The Smithsonian Institution is home to some of the world's finest collections, but it's beset by problems, and Smithsonian scientists are up in arms over Secretary Lawrence Small's efforts to fix them

Turmoil Behind the Exhibits

Smithsonian fireworks. The institution's historic castle and its chief, Lawrence M. Small (*below*).

On 4 April, Lucy Spelman, director of the Smithsonian Institution's National Zoo, drove an hour west of Washington, D.C., to deliver some grim news. She told 65 employees of the zoo's Conservation and Research Center (CRC) in Front Royal, Virginia, that the Smithsonian planned to close the sprawling facility, one of the world's oldest centers for research on endangered species. That same day, scientists at another Smithsonian research facility, the Center for Materials Research and Education (SCMRE) in Suitland, Maryland, learned that they, too, could be out of a job by the end of the year: Their center had also been tagged for the ax (*Science*, 13 April, p. 183). The reaction was swift, noisy, and effective.

The announcements caused a public eruption of discontent that had been festering behind the Smithsonian's famous exhibits for more than a year. The planned closures were the first casualties in a battle over the future of science at the venerable institution. Over the next few weeks, a flurry of newspaper stories told of trouble in the nation's attic. Smithsonian scientists accused the institution's top brass of killing off science to fund splashy exhibits and undermining the Smithsonian's credibility as a result. The director of the National Museum of Natural History (NMNH), Robert Fri, resigned, saying he could no longer support the policies of his boss. And Virginia and Maryland politicians rushed to the defense of the two threatened facilities. In the end, the public fuss gained the CRC a reprieve. But the tussle over Smithsonian science is far from over.

At the eye of the storm is Lawrence M. Small, the Smithsonian's secretary. A former chair of the executive committee of the board of directors of Citibank and president and chief operating officer of Fannie Mae, the large home mortgage institution, Small brought a corporate style to the Smithsonian when he was installed in January 2000 as its 11th secretary. He is the first nonacademic to head the institution since it was founded in 1846 with a gift from British scientist James Smithson "for the increase and diffusion of knowledge."

Small came in as a reformer with a pledge to put the Smithsonian on a firmer financial footing, define a new "mission" for the institution, and subject its activities to more rigorous assessments. He has announced his intention to reorganize science throughout the Smithsonian into "centers of excellence," administratively separate from the public exhibits, and raise its visibility. Good science would get more support, while lower priority areas would be phased out. "It's necessary for us to set our priorities in a thoughtful, paninstitutional way" and focus on fewer themes so "we can make a more compelling case" to potential donors, he said in a recent interview with *Science*.

Those plans have generated deep anxiety, in part because they have yet to be spelled out in detail. Researchers, who have felt left out of the process, don't yet know to whom their groups will be reporting—or even whether their work will be phased out. The discontent is deepest at the NMNH, the largest Smithsonian unit and, arguably, the one with the most to lose in a shake-up.

The uncertainties could persist for months. In May, following the furor over the planned closure of the CRC, the Smithsonian's Board of Regents approved the creation of a blue-ribbon commission of prominent scientists from within and outside the Smithsonian to work with Small on the scientific reorganization. The panel, which had not been appointed when this issue went to press, is expected to make preliminary recommendations by the end of the year. In the meantime, concerned members of Congress have told Small not to act without the commission's approval.

Small has justified his

CREDITS: (LEFT TO RIGHT) CHIP CLARK/NATIONAL MUSEUM OF NATURAL HISTORY; SMITHSONIAN INSTITUTION; RICK KOZAK

actions in part on the grounds that, although some areas of science are outstanding, others are not up to par and leadership has been lacking. To examine the basis for those charges, *Science* obtained the reports of outside reviews of the Smithsonian's major science programs, asked the Institute for Scientific Information (ISI) in Philadelphia to analyze the scientific output of Smithsonian scientists, and talked to dozens of scientists inside and outside the institution. The picture that emerges is of a scientific enterprise that is, as one review put it, a "national treasure," but that is beset by budget problems and in need of reforms. "There's so much potential there," says Hans-Dieter Sues, vice president for collections and research at the Royal Ontario Museum in Toronto. "Somehow, the creative spark needs to be reignited."

