Will NASA's Research Reforms Fly?

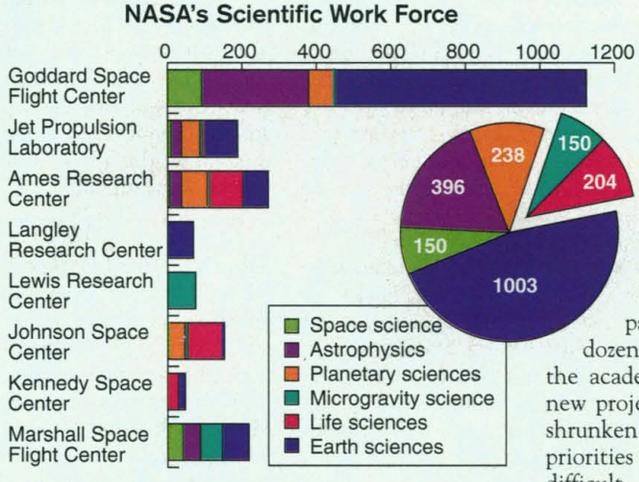
With major budget cuts looming, space agency managers have a plan to cut costs while improving science. Insiders and outsiders worry that quick fixes may do more harm than good

Astronauts returning to Earth after many days in orbit are often plagued by dizziness. So scientists at the National Aeronautics and Space Administration's (NASA's) Johnson Space Center in Houston came up with a possible solution—an apparatus worn by crew members to improve circulation during weightlessness. But the million-dollar project caught the skeptical eye of a new generation of life sciences managers at NASA headquarters. An outside panel was asked to review the effort and rejected it early last year; headquarters officials ordered it taken off the list of experiments slated to fly last month on the space shuttle Columbia. Houston officials balked, however. They resisted canceling the experiment until just weeks before launch, when it was finally scrubbed.

The incident is a telling example of the upheavals under way within NASA's science program. New managers, many from academia, are setting out to reform and improve the agency's research complex, which spans a dozen centers and includes more than 2000 employee and contractor scientists. The changes are a response to a looming $2 billion cut in NASA's $14 billion budget over the next 5 years, which includes an expected reduction in the agency's work force from 23,000 to 17,500. Science managers hope to keep research—and researchers—from being crushed by the belt-tightening, but they must have a quality product. "We've got to try and preserve science," insists France Cordova, NASA's chief scientist, who until late 1993 was a Pennsylvania State University astronomer. "And so we've got to make sure it's good and reputable."

The centerpiece of NASA's attempt to improve its science while reducing personnel is a proposal to create independent institutes that would take over much of the research now conducted at five NASA centers (see box). NASA officials also plan to reorganize and cut in half the number of employees at the agency's three offices at Washington headquarters, which oversee those scientific activities. In addition, they are pushing to tighten research standards for life sciences at centers like Johnson by using more outside peer review. These changes are aimed at staving off more drastic proposals, such as the one made earlier this year by an internal NASA management team to abandon science efforts at some centers and lay off an unspecified number of researchers (*Science*, 24 February, p. 1087).

Outside scientists and managers familiar with the agency believe that NASA science is ripe for reform. "Now is the time to experiment," says Daniel Fink, an independent consultant who was a member of a National Research Council (NRC) panel that recently recommended changes in the way NASA does science. And as a shrinking budget puts the squeeze on science, "then you want to be sure [what is done] is the best," adds Anneila Sargent, a California Institute of Technology astronomer and chair of NASA's space science advisory subcommittee.



Come together. NASA hopes reforms will improve the quality of microgravity and life sciences, a small slice of its overall research team.

But many scientists both inside and outside NASA fear that the agency is making changes too quickly in the rush to cure its budget woes, and that hastily conceived reforms could shortchange rather than improve NASA research. Worse, they say the reforms could be a Trojan horse for cutting back on science—a charge Cordova rejects. Agency managers want to begin setting up the first institutes early next year, and the reorganization of NASA's three science offices is well under way. Yet scientists in NASA's centers say they are confused, and they fear for their jobs. "I don't understand what they are doing, and it is raising a lot of anxiety," says Chuck Sawin, director of space biomedical research at Johnson Space Center. And many in the scientific community outside the agency share that concern. "The pace is a little scary for me," says Mary Jane Osborn, a microbiologist with the University of Connecticut Health Center who also chairs an NRC panel on space biology. "It is more important to do this right than instantly."

