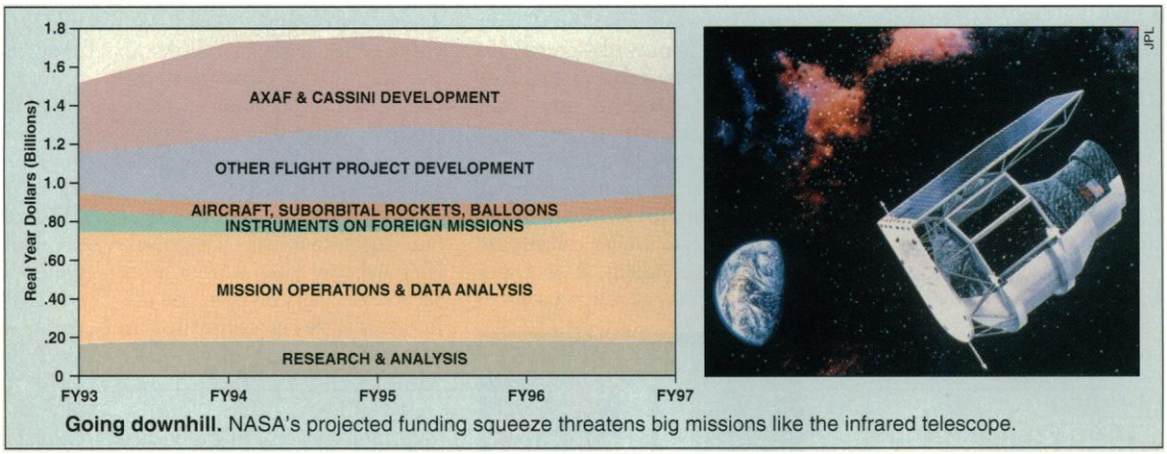
The Coming Crunch for Space Science

With NASA's science budget expected to drop for the rest of the decade, missions may be shut down early and data analysis may be short-changed

Space scientists have seen the future, and it hurts. Last week, the National Aeronautics and Space Administration (NASA) sent a budget request to Congress that contains its first cut in research and development for more than a decade, and forecasts an annual decline in the space science budget of nearly 10%, in real terms, over the next two years. The picture for space science is not pretty: Major new missions, until this year an annual event, will become a rarity. Money for whatever does fly will partly come from shutting down working spacecraft. There won't be enough money to analyze all the data these probes send back. And in a growing number of cases, NASA will pay only to collect the data, leaving scientists to seek other sources of money to analyze them.



Going downhill. NASA's projected funding squeeze threatens big missions like the infrared telescope.

Why is this happening? The answer lies in the constraints on the federal budget that require the administration to find cuts for every new program it wants (*Science*, 11 February, p. 744). NASA's overall budget is scheduled to shrink by some $250 million in 1995, to $14.3 billion, and Congress could impose additional cuts. Within that tight budget, NASA has increased funding for Mission to Planet Earth, up 21% to $1.24 billion, and other environmental monitoring missions. And an increasing number of active spacecraft—the legacy of space science's growth in the late 1980s and early 1990s—has saddled the agency with a rising bill to keep them operating. The trends leave little room for data analysis and new missions.

Wesley Huntress, NASA's associate administrator for space science, doesn't pretend otherwise. "Clearly, if we're going to be serious about the agency's budget as a whole remaining flat, and if Mission to Planet Earth [MTPE] is going to grow, something has to give," he says. "In this budget projection, that's space science."

The increased funding for MTPE—an $18-billion project to orbit remote sensing satellites to monitor global warming and other environmental trends—is included in NASA's overall calculations of what it spends on science, but most space scientists don't consider it part of their research portfolio, says Mark Allen, head of the Space Studies Board at the National Academy of Sciences. Indeed, says Peter Boyce, president of the American Astronomical Society, "There's a concern that environmental priorities have put space science at the bottom of the heap."

