

Go Somewhere!

7 Seven
Ideas
That Will
Correct
NASA's
Trajectory
and
Get Americans
to Love the
Space
Program Again
By Dawn Stover

OLD GLORY: Four months after the first manned lunar landing in 1969, Charles "Pete" Conrad unfurls the flag on the Apollo 12 mission. No astronauts have set foot on the moon since Apollo 17 in 1972.

Houston, you have a problem.

It's a problem that isn't fixable with duct tape and a carbon dioxide filter. And the problem isn't just with Houston; it also affects Cape Canaveral, Cleveland, Huntsville, Pasadena, Washington, D.C.—especially Washington, D.C.—and other NASA centers around the country.

At age 43, America's space agency is having a midlife crisis. In its youth, NASA put men on the moon and inspired the nation's schoolchildren to study science, mathematics, and engineering. Today, like many middle-age Americans, NASA is struggling to get back in shape and find meaning in its life. The agency's main focus, the international space station, is mired in cost overruns that have driven the estimated price from \$17.4 billion to more than \$30 billion—and nobody believes even those numbers. Moreover, two of the past three missions to Mars have ended in disaster. In 1999 the Mars Polar Lander, which was supposed to gently touch down and search for ice, crashed into the planet's surface instead. That same year the Mars Climate Orbiter, intended to be a Martian weather satellite, was an even bigger embarrassment. It burned up in the atmosphere because of what seems a ludicrously careless mistake: The engineers neglected to convert navigation figures from English units to metric.

NASA lacks a mission—in the larger sense of that word. If the agency does not act soon, it stands to become a relic of the 20th century. After interviewing dozens of experts—including NASA officials, astronauts, space policy analysts, and leaders in the private sector—POPULAR SCIENCE has come to the conclusion that to recover its authority, NASA needs to go somewhere: namely, Mars. The "M-word," as some people within the agency refer to it. A destination that is only whispered behind closed doors, when it should instead be proclaimed as the fore-

most target of the world's greatest space agency.

A recent changing of the guard at NASA makes this a fitting time to reevaluate the agency's goals. Administrator Daniel S. Goldin stepped down late last year after heading the agency for nearly a decade. Goldin is an aerospace engineer who urged his employees to develop innovative technologies; his replacement, Sean O'Keefe, is a number cruncher with no experience in the nation's space program. Some observers expect O'Keefe, who was previously deputy director of the Office of Management and Budget, to cut the number of shuttle missions from six per year to four, lay off astronauts and engineers, and perhaps close some NASA centers. Even enthusiasts of the space program are convinced that such drastic measures are necessary to restore NASA's political credibility.

"Sean is not going to NASA to personally design rockets," House Science Committee Chairman Sherwood Boehlert (R-N.Y.) said while introducing O'Keefe at his Senate confirmation hearing last December. "But he knows enough about rockets to know that they burn cash just as assuredly as they burn fuel, and that both propellants are finite. It won't hurt NASA to have someone who can husband the agency's resources."

To be fair, during Goldin's tenure NASA logged many spectacular achievements—all without increasing the agency's budget in recent years. The on-time launch rate for the space shuttle went from 23 percent to 84 percent; 160 of 171 missions were successful; and there were no serious injuries. Unmanned spacecraft have provided unprecedented views of comets, asteroids, Mars, and the moons of Jupiter. The Hubble Space Telescope's studies of black holes, wandering planets, and exploding stars have turned science fiction into science fact. And despite the failures of the Mars probes in 1999, NASA has lost only \$550 million worth of hardware out of a total of \$23.5 billion launched.

Still, NASA has lost its hold on the public imagination. The agency must reassert its primacy—which shouldn't be hard, given that it's the only government agency with the entire universe as its domain. And it must be willing to take risks. "When

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TRIUMPH AND TRIBULATION: The original Mercury astronauts; the Mariner 1 Venus-fly-by probe, which quickly flew off course and was destroyed; Edwin "Buzz" Aldrin



Why go to Mars? For the same reason we went to the moon:

NASA has a vision, a compelling vision that all are following, there's nothing it can't do," says Keith Cowing, a former NASA space scientist who runs nasawatch.com.

Administrator O'Keefe joins the agency at an exciting juncture. Here are our recommendations for change.