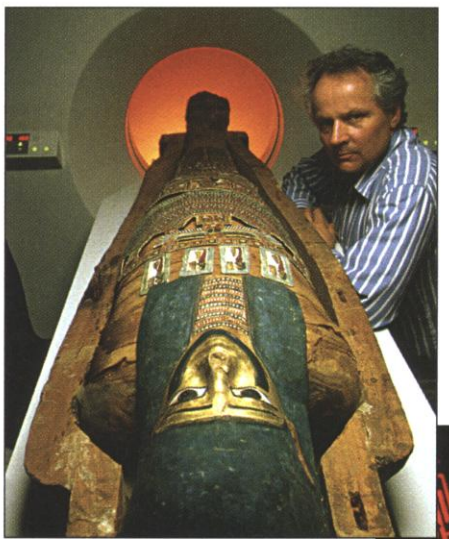
The big squeeze

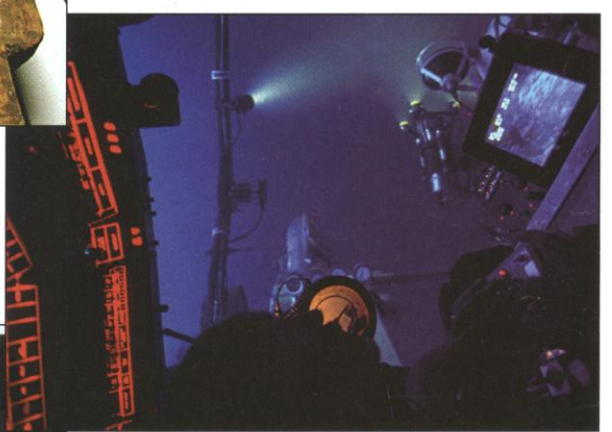
Nobody doubts that Small took on a big challenge when he became secretary. Under his charge are the National Zoo and 16 museums covering a wide range of subjects including art, architecture, American history, and natural history. Like the zoo, most of the museums are based in Washington, D.C., many of them laid out in parallel down a grassy mall that extends about a kilometer to the steps of the U.S. Capitol. Free of charge to all comers, the museums and their exhibits are the veneer, the public view of some 155 years of research, scholarship, and collections by Smithsonian curators. Together, they draw more visitors than any other institution in the world.

Behind that veneer is a sprawling research enterprise spread among the museums and a half-dozen separate research centers, including the Smithsonian Tropical Research Institute (STRI) at sites throughout Panama, the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Massachusetts, and the Smithsonian Environmental Research Center (SERC) in Edgewater, Maryland. Both the veneer and the base on which it rests are in financial trouble.

Support from the federal government, which covers about 70% of the Smithsonian budget, hasn't even kept up with the payroll over the past decade. Yet the institution has embarked on a string of major capital projects, including construction of a new building on the mall for the National Museum of the American Indian, that were started long before Small arrived. Cost overruns on the new museum and sharp increases in the costs of renovating aging buildings have caused the postponement of some repairs and other construction projects.

The Bush Administration's budget, submitted to Congress in April, won't help: Although Small says he requested a "huge" increase, the Office of Management and Budget approved a mere $40 million more for next year, for a total of $494 million.





Diverse science. Smithsonian scientists run CT scans on mummies (Bruno Frohlich, above), identify birds from feathers caught in plane engines (Roxie Laybourne, below), explore the undersea world, and much, much more.

Some $30 million of that increase will go to building the new museum and restoring old ones. What's left won't cover the $15.6 million increase needed for salaries, utilities, and postage; nor will it fund "institution priorities": setting up a satellite air and space museum ($1.7 million), buying a new financial system and updating computers and security systems for $8 million, and a new $2 million outreach program. Thus the secretary expects to find $13.45 million from other programs.

That's bad news for science, which would get about the same as last year: $113 million—60% of which will pay for salaries. Smithsonian science has been chronically short of funds for years. Over the past decade, research dollars have decreased by almost a quarter Smithsonian-wide, and while the number of Smithsonian employees has jumped 41%, reaching 5700 in 1999, the number of curators in natural history alone has slipped from 118 to 99 during that same decade. "We're overstressed and overbooked on everything we try to do here," says Richard Benson, who chairs the paleontology department.

A mixed bag

Those budget pressures are forcing a hard look at the quality of science at the Smithsonian. Just how good is it? The question is difficult to answer because the sweeping range of the science at the institution defies easy comparison, and in many cases—especially in the NMNH—scientists play an important role that may not show up in the traditional measures of scientific excellence: maintaining and making use of valuable collections. But many consider it the ultimate information source. "The Smithsonian research effort is so large and broad based that no other museum in the world can hold a candle to it," says Michael Mares, director of the Sam Noble Oklahoma Museum of Natural History in Norman.