NASA officials say the 1995 request for space science, $1.766 billion, could have been worse: At one point late in the budget cycle, at least two fully operational science missions were lined up for termination. "I think the science community ought to feel good about this budget," says Huntress. "We didn't lose any missions and we didn't have to turn anything off. It could have happened." But many scientists think that it is plenty bad enough. The only new missions in the budget are second shots at previous failures—a proposed reflight of a 1992 Space Shuttle tether experiment that didn't work and the first of two small spacecraft to recapture some of the science lost when the Mars Observer disappeared last August. And NASA projects a decline for the rest of the decade of about 7% a year (see chart) in absolute dollars, without any allowance for inflation.

"This is a minimalist budget," says Lennard Fisk, a University of Michigan astrophysicist and former head of NASA's space science programs. "It's simply sustaining what we agreed to be done many years ago." The key question, he says, is, "What's in the budget that's going to be there when the current missions are gone? If you don't have anything you're going to be launching in 3-5 years, you're basically running a going-out-of-business sale."

At the moment, NASA's space science future lies in two large missions that have already been approved—the $3.5-billion Cassini mission to Saturn and the $2.2-billion Advanced X-ray Astrophysics Facility (AXAF), which are scheduled to be launched in 1997 and 1998, respectively—as well as a number of much smaller missions in its Discovery and Explorer series. A third major effort, the $2-billion Space Infrared Telescope Facility (SIRTF), was originally planned for 1997 or 1998 as the last of the four Great Observatories. But NASA didn't have enough money to request it this year, and its future is uncertain. Officials are now trying to lower the cost of SIRTF to below $350 million, and are thinking about dividing it into two smaller spacecraft, one of which could be an international project.

NASA's budget realities mean that the Hubble space telescope, AXAF, and Cassini are dinosaurs. "Given the budget deficit, we're not going to be able to fund missions like that any more," says Huntress. Discovery- and Explorer-class spacecraft, which cost around $100 million, are a popular stopgap, and fit into NASA Administrator Daniel Goldin's emphasis on "smaller, cheaper, faster" missions. But they support many fewer scientists than the larger missions, and lack the range of instruments to do "one-shot" surveys of planets or regions.

NASA's budget projects reductions in

small science, too. An analysis by the American Association for the Advancement of Science (which publishes *Science*), based on NASA's figures, calculates that the agency's 1995 request represents a 7.6% ($143 million) cut in basic research, a category made up mostly of grants to scientists for technology development and data analysis. (NASA's figures, which include mission operations and facilities, show an increase of 2.6% for space science.)

The cuts are likely to fall first on those analyzing data. For Jet Propulsion Laboratory space scientist David Crisp, the 1995 request means the loss of an already approved $140,000 grant to analyze data from Venus. Crisp's grant is a casualty of the cancellation of data analysis programs for Mars, the Voyager flyby of Neptune, and the Magellan and Pioneer missions to Venus. NASA saved $4.5 million by giving Venus the cold shoulder, but disrupted the lives of dozens of scientists. "I spent a month writing the proposal," says Crisp. "I hate to see these things fall by the wayside after they've been approved."

Individual programs have been killed before, but next year NASA will preview a new model that may be used to cut costs from any aging missions. For the first time, the agency will pay to operate spacecraft without funding scientists to analyze the data they produce. The initial round of spacecraft to go that route will be the International Ultraviolet Explorer (IUE) and the U.S. component of the international ROSAT mission. In a last-minute appeal to the White House, NASA won approval to request enough money to save the satellites but not enough to pay for data analysis.

NASA expects scientists somehow to find funding elsewhere to do the analysis, much as they now do for some ground-based observatories, such as Kitt Peak in Arizona. But researchers point out that the National Science Foundation, which supports work at Kitt Peak, is oriented toward ground-based astronomy and doesn't have the resources to pick up the tab for NASA programs.

