now. She says that this will be the first formal architectural evaluation of a proposed off-Earth facility at the Johnson Space Center in more than a decade. Usually, architects don't build space facilities; engineers do. Adams, however, was brought in from the beginning to think through fundamental issues of design and aesthetics, because understanding human factors is seen as essential in these long-duration tests. Like nearly everyone I meet at NASA, Adams doesn't see what she's working on as a mere job. Instead, it's a kind of holy mission. "There is no obvious economic or political gain in the space program," she

*Architect Adams, who has been inspired by communal, eco-friendly theories of social organization, is a surprising presence at NASA.*

**"It's just incredibly noble. We can do it. And we are actually crazy enough to spend the money to do it. Anything you do that is this enormous, this huge, and that's not for your own gain, but just because it fulfills some greater human dream—isn't that noble?"**

explains. "It's just incredibly noble. We can do it. And we are actually crazy enough to spend the money to do it. Anything you do that is this enormous, this huge, and that's not for your own gain, but just because it fulfills some greater human dream—isn't that noble?"

Adams works for Lockheed Martin, the aerospace giant, who contracts her out to NASA. Lockheed hired her in May, because NASA decided it needed an architect to design the ALSTF. Adams had never worked on an outer-space mission before. She was chosen because of her interest and experience building ecologically sustainable urban architecture. After graduating from the Yale School of Architecture, Adams worked with Kenzo Tange Associates in Tokyo. There she developed grand urban redevelopment projects, including a proposal to rebuild 2,000 acres of Roman suburbs, the construction of skyscrapers in Kuala Lumpur, and a lavish multi-tiered rooftop disco in Tokyo. Two years later, she moved to Berlin and worked on redevelopment projects there; afterward, she relocated to Seattle, where she was hoping to help create an urban light-rail system—then came the call from NASA.

Adams is fascinated by the metaphor of metabolism; of buildings and complexes of buildings living in symbiosis with the people who inhabit them; the flow of human movement through space colliding, combining, and dividing. It is an image that comes from her time with Kenzo Tange. Tange is the éminence grise of Japanese architecture; he began his career by rebuilding Hiroshima's city center in stages during the '40s and '50s, and went on to create Tokyo's 1964 Olympic stadium and city hall. His buildings are vast complexes, and his main ambition, in the age of imperial modern architecture of the '50s and '60s, was to build entire cities. Adams, in a sense, has inherited that ambition to build complete worlds; she, however, wants to build her worlds in miniature. She sees the ALSTF as a tiny planet, with the environment sustaining human life, and human life sustaining the environment.

"In 2000 we will have three units," she says, describing the first phase of the ALSTF, "a life-support chamber with an exercise area, a bio-mass production chamber, and the 'hab' [habitation] chamber. What this is all about is establishing balance. We have a bunch of wheat plants and four people and they keep each other alive." NASA believes this is technically feasible. Last March, the agency placed four scientists in isolation for 60 days, within a sealed three-story-tall metal cylinder (originally built to simulate Skylab and nicknamed the "Can") at the Johnson Space Center. Throughout the experiment, the crew breathed air cleaned by wheat plants and drank water purified by algae. Another test, lasting 90 days, was to end a few days before Christmas. If it works, NASA can be confident that a self-sustaining life-support system is possible. Eventually, both the space module and the Mars habitation (which may turn out to be one and the same) will be designed using principles developed for the ALSTF.

In traditional space missions, the life-support system sustains physical bodies with food, air, and water. But what about the mind? On a mission to Mars, the life-support system has to support the intangible as well—hard-to-define mental needs, which could kill or injure an astronaut if left untended. Going to Mars, there are new "mission critical" factors like boredom, sanity, and crew compatibility. Boredom—what to do for six months in steerage—is one of the most insidious psychological issues a long-duration mission faces.

The auguries from previous long-haul missions—most of them Russian—are not promising. The Russians have specialized in long-duration missions (the average Russian astronaut has spent 148 days in space; the U.S. average is 23 days). The lone long-term U.S. mission—Skylab 4—lasted 84 days, beginning badly when one of the three astronauts vomited and the commander decided to keep it secret from mission control. Mission control, however, heard every word, through an open mike. The crew, alienated from Houston, later went on a daylong strike, exhausted from overwork. Only after mission control agreed to let the crew set their own schedules did they continue working. NASA never flew a long mission again. Detailed information on Russian missions that suffered from crew problems is hard to obtain, but a confidential memo was briefly shown to me at the Space Center, detailing what NASA knows about problems on Russian missions.

In 1976, Soyuz 21, flown by cosmonauts Boris Volynov and Vitaly Zholobov, completed 49 of 56 scheduled days aloft. It was brought back early due to "interpersonal problems." Back then, the official explanation was that an "acrid odor" in the cabin had "nearly exceeded the crew's tolerance level." In 1985, Soyuz T-14 completed only 65 days out of a planned 216-day mission. It was recalled, the memo reports, because of "medical problems and mood and performance difficulties." The new station commander who had been sent up to the station, Vladimir Vasyutin, was having a nervous breakdown. Soyuz TM-2, with Yuri Romanenko and Alexander Laveykin on board, was "terminated after six of 11 planned months because of interpersonal problems." Laveykin was brought back after five months in orbit, officially because of "heart problems." Romanenko stayed, and went on to set the then–world record for time on a single mission: 326 days in space. The document I saw then claimed that "the first U.S.-Russian Mir-18, in 1995, had a lot of psychological problems, a fine was levied against a Russian crew member, and the American astronaut complained that psychology was a main issue in any long-term missions." When Norm Thaggard, the American on that Mir mission, came home, he said, "If I had been looking at six months [aboard Mir], I would have been real worried...that I wasn't going to make it." At the time, Thaggard had set a U.S. record of 115 days on a single mission. A successful mission to Mars will last roughly 1,000 days.

Going to Mars requires a new breed of astronaut. NASA is built around the more traditional model of the astronaut corps. These are the people who, symbolically, are at the top of the agency. They are also a distillation of its values. To change the astronaut corps means changing NASA, and that may be very hard. It's like telling jet pilots one day that now they're all submariners. There'll be no more flying at Mach 2 thousands of feet above the Earth, the brilliant sun above and the round Earth below. Instead, there'll be no day and no night and no movement other than the shifting of a submarine as it rises and falls in an ocean you cannot see.

"NASA is the pilot and engineering mentality gone berserk," Patricia Santy tells me. "They don't think about feelings; they think about doing. In the military there are checks and balances, but at NASA there are none. Engineers run everything." We're having breakfast a few miles from NASA, where Santy is persona non grata. She used to be a NASA psychiatrist, as well as a flight surgeon and chief of the biological behavioral lab. She quit in 1991, after seven years at the agency, because she claims NASA refused to research the psychological factors that can affect space travel. Santy is in her 40s, with short brown hair and glasses. She is an associate professor of psychiatry and behavioral science at the University of Texas at Galveston, 30 miles south of the Johnson Space Center, where she specializes in what she terms "psychological adaptation to isolated confined environments."

Santy sees a pattern of deception at NASA that goes back to the Mercury missions of the early '60s; a

***Glad we aren't there:*** *Four of the guinea pigs in the 90-day isolation experiment.*