An engineering tilt

Cordova insists the agency won't rush the changes. "We don't have to do this in a week," she says. But the pressure is on. NASA Administrator Daniel Goldin wants to reduce personnel rather than cut programs to accommodate the budget squeeze. Earlier this month, NASA announced it would give greater control of space shuttle operations to a private aerospace corporation. And the agency already has slashed by more than half the number of NASA employees overseeing industry work on the space station.

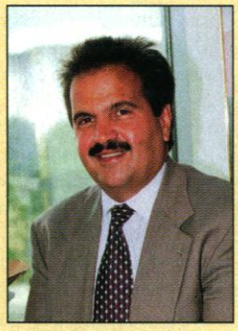
Science managers, with their nearly $3 billion research portfolio, are eager to be seen doing their part. But they face members of half a dozen disciplines within NASA and in the academic community who hunger for new projects that are incompatible with a shrunken agency. "The task of establishing priorities and making choices will be more difficult, and possibly more contentious, than in the past," warns the NRC report, *Managing the Space Sciences*. Astronomers are eager to launch an infrared telescope to follow Hubble, while earth scientists who draw on satellite images—a once obscure field—now look forward to a sophisticated system of orbiting platforms to measure global change (*Science*, 1 September, p. 1208). And while life and microgravity scientists traditionally have been at the bottom of NASA's scientific pecking order, they expect to be flying high once the space station provides them with an orbiting laboratory at the end of the decade.

To make the tough choices, the NRC panel urged the space agency to use more rigorous peer review. That is not much of an issue in areas where NASA has traditionally excelled—astronomy, astrophysics, planetary science, and space physics. But those in the life and microgravity sciences, although fewer in number, have come under withering fire from their peers for failing to meet academic

NASA Urged to Rethink Plan for Institutes

MOUNTAIN VIEW, CALIFORNIA—Al Diaz spent 3 months drawing up a radical plan to preserve science funded by the National Aeronautics and Space Administration (NASA) that would create a batch of privately run institutes. But last week it took Donald Jacobs only four words to sum up his reaction after he was briefed on the plan by Diaz, NASA's deputy science chief: "It's dead on arrival."

Jacobs, a retired Boeing Co. vice president and member of NASA's Advisory Council (NAC), delivered his verdict during a 2-day meeting at NASA's Ames Research Center. And he wasn't the only member of the top-level group of outside scientists, engineers, and industry officials to offer a harsh judgment. Panelists said Diaz failed to explain adequately whether the institutes were being created to improve science or to save money, and that such ambiguity will kill the idea in Congress and within the scientific community. They're not the only ones with doubts: University officials are worried that NASA may be trying to dump a personnel problem into their laps.



Sales pitch. NASA's Al Diaz seeks support for new institutes.

The institutes are intended to get civil service scientists off the NASA payroll by transferring them to private institutes largely funded by the agency but operated by universities. Diaz and NASA Chief Scientist France Cordova argue that the move will reinvigorate the agency's science program and reduce the number of NASA employees.

While Diaz's official report will not be released until 1 December, he has discussed its details recently with various outside scientific groups. By his reckoning, three of the 11 proposed institutes could be assembled quickly from existing organizations, and work on a fourth could get under way soon. The remaining seven require more study—and two may have to take a different route because they deal with data storage and engineering work rather than research (see chart).

Visits to a dozen mostly non-NASA science institutes around the country convinced Diaz and his team that each proposed institute should be operated by a nonprofit consortium, drawing on a nearby university for talent and industry for technical support. NASA centers would provide administrative backing, but each institute would set its own agenda and possibly carry out its own review of proposed research, two functions now handled by headquarters. "If it works correctly, the best people from the centers are going to survive, while the deadwood will drop by the wayside," says one university official.

However, NASA can't proceed on its own. It needs Congress to untangle a complicated web of civil service restrictions, as well as to give it authority to set up and fund the new structure. It also needs to find parties willing to take on the risk of operating such institutes.

Diaz says he is confident NASA will overcome these hurdles, but others are not. NAC members warned him that the agency must sharpen its arguments: The reasoning "sounds different from everybody you talk to," complains Bruce Murray, a NAC member and planetary scientist at the California Institute of Technology. "This is not going to go anywhere" in its current form, warned Lori Garver, another adviser who is executive director of the National Space Society.

University managers also want more details before embracing the idea. The presidents of the University of California and Stanford University, for example, are preparing a joint letter to NASA that outlines strict conditions the agency must meet before they would consider taking over Ames Research Center's science work. It's no small task: The Astrobiology Institute at Ames could have 1000 scientists and a budget of $200 million. But depending on federal funding could be risky. "We don't regard this as a cash cow," says one Stanford official. "And we don't want to be saddled with NASA's personnel problems." Other university sources seconded that concern. "The most cynical view is that NASA is hiring someone to fire [agency scientists]," says one.