1 SEND ASTRONAUTS TO MARS

"The logical next step is a mission to Mars, but America's probably not ready for that yet," says former Administrator Goldin, now a senior fellow at the Council on Competitiveness. We respectfully disagree. Why is it time to go to Mars? For the same reason we went to the moon: to be first, and to see what's there. Without exploration, the United States itself wouldn't exist. "If you don't think humans are born to explore, watch a 1-year-old learning to walk," says Ed Weiler, NASA's associate administrator for space science.

Admittedly, there are plenty of places left to explore here on Earth. We've mapped the moon better than our own oceans, for example. But to understand our place in the universe, we must continue to explore outer space. Mars, the planet in the solar system most like our own, is the obvious next destination. Conditions on most other large objects within reach are too inhospitable for even a short visit, let alone permanent habitation.

It isn't as though NASA hasn't talked about going to Mars—even drawn up preliminary plans and forecast launch dates. But the agency has yet to demonstrate a serious commitment to a manned Mars mission, and has therefore been unable to build the public support and political will necessary to make it happen. We're probably further from Mars today than we were in 1989, when President George Bush Sr. called for a manned mission to Mars by 2019, the 50th anniversary of the Apollo landing. No subsequent administrations, including his son's, have carried the torch.

On May 25, 1961, President John F. Kennedy announced before a special joint session of Congress the goal of sending an

American to the moon before the end of the decade. Eight years later, Neil Armstrong stepped off the Lunar Module's ladder and onto the moon's surface. Mars, however, will be a more complex challenge.

For one thing, it's 48 million miles away, on average—200 times farther than the moon. With existing technology, it will take months to get there, not the four days it took to get to the moon. On the way, the astronauts will face dangerous radiation, bone loss, and the rigors of living in a confined space with no privacy. When they arrive, nobody will be there to carry them off the ship on stretchers. And once on the Martian surface, the astronauts will need spacesuits that are designed to last for six months. The Apollo suits were made to last four days and then be discarded.

Mission Controller

NASA Administrator Daniel S. Goldin resigned at the end of 2001. His successor brings a new tone to the agency.

Daniel S. Goldin



BACKGROUND:

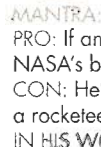
Before taking the helm at NASA in April 1992, Goldin, 61, spent 25 years at the TRW Space and Technology Group, where he led defense projects and managed production of advanced communication spacecraft and space technologies.

MANTRA: Faster, better, cheaper.
PRO: He wasn't afraid to speak his mind.

CON: Everyone around him was. **IN HIS WORDS:** "NASA is one of the most open agencies because everyone is a rocket scientist in America and everyone loves what we do. That is why we get more attention. It is not that they are against us, they love us more."

Sean O'Keefe

BACKGROUND: O'Keefe, 46, came to NASA in January from the federal Office of Management and Budget, where he had been deputy director since March 2001.



MANTRA:

Get back to basics.
PRO: If anyone can balance NASA's books, he can.

CON: He's a budgeteer, not a rocketeer.

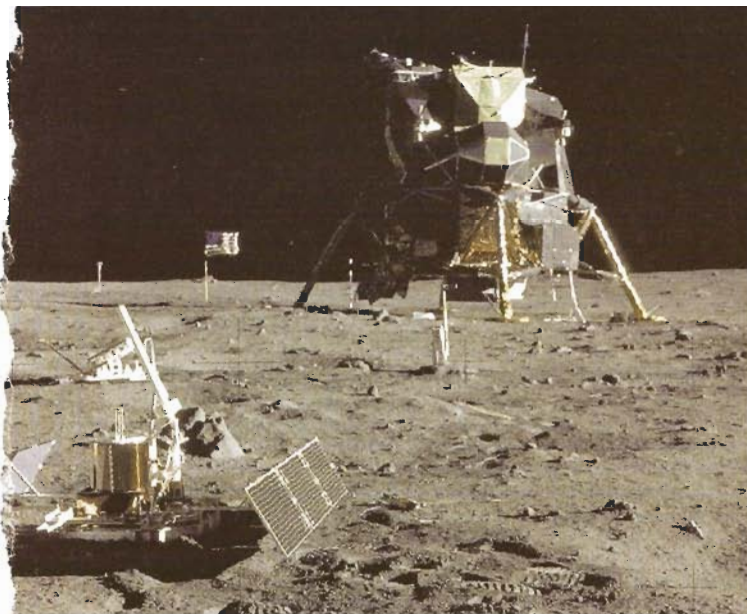
IN HIS WORDS: "All of the building blocks for a comprehensive and aggressive strategy of reform for NASA are now being placed. If we build this foundation correctly . . . there should be a significant reduction in the amount of resources needed to carry out what is currently on NASA's plate."