The ISI figures seem to bear out that perception. The natural history museum, STRI, SERC, and the astrophysical observatory rank in the top 1% of institutions in terms of their scientific impact, as measured by the number of publications they produce in their appropriate fields and the average number of citations each paper receives (see table, p. 197). The astrophysical observatory, which is linked to Harvard's astronomy department, is considered among the best astronomy centers in the world. And STRI's work on tropical forests and coral reefs have been cornerstones in

CREDITS: CHIP CLARK/NATIONAL MUSEUM OF NATURAL HISTORY, SMITHSONIAN INSTITUTION

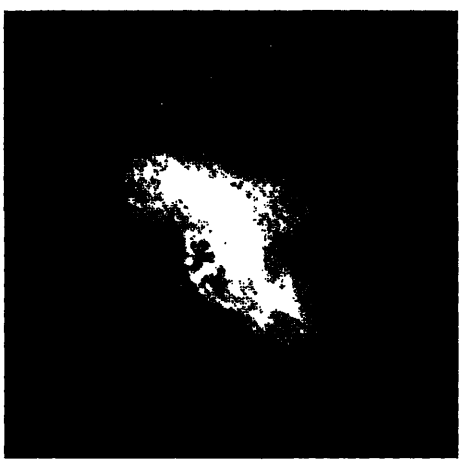
Jewels in the Crown I: Astrophysical Observatory

CAMBRIDGE, MASSACHUSETTS—With its formidable staff of 240 scientists, a bevy of cutting-edge instruments, and a long-standing partnership with one of the world's great universities, the Harvard-Smithsonian Center for Astrophysics is one of the Smithsonian's—and one of the world's—premier research facilities. But the 111-year-old center is embroiled in a quiet institutional crisis.

Cost overruns are straining a tightening budget, while rising salaries and a severe lack of office space limit new hires and new programs. At the same time, researchers are up in arms about director Irwin Shapiro's plan to increase Harvard's influence at the center. "This is a pivotal time for us," says Andrea Dupree, a longtime center researcher and past president of the American Astronomical Society. "We need to make decisions about our future, and there's a sense we are going to be left out."

The center is the result of a 1973 merger of Harvard's and the Smithsonian's observatory programs. Since 1985, shortly after Shapiro became chief, it has doubled its staff and more than tripled its budget. Facilities range from the Multiple Mirror Telescope (MMT) on Mount Hopkins in Arizona—currently being upgraded—to the Submillimeter Array (SMA) now under construction on Mauna Kea in Hawaii. A committee of outside scholars who reviewed the center in 2000 was "uniformly impressed" by the state of its operations and science, according to a copy obtained by *Science*.

But there are signs of strain. In 1984, the SMA was to cost $25 million and take 6 years to build; the most recent estimate is $70 million in current dollars, and a series of technical troubles has delayed the effort by several years. The MMT conversion to a more powerful set of telescopes also has encountered technical troubles and is short-staffed. Other projects, such as NASA's Chandra X-ray Observatory which is operated by the center, are running smoothly. But a stagnant budget in recent years has left Shapiro with little flexibility. Travel, support, and computer system funds have suffered. "Such a pattern cannot continue indefinitely, as it will eventually strangle the institution," warns the committee, which urged Shapiro to come up with a long-term plan—and hinted that it is time for new leadership. Shapiro, who says the plan will be ready by December, insists that he has no plans to retire.



High impact. Crab Nebula as seen by NASA's Chandra spacecraft, operated by the Harvard-Smithsonian center.

The tight budget is not Shapiro's only difficulty. He wants to increase the number of center scientists who have joint appointments at Harvard and give the university a greater say in appointing them. He contends that reviving the tradition of appointing joint researchers—the last of whom was hired 13 years ago—is essential to maintain Smithsonian representation on the Harvard faculty. Many center astronomers say it will make second-class citizens of those paid purely by the Smithsonian.

Smithsonian Secretary Lawrence M. Small likely will have to wade into the center's issues in the coming months. Although he has other fish to fry as he revamps the institution, he will have plenty of work to do to keep one of the Smithsonian's jewels well polished.

–A.L.

tropical and marine ecology.