The council plans to ask NASA Administrator Daniel Goldin to slow down and rethink the plan. Diaz says he welcomes suggestions, but he warned the advisers that the only alternative may be significant layoffs that would damage NASA's ability to do quality science. "We're in a very precarious situation," he said.

–A.L.

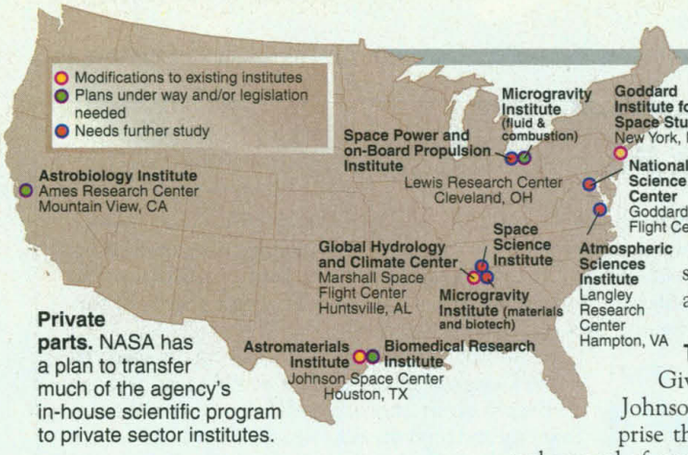
standards. The complaints even prompted the Senate, in 1993, to demand greater peer review of the disciplines. "They have always been stepchildren," says Norine Noonan, vice president for research at the Florida Institute of Technology and a former White House official who oversaw the agency's budget.

Part of the criticism of the life and microgravity sciences stems from the fact that the programs to which they are linked most closely—the space shuttle and space station—are dominated by a field that typically does not practice academic-style peer review. Life and microgravity researchers require closer cooperation from astronauts and ground-based engineers than do astronomy and physics experiments, which generally only require a ride into space. As a result, the work is shaped by that environment. "It's a completely engineering culture," says Lynn Margulis, a University of Massachusetts biologist who has worked closely with NASA. "The main driver is to fly, and science is a tool to justify that."

Despite this tradition, the microgravity program, concentrated at Marshall Space Flight Center in Huntsville, Alabama, is starting to clean up its scientific act, says Martin Glicksman, a physical metallurgist at Rensselaer Polytechnic Institute in New York and chair of the NRC's committee on microgravity research. Glicksman, who is preparing a $12 million crystal-growth experiment for a February shuttle launch, says that "NASA got egg all over its face" in the early 1980s with "talk of perfect ball bearings. But since then they have culled out the junk," he says, applying three layers of scientific review to experiments slated for the shuttle. "NASA now has a formula for success," he says.

The life sciences program, however, remains controversial. In its early years, NASA hired a small cadre of researchers to keep astronauts healthy and to explore the effects of outer space on plants and animals, but outsiders have little good to say about the work. "There was some really poor research," says Margulis, including experiments on mammals aboard orbiting capsules that produced little of value. Adds Osborn: "The peer review was inadequate, and too many life sciences experiments were rinky-dink and not particularly useful."

The lower body, negative-pressure apparatus built at Johnson Space Center is a case in point. Astronauts complained about the amount of time they had to spend wearing the awkward device, which was designed to reduce dizziness by improving their circulation. And it didn't help the experiment's



Private parts. NASA has a plan to transfer much of the agency's in-house scientific program to private sector institutes.

SOURCE: NASA

chances when a test subject on Earth fainted during a bungled injection of a drug that accompanied its use. Yet the project was never seriously threatened until NASA's new management ordered the outside review that sparked the protracted struggle between headquarters and the center.

Scientists say that the Houston center's intransigence in removing the experiment from Columbia's manifest even after it was panned by outside reviewers is revealing. "Johnson [Space Center] has a history of independence of operation," says Osborn. "They are not used to having their research reviewed, much less previewed." Other NASA and academic sources, who declined to be identified, agree that the center's attitude has damaged NASA's reputation. "Life scientists at Johnson have been totally isolated and arrogant," says one.

Frank Sulzman, NASA deputy director of life sciences, says removing the experiment from the shuttle "shows our commitment to a fully peer-reviewed program." Although Johnson's Sawin says the delay was the result of a feud between two offices at headquarters, not a refusal to accept outside review, he adds that much of the center's research should not be subject to the normal standards of academic science because its goal is operational, not scientific. "Our internal program has really been set back by this," he says about the push for outside review, adding that it has delayed the launch of some experiments.