"We want to do more than send men and women to Mars," says Weiler of NASA. "We want to get them back safely."

Going to Mars is not only going to be difficult—it's going to be expensive. "Most Americans probably don't remember that the Apollo program ate up about 4 percent of the [nation's] total budget," Weiler adds. Meanwhile, the entire current NASA budget is now less than 1 percent of the national total. And even if money were unlimited, it will take years to develop the necessary technology. NASA's Mars plans won't be taken seriously until the agency lays out the logical progression of steps that must be taken and attaches realistic dates to them.

Once NASA establishes that its overarching goal is to reach Mars—say, within a generation—then other pieces of the space program will begin to fall into place. Research on the space station will focus on learning the biological effects of long-duration space travel. Unmanned probes will lay the groundwork for a future manned landing. And engineers will have a likely destination for the next-generation space vehicle. A commitment to Mars will refocus the agency and give it a sense of mission.

Aldrin gazes at Apollo 11's Eagle Lunar Module, as photographed by Neil Armstrong.



to be first and to find out what's there.

2 COMPLETE THE INTERNATIONAL SPACE STATION AT A REASONABLE PRICE

NASA observers joke that the space station has become a black hole, sucking money out of all the agency's other programs. Conceived in the 1980s, then redesigned and delayed countless times before the first module was launched in 1998, the 150-ton station is the largest spacecraft ever built, and has been occupied by a crew of three astronauts for more than a year. It's an impressive technical achievement, much more sophisticated than the Russian Mir station, but it's only half finished.

Meanwhile, the station is threatening to suck in ever-larger amounts of cash. "NASA's situation right now is like you've got a favorite son living in your house who is an addict, and who has a huge amount of potential, but you can't get him off his habit," Rick Tumlinson, president of the Space Frontier Foundation, says of the space station. "You don't fix an addict by giving him more heroin."

Because of all the financial difficulties, NASA has postponed its plans for adding a habitation module and emergency crew-return vehicle to the international space station. Without them, the station can accommodate only a crew of three, which severely limits the amount of scientific work that can be done onboard. Most experts we spoke with are convinced that the station will never be very useful as a research facility—and won't provide the data we need to venture farther into space—until it can accommodate a crew of six or more. Meanwhile, NASA's European counterparts are threatening to back out of the 16-nation partnership.

NASA's flagship must be slowed down, brought under control, and pointed in the right direction—with future station activities focused on preparation for manned missions beyond Earth's orbit. The biggest challenge is to cut costs for the station without compromising safety.

"The best way to get to Mars is to do the space station right," says Cowing. "Like it or not, the station is NASA's central goal right now, and NASA will never get to do anything big again until the station is reined in and accomplishes what it was intended to do."

3 LET PRIVATE COMPANIES REIGN BETWEEN EARTH AND THE MOON

NASA's biggest investments, the space station and the shuttle, are like a dysfunctional couple: They keep each other mired in unproductive behavior. The shuttle has become little more than a vehicle for getting to and from the space station, and the station has become somewhere for the shuttle to go. Instead of setting its sights on the solar system and beyond, NASA is spinning around Earth at a distance of only 220 miles on average.

It's time for the agency to begin to relinquish its grip on some portions of the space program. "NASA is an exploration agency, not a construction company or a landlord," says Tumlinson. In his view, NASA should behave more like Lewis and Clark, and less like the shopkeepers who followed them. He says NASA should vacate the near frontier—the area from Earth to the moon that has already been physically explored by humans—and move on to the far frontier. "I want to see astronauts rappelling off the cliffs of Mars," he says, "with the goal that they will be followed by settlers. That handoff is where we've fallen apart."

The federal government has a tradition of developing new technologies and then passing them on to industry. The Internet, for example, got its start that way. But because the shuttle and space station are national assets and symbols, privatization should not be taken lightly. It should be gradual, and it should not be a giveaway: Businesses should shoulder the majority of the financial burden.

NASA could start by purchasing more goods and services from industry suppliers, as the Pentagon does. The agency

could also hand over more management tasks. For example, NASA could contract with a commercial firm to operate the unmanned ships that haul supplies to the space station. The agency could also consider turning over the oldest of the nation's four space shuttles, Columbia, to a quasi-governmental agency, something like the Port Authority of New York and New Jersey.