Jeffrey Linsky, a University of Colorado astrophysicist who heads the IUE user group, says NASA asked the scientists to rank their needs before making the cuts. Keeping the spacecraft operating was at the top of the list, and data analysis grants were at the bottom. "We can't say they didn't follow our priorities," he says ruefully. But the $4-million cut will rob about 200 scientists of a significant part of their funding and eliminate slots for graduate students and post-docs.

And it gets worse. Linsky says NASA has warned scientists that it may adopt this strategy with other astrophysics missions that are already flying, including ASTRO-D, the Extreme Ultraviolet Explorer, and the Compton Gamma Ray Observatory. "This is going to mean an enormous amount of pain for university scientists," he predicts.

Guenter Riegler, head of the science operations branch of NASA's astrophysics division, confirms that the pay-your-own-way model may soon be extended to other missions, but he predicts it will work for only a few years. "After more and more missions get into this mold, the system will break," he says. "Then you have to trade new missions for old ones."

Many space scientists cringe at the thought of turning off productive missions, especially to make way for replacements that could fail. "It's foolhardy to pay to send up things and then turn them off to get money to start new things, which may not get up or work," says Harvey Tananbaum, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics, who heads the AXAF science center. He also points out that the savings from shutting down any but the largest spacecraft would pay for only a fraction of the cost of a new mission.

Nevertheless, NASA officials don't see many other ways to accommodate new missions. "We want to make sure not to turn off missions prematurely," says Huntress. "On the other hand, we don't want to extend them so far—just for the sake of wringing every last drop out of them—such that we don't have enough money for new missions." The approach implies a tough choice: NASA must weigh the benefits of beginning a new program against what will be lost by terminating an existing mission. For the first time, says NASA chief scientist France Cordova, the agency plans to involve the science community in that decision, using interdisciplinary panels of researchers to analyze how much science would be generated by each spacecraft for each additional year aloft.

But whatever they do, space scientists cannot escape the fact that NASA has changed the way it does business. And over the next few years, those who observe the heavens for a living may find themselves wishing on a star for money to do their research.

–Christopher Anderson

BIOTECHNOLOGY

NIH Drops Bid for Gene Patents

In June 1991 the National Institutes of Health (NIH) stunned the biotech community by filing for patents on uncharacterized gene fragments sequenced by its scientists. The filings, which NIH officials said were designed to protect the government's rights in case the sequences had any commercial value, spawned a fierce debate about whether anyone could own such fragments, whose functions were not yet known, or whether the sequences should remain in the public domain.

RICK KOZAK

Just say no. NIH Director Harold Varmus pulls the plug on patents for gene sequences.

Last week NIH surprised the community again, announcing that it was withdrawing its patent applications for 6,869 sequences. Director Harold Varmus said patents on such partial sequences are "not in the best interests of the public or science." But the issue is far from dead, because NIH was not alone in trying to patent gene fragments. Several companies have said they are pursuing similar patents, and many others are thought to be doing so privately. These applications are not affected by NIH's about-turn.

NIH's decision leaves unresolved the question of whether uncharacterized gene fragments can, in fact, be patented. Early on, Officials from the Patent and Trademark Office (PTO) told NIH that they planned to reject the patents, which would force the matter to the patent appeals court, where a decision would have greater significance. But NIH dropped the application before the appeals court got the case. It will now be up to private companies to test the legal waters, but their dealings with the PTO are likely to be far more secretive. Indeed, if their patents are rejected, they may keep that information to themselves, on the assumption that acknowledging defeat could depress the price of their stock.

NIH started the ball rolling when geneticist Craig Venter, then at the National Institute of Neurological Disorders and Stroke, sequenced thousands of fragments of complementary DNA (cDNA), which represents expressed genes, as a quick way to get some genetic information without mapping and sequencing the entire genome. Then-NIH director Bernadine Healy, motivated by a congressional mandate to encourage the transfer of federal technology to industry, decided to file patents on Venter's sequences, with the idea of licensing them to