STRI, SERC, and the astrophysical observatory have managed to weather the fiscal drought in recent years and remain strong. They are focusing on "hot" research fields and have been able to attract considerable outside support (see chart, p. 198). But the NMNH hasn't done as well. "We've had several years of very marginal funding in this museum, and we've never been able to break out of it," says Smithsonian anthropologist Donald Ortner. And museum scientists have had a tough time generating outside support, in part because the National Science Foundation traditionally funds research involving other government-supported scientists only if they team up as co-investigators with university researchers.

The museum has also suffered chronic leadership problems. While STRI and the astrophysical observatory have had long-term, stable leadership, NMNH has had eight in the past 20 years alone. Larry Abele, a systematist at Florida State University in Tallahassee, realized the seriousness of the situation when it took two tries for the museum to find a new director in 1995. It seemed clear then that "the national museum was really losing its position as a leader in the world of systematic and evolutionary biology," he recalls.

Trouble at Natural History

The same perception troubled the man who eventually took the job, Fri, a soft-spoken energy expert. In 1998, Fri instituted a series of reviews of the museum's science. Panels of outside experts evaluated the life, human, and earth sciences programs. Then a committee headed by Jack Gibbons, President Clinton's first science adviser, and entomologist May Berenbaum of the University of Illinois, Urbana-Champaign, worked with the chairs of the three expert panels—Abele, Jane Buikstra of the University of New Mexico, Albuquerque, and Alfred Fischer of the University of Southern California in Los Angeles—to integrate their findings into a report recommending change in the museum as a whole. The panels found a mixed bag and problems that go beyond the budget squeeze.

The Berenbaum-Gibbons panel pointed to many strengths across the museum. The museum's life scientists "have significantly contributed to our fundamental knowledge of numbers and kinds of macroorganisms on earth," it said. The geological and paleontological collections are "second to none in the world." The gems and minerals collection and the scholarship associated with it "are particularly notable." Work on volcanism "sets a standard for excellence." The human science program has developed "an incomparable resource documenting the history of humankind in North America" and "advanced our knowledge of significant issues ranging from the origins of agriculture to human origins."

However, the panel continued, "the NMNH is not known institutionally for having developed great principles and theory, particularly in life sciences, nor has it as yet established a noteworthy position in the ecological and evolutionary sides of systematics and natural history." It complained about "departmental insularity and fragmented vision, in which curators seemed to be more concerned with their turf than in crossing departmental boundaries to pursue such matters as global change, biocomplexity, and conservation."

The panel urged the museum to turn more toward synthesizing data, developing broad concepts, and addressing the impact of human history on the natural world. It also called for more stringent evaluations of research productivity and expressed concern about lack of staff turnover, noting that the number of curators over 65—about 25%—

CREDIT: NASA/CXC/SAO

PUBLICATION IMPACT*

	No. of papers	Citations/paper
Smithsonian Institution (all)†		
Plant and Animal Science	1707	6.0
Environment/Ecology	438	10.7
Geosciences	236	6.1
Space Sciences (CfA)	2810	17.0
National Museum of Natural History		
Plant and Animal Science	482	3.7
Smithsonian Tropical Research Institute		
Plant and Animal Science	190	13.0
Environment/Ecology	277	7.4
Smithsonian Environmental Research Center		
Plant and Animal Science	105	15.0
Environment/Ecology	98	12.8
Field Museum of Natural History (Chicago)		
Plant and Animal Science	309	4.4
American Museum of Natural History (NYC)		
Plant and Animal Science	258	4.2

* Papers and citations cannot be compared across fields because each discipline has a different publishing strategy. Some counts may be depressed because some taxonomic journals are not included, and the affiliation often shows up as Smithsonian Institution rather than a constituent unit. † Includes data from NMNH, STRI, and SERC, broken out separately below.

at the museum had tripled since 1987.

"We drafted a very substantive report, and this was bought into by the scientists," recalls David Dilcher, a paleobotanist at the University of Florida, Gainesville, who served on the life sciences panel. "We have [developed] a wide array of wonderful science without an understanding of what we're strategically positioned to do," explains Melinda Zeder, a Smithsonian anthropologist. "With the current funding climate, there is a need for finding [a] vision" and setting priorities. "Everyone understood where they were going and were ready to implement this work," says Emilio Moran, an anthropologist at Indiana University, Bloomington, who is an adviser to the museum.

The Small revolution

The NMNH's outside panel delivered its report on 24 January 2000. That same day, Small was installed as secretary.