NASA should also work harder to encourage private citizens to experience space. Even exploration can be privatized to a certain degree, as South African entrepreneur Mark Shuttleworth is attempting to demonstrate with his flight this month to the international space station (see "Self-Made Scientist," at left).

Self-Made Scientist



Mark Shuttleworth is about to become the first private explorer in space. The 28-year-old Internet entrepreneur from South Africa is paying his own way to fly to the space station this month aboard a Russian Soyuz. The trip was arranged by Space Adventures, the company that sent American businessman Dennis Tito to the station last April. But unlike Tito, Shuttleworth doesn't consider himself a tourist. Shuttleworth spent almost a year in Russia training to become a full-fledged crew member. He also worked with South African medical researchers to design the experiments he will conduct in orbit, which are intended to further the study of AIDS and other diseases.

"For me, this is about experiencing cutting-edge science in an extreme environment, about reaching out to learners in Africa and inspiring them to take the hard mathematics courses instead of the easier ones, and about the personal challenges that go with working hard and being alone in a foreign environment," says Shuttleworth. "If I had a choice between buying a ticket at a kiosk and being in space immediately, and doing it this way, there's no doubt in my mind I'd be in this program, not the tourism one."

4 BUILD A NEXT-GEN SPACE SHUTTLE

The space shuttle has been flying for more than two decades and the risks of another Challenger-type accident are mounting, but there's no viable replacement on the horizon. NASA's leading candidate, the X-33, was canceled last

year after five years of work and a \$1.25 billion investment. Unlike the current space shuttle—which is propelled partway into orbit by detachable rocket boosters and makes the second leg of the journey on its own engine power—the X-33 was a prototype for a vehicle, VentureStar, that was supposed to hurtle from the ground to orbit in a single bound. But the necessary technology proved too ambitious.

The solution, according to Apollo 11 astronaut Buzz Aldrin, is to stick with the two-stage launch system but improve on it incrementally. The agency could start by creating more advanced boosters, and only later—when technology and funds allow—develop state-of-the-art vehicles for them to propel.

NASA could stretch its budget for the new shuttle by collaborating with the Pentagon. Rockets are rockets, regardless of whether they're launching a spy satellite or a telescope—the Hubble Space Telescope is basically a Keyhole spy satellite pointed at the sky instead of the ground. Given that Administrator O'Keefe has served as Secretary of the Navy, on Dick Cheney's Pentagon management team (during George Bush Sr.'s administration), and on the staff of the Senate's Defense Appropriations Subcommittee, he should know how best to take advantage of the Pentagon's expertise.

5 CELEBRATE HUMAN ACHIEVEMENT

Remember the Curt Brown shuttle mission of 1998? Of course you don't. You know it as the John Glenn mission—though Brown was the commander. That's because Americans made a connection with Glenn and the other Mercury and Apollo astronauts. We felt we knew them as individuals and so felt invested in their enterprise. Since then, NASA has managed to turn a corps of potential heroes into a bunch of virtually indistinguishable automatons.

Although NASA now has astronauts living for long periods on the space station, the agency has sanitized their experience, portraying them as little more than glorified construction workers. When Bill Shepherd, the commander of the first crew to live aboard the station, began keeping a daily journal that gave the public a sense of what life was *really* like on the station, NASA responded by removing it from public view.

More honesty would go a long way. Even failures can rally support. Remember the heroes of Apollo 13? Exciting as it may be to feel the roar of the shuttle's engines at Cape Canaveral, or to catch the twinkle of the space station as it passes overhead, or to see a little rover climbing over a rock millions of miles away, it isn't the hardware that moves us. It's

the astronauts with their cheeks stretched by G forces, the astronauts telling us what lightning looks like from space, and the scientists jumping with glee because their lander touches down safely on Mars.

We aren't suggesting that NASA resort to gimmicks. "We are no longer in the 'romantic' era of spaceflight," says John M. Logsdon, director of the Space Policy Institute at George Washington University in Washington, D.C. "By now, space must be more than public entertainment." But NASA shouldn't be ashamed of capitalizing on the PR appeal of its employees.

And the agency should stop pretending that it is motivated solely by science. Hardly anyone believed that an experiment involving only one subject—who was unwilling to turn over all of his medical records—could contribute much to our understanding of aging. Yet NASA insisted that John Glenn's flight was purely for the sake of science. And when the agency was considering sending an all-female shuttle crew into space—a novelty sure to attract press attention—officials insisted the goal was simply to study gender differences.

Americans loved seeing astronauts step onto the moon, plant a flag there, and even swing a golf club. Did these things have scientific value? Not much. But they inspired a generation to study science, math, and engineering. The economic prosperity of the 1990s was a result of the technology revolution fueled by the space program.

"Somebody didn't just wake up one day and invent the cellphone or the Internet," says Weiler, NASA's chief space scientist. "I wouldn't be a scientist working at NASA today if it weren't for NASA inspiring me as a kid."

6 DON'T FOCUS TOO NARROWLY

Goldin is best known for infusing NASA with his "faster, better, cheaper" mantra, known to NASA insiders as FBC: Put fewer and simpler instruments on each spacecraft, build them quickly and relatively inexpensively, and launch a whole bunch

NASA Milestones

NASA has had its share of ups and downs over the years.

1958 National Aeronautics and Space Act establishes NASA.

1961 Russian cosmonaut Yuri Gagarin becomes the first human in space. A month later, Alan Shepard becomes the first American in space. Kennedy vows to land Americans on the moon.

1962 John Glenn becomes the first American to orbit Earth. Mariner 1, America's first attempt at an interplanetary spacecraft, ends up at the bottom of the Atlantic Ocean.

1965 Mariner 4 flies past Mars, sending back the first images of the Red Planet's surface.

1967 Fire kills Apollo astronauts Roger Chaffee, Virgil Grissom, and Edward White.

1969 Apollo 11 astronauts land successfully on the moon.

1970 Apollo 13 mission aborted after rupture of oxygen tank.

1976 Viking 1 sends back the first close-up images of Mars.

1977 The twin Voyager spacecraft begin their grand tour of the outer planets.

1981 Maiden voyage of the first space shuttle, Columbia.

1986 The Challenger explodes.

1990 Hubble Space Telescope is launched with a faulty mirror.

1997 Pathfinder mission lands on Mars using airbags.

1998 The first component of the international space station is launched. Glenn returns to space on the STS-95 shuttle.

1999 Mars Climate Orbiter and Polar Lander missions lost.

2000 The first crew of three takes up residence in the international space station.

2001 The White House reveals a \$4 billion cost overrun in the space station program. X-33 next-generation spacecraft is canceled.

MARVELS AND MISSTEPS: Voyager 1 photographed Jupiter and its planet-size moons



If we back up the planetary "hard

of them. That way, if you lose one, you haven't thrown away a decade's worth of work.

In the 1980s, NASA was launching only about one space-science mission per year. Now the agency launches as many as 10. And FBC has created some major successes, such as the Mars Pathfinder, a spacecraft that deployed airbags to land on Mars and then released a robotic rover to investigate the planet's rocky surface. But NASA has been putting too many eggs in the FBC basket. True, the agency has continued to support some big-science missions, such as the Space Infrared Telescope Facility. Nevertheless, FBC has created the false expectation that NASA can achieve its scientific goals while minimally funding expensive missions and basic research. "What they've done is pushed the culture toward smaller spacecraft with fewer instruments," says author James Oberg.

Certainly, Pathfinder proved that even inexpensive, robotic missions have the power to create public excitement about space, and to return useful images and results. But though a robot can send back interesting data, it can't make sophisticated interpretations. Unmanned missions, while important precursors to human exploration, are a poor substitute for it.

7 PROMOTE NATIONAL SECURITY

When astronauts first reached the moon and looked back at their home planet, they saw a small, fragile, blue orb. Their photographs made us realize how precious and vulnerable our planet is. Human life is threatened these days not only by terrorism and the specter of nuclear, chemical, or biological holocaust. We also face global threats such as climate change, species extinction, and the possibility of an asteroid impact that could wipe out most of life on Earth. NASA has a role to play in protecting us from these dangers.

NASA-developed instruments can help spot the work of terrorists, NASA's Earth-monitoring satellites can provide information about environmental problems. NASA telescopes can

search for Earth-bound asteroids. And NASA's programs in aeronautics—the forgotten first "A" in NASA—can improve aviation safety. But perhaps NASA's most important mission is to search out a safe refuge for human civilization.

"At some point, we really are going to have to get out of here," says William E. Burrows, author of *This New Ocean: The Story of the First Space Age*. "Nobody's talking about abandoning ship. Earth is a very seaworthy ship. But no skipper in his right mind goes to sea without a lifeboat and insurance." In an address last May at Princeton University's Institute for Advanced Study, Burrows proposed a long-range strategy for using space to protect mankind, called ARC (Alliance to Rescue Civilization). The idea is to back up the planetary "hard drive"—the record of our civilization—and store it elsewhere, such as on a manned outpost on Mars. "If dinosaurs had had a space program," Burrows says, "they'd still be here."

NASA's troubles have been brewing for many years. In the cover story of our July 1989 issue, we marked the 20th anniversary of the Apollo landing by asking experts inside and outside NASA whether the agency was "lost in space." The issues facing NASA then, particularly the question of whether the space station and shuttle should dominate the space program, are still pressing. And NASA hasn't taken the advice it got 13 years ago—to set clear long-term goals for space exploration.

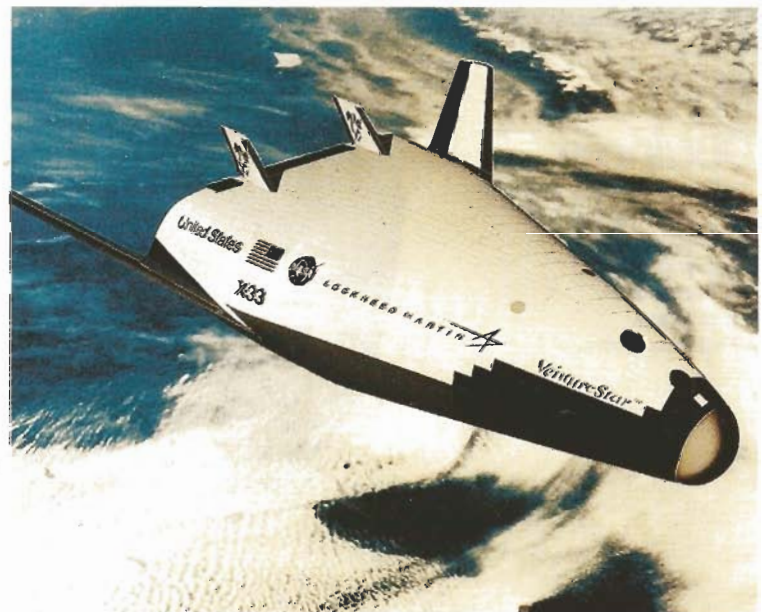
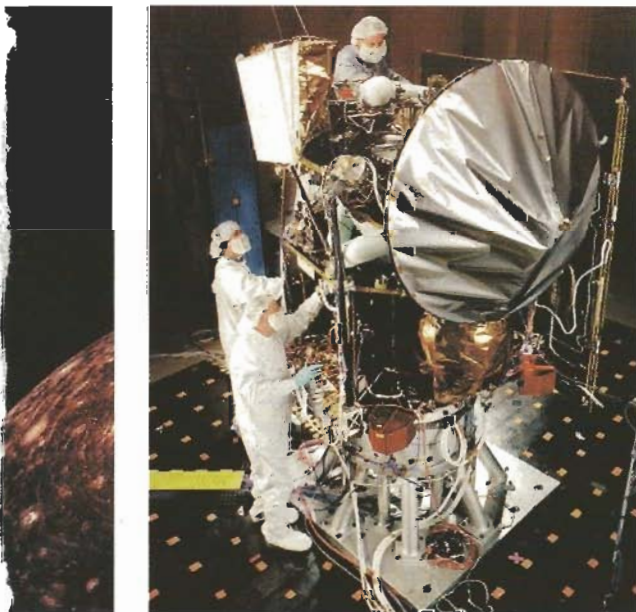
NASA still has the potential to inspire, advance, and protect humanity. It's time for the space agency to get itself back on the proper trajectory. ■

WE'LL SEND YOUR IDEAS TO NASA

What do you want to tell NASA? We invite readers to comment on the space agency in a public forum that will be hosted on our Web site. POPULAR SCIENCE editors will forward selected responses to the agency's new administrator.

Go to our NASA bulletin board at www.popsoci.com/exclusive

in 1979; 1999's ill-fated Mars Polar Lander; proposed VentureStar replacement for space shuttle was canceled after five years and \$1.25 billion in investments.



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