NASA's other major center that conducts life sciences research is Ames Research Center in Mountain View, California. Although outside review is common—"Everything we do has been 100% peer reviewed since before 1981," says Ken Souza, Ames associate director for life sciences—some of its projects have come under fire from former employees and outside academics, and an internal panel earlier this year suggested eliminating the science done at the center. Ames is also under attack from the People for the Ethical Treatment of Animals, which charges the center with widespread misconduct in the care of laboratory animals and the use of monkeys in space. The lab's veterinarian resigned earlier this year in protest; an independent panel verified some of the veterinarian's concerns (*Science*, 23 June, p. 1692). The controversy puts an unwelcome spotlight on Ames researchers already nervous about their fate.

Tighter reins

Given the problems at Johnson and Ames, it is no surprise that both are listed in the early round of centers to be converted into science institutes. NASA officials say they are eager to change the perception among some in the academic community that science at its centers is merely an adjunct to multibillion-dollar engineering projects. The new institutes, they argue, would link NASA research more firmly to universities, shrink federal payrolls, and preserve funds for science. The institutes would also reduce the power of the centers, which agency sources say is one of Goldin's overall goals.

In the meantime, however, NASA is reducing the size of headquarters. The NRC panel, which completed most of its work before the institute concept was ripe, warned that this could backfire by passing power back to the centers. That shift, in turn, could weaken NASA's ability to perform quality science. Peer review "has been so strongly centralized because of the suspicions of the community that if the centers do it, they will take advantage of it to capture the research money," says John McElroy, a former senior NASA manager now at the University of Texas, Arlington.

Cordova insists that NASA headquarters will keep a tight rein on peer review until the institutes are in place. She also says she is confident that the institutes and other reforms under way will improve science at an agency with a reputation for scientific isolation and arrogance. Her challenge is to demonstrate to a skeptical research community and a tight-fisted Congress that NASA can deliver on that promise.

–Andrew Lawler

NEUROBIOLOGY

New Clues Found to Huntington's

SAN DIEGO—When researchers cloned the gene that causes Huntington's disease in 1993, its sequence yielded few insights into how the gene's protein product—called huntingtin—may cause this debilitating neurodegenerative disease. But earlier this week at the annual meeting of the Society for Neuroscience, two teams reported results that may help solve this mystery—and perhaps also lead to a better understanding of related diseases, known as the spinal and cerebellar ataxias, that are caused by similar mutations. The researchers have found a protein partner for huntingtin, together with indications that the disease-causing mutations alter the interaction between the two proteins.

It's still unclear how this might cause the neuronal degeneration of Huntington's, but researchers are nevertheless encouraged by the findings. They are "enormously exciting," says Huntington's researcher Nancy Wexler, of Columbia University. "We have two proteins to work with now." *Nature*, which is publishing the work in its 23 November issue, took the unusual step of lifting its embargo 10 days early and published a News and Views piece previewing the work on 9 November.

The proteins involved in Huntington's and the other conditions have a common feature: a stretch of repeated copies of the amino acid glutamine. In the disease-causing mutants these expand in number from less than 35 glutamines in a row to 38 or more. One of the many questions that have puzzled researchers is why huntingtin and the other proteins abruptly begin causing disease when they accumulate 38 to 40 glutamines. That's where the new work comes in.

Frederic Saudou and his colleagues Yvon Trottier and Jean-Louis Mandel, of the University of Strasbourg, France, found a monoclonal antibody that binds to polyglutamine in the disease-causing forms of huntingtin and four of the other proteins. It doesn't bind to versions of the proteins with less than 35 glutamines, suggesting their shape doesn't fit the antibody molecule.

The shape change associated with the mutation may alter the protein's binding to its new partner, a protein called HAP-1 (for huntingtin-associated protein), discovered by Christopher Ross and his colleagues Xiao-Jiang Li and Shi-Hua Li at the Johns Hopkins University School of Medicine. They found that HAP-1 binds to normal huntingtin, but binds even more tightly to the mutant version. That tighter binding may somehow change the way huntingtin and HAP-1 function, causing neuron death, says Ross.

What's more, similar proteins may be at work in the spinal and cerebellar ataxias. Ross's group has found a HAP-1–related protein that doesn't bind huntingtin and is testing to see whether it binds to one of the glutamine-rich proteins that causes the other diseases. If so, they may have found the key players not only in Huntington's, but in related diseases as well.

–Marcia Barinaga