Three weeks after taking office, Small announced a new structure for managing science across the Smithsonian. He promoted the Smithsonian's provost, biologist Dennis O'Connor, to a new position of under secretary for science, with oversight over all the institution's science programs. In a memorandum to the staff announcing the reorganization, Small said he planned "to focus the Institution's resources into centers of excellence, which should receive most of the funds devoted to science" and "develop plans to phase out ... the scientific activities that are determined to be outside our chosen areas of specialization." O'Connor—who was later joined by former deputy STRI director Anthony Coates in the new position of director for scientific research programs—began reviewing all the Smithsonian programs and the external reviews that had piled up over the years, and they looked at the c.v. of every Smithsonian scientist.

When Small first arrived, many scientists welcomed the prospect of reform. "I think he understands the problem: We need money," says Ortner. "I think he's right on target there." But Small soon began rubbing scientists the wrong way with remarks that seemed critical of the work the museum scientists had done. He called the collections disorganized, a new museum exhibit too dense with information, and constantly lauded the astrophysicists while criticizing natural history researchers. They felt they were being blamed for problems beyond their control. "What we need is support, not detraction and insults from the secretary," says Vic Springer, a fish systematist at the NMNH. To make matters worse, in the summer of 2000, Small froze endowed funds that scientists relied on for special projects. The freeze proved temporary but fueled suspicions that he was robbing science's till to support pet projects.

But Small and his scientists were trying to work together. Small set up regular breakfast meetings, held "town meetings," and called individual scientists to ask for their thoughts. In response to Small's call for a small number of "themes" to describe Smithsonian science, representatives from each department at the NMNH formed a science council that came up with nine crosscutting themes, or research questions, and proposed that all of the NMNH be realigned into three areas: earth and planetary systems; evolution, diversity, and dynamics of life; and human dimensions of diversity and change.

Despite these efforts, new strains emerged. Small ceased to meet regularly with museum directors, and more and more museum administrators felt left out of strategic planning sessions. Tensions came to a head in March 2001, when Ross Simons, head of science at NMNH, and Coates briefed the science council on the outlines of a reorganization plan. The Smithsonian's science operations and personnel would report to four "institutes" spanning the entire institution: biodiversity, astrophysics, human sciences, and earth and planetary sciences. In addition, science and public programs—which include the exhibits—would be managed separately.

In interviews with *Science*, Small said the changes were needed for "better coordination and better sharing of resources." Once the administrative units are congruous with a few scientific themes the Smithsonian can excel in, Small said, he will be able to raise money for those themes. Small also

Jewels in the Crown II: Environment Center

Barely an hour away from the turmoil in Washington, D.C., researchers at the Smithsonian Environmental Research Center (SERC) in Edgewater, Maryland, do long-term ecological research, monitoring the Chesapeake Bay estuary and the interconnected ecosystems at the 1000-hectare site. Elsewhere around the world, SERC scientists study the effects of global change and landscape ecology. During the summer, the research staff swells to 130, although only 14 researchers are full-time Smithsonian senior scientists. As with the astrophysical observatory, this center is not as reliant on money from Congress as is the National Museum of Natural History; some 60% of its support comes from outside grants and contracts. "It's an entrepreneurial staff, working in topical areas that agencies are interested in funding," says Ross Simons, its director. **–E.P.**

Living lab. Chambers at SERC test the effect of high carbon dioxide concentrations on plant growth.

CREDITS: SOURCE: INSTITUTE FOR SCIENTIFIC INFORMATION; SERC

Jewels in the Crown III: Tropical Research Center

Since the 1920s, the Smithsonian Tropical Research Institute (STRI) in Panama has been a favorite study site for tropical researchers. STRI currently operates nine field stations in Panama that focus on everything from cloud forests to coral reefs. More than 600 visiting scientists flock to the centrally located Barro Colorado Island facility in a typical year, often lured by the chance to work shoulder-to-shoulder with STRI's 33 principal investigators. "There is no place like it; the quality of their investigators and their publication rates are remarkable," says Chris Peterson, a coral reef researcher at the College of the Atlantic in Bar Harbor, Maine, who did postdoctoral work at STRI in the late 1980s.

STRI's budget has been essentially flat at about $15 million over the last 3 years, with about a third of the total coming from private donations and contracts. Despite the financial stagnation, however, outsiders perceive STRI to be thriving. A five-member visiting committee that graded STRI late last year concluded, "Among hundreds of tropical research institutions around the world, STRI is undeniably the best," singling out research in ecology, evolution, animal behavior, and anthropology for special praise.

That may be due to something that many observers say the National Museum of Natural History lacks: energetic and consistent leadership. Tropical biologist Ira Rubinoff, widely regarded as a model of the politically savvy scientist, has led STRI for 28 years.

–D.M.

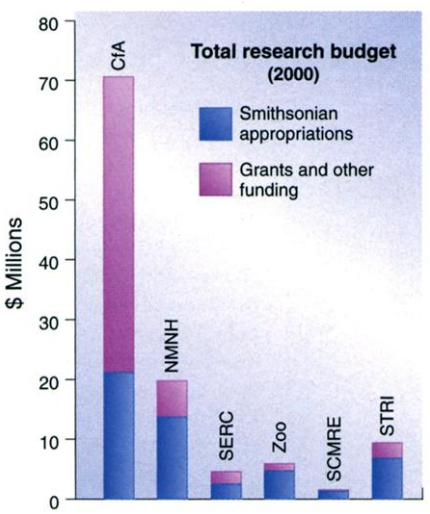
Coral reef life. STRI made its mark studying both marine and terrestrial tropical biodiversity.

argued that better science would result if scientists didn't have to divide their time between public programs and research, and they could develop more fruitful collaborations with Smithsonian colleagues interested in the same themes. "If we want to stop withering on the vine," adds Coates, "we have to do something about it by pruning ourselves, reorganizing ourselves, and getting out into the private sector."

But the council scientists left the meeting shaking their heads. Many say they support the idea of discipline-based centers of excellence, but some question the wisdom of restructuring the entire science program to create them. "I think [revitalizing science] requires a more nuanced approach than reorganizing the structure," says Zeder. STRI evolutionary biology Mary Jane West-Eberhard agrees, suggesting that stable funding and "strong leadership that can distinguish between delayed payoffs and deadwood" are the solutions.

Many found the move to divide science from public programs especially troubling if it separates scientists from the building of exhibits. "There needs to be the sense of obligation to the public; they need to work with the public to engender public enthusiasm [for science]," says Dilcher. Adds Conrad Labandeira, a Smithsonian paleobiologist, "It would be an unmitigated disaster."

In the face of these criticisms, Small, O'Connor, and Coates decided not to release details of the impending reorganization until the Smithsonian's Board of Regents had a chance to review it at its next meeting in early May. Rumors filled the void left by their silence, fanning concerns about the future and about Small's true intentions. It didn't help that Small suspended the procedure by which scientists get promotions and raises, expecting in May to implement a new one based on the reorganization.



Federal trough. NASA funding makes the astrophysical observatory the big breadwinner.

The announcement on 4 April of the planned closure of the CRC and the SCMRE provided the spark that ignited this powder keg. Small and zoo chief Spelman justified the cuts, which were included in the Bush Administration's budget submission to Congress, as being necessary to free up funds for higher priority efforts, including refurbishing and updating exhibits and programs at the zoo. Spelman noted that some of the work of the CRC would be transferred to the zoo's main site in Washington, D.C.

Over the next several weeks, however, congressional representatives, scientific organizations, and individual researchers stood up to defend these centers. Many scientists felt that the cuts were further evidence that Small regarded science as a low priority. "Small has articulated support for science, but at the same time, we don't see support," says NMNH paleontologist Doug Erwin.

The heated rhetoric continued until, on the eve of the regents' meeting, Small withdrew the proposal to close the CRC, saying the reasons had been misinterpreted. Small provided the regents (and eventually the press) with a white paper called "Science for the 21st Century," again laying out the rationale for centers of excellence and focusing on areas of science the Smithsonian does best. But the document provided no details of how the science would be structured or what would be cut.

The regents approved the overall concept. Given the funding trends, "we can't be all things to all people," says one regent, microbiologist Manuel Ibáñez of Corpus Christi, Texas. The details will now be worked out in conjunction with the blue-ribbon committee. Coates expects the group to consider not just a reorganization strategy proposed by Small but also a plan drawn up by the scientists themselves. And although everyone is anxious to have Smithsonian life settle down, he expects the committee's work to take at least to the end of the year.

Natural History may have to face the changes without a leader. In June, Fri submitted his resignation. He declines to discuss his reasons, but in a terse statement he issued at the time, he said "I do not feel that I can make [the] commitment enthusiastically" to the impending changes.

All along, Small has argued that the Smithsonian's science lacks visibility. That's now changed: Key members of Congress are now acutely aware of the Smithsonian's science programs, and last week a Senate committee blocked the closure of the SCMRE. If Congress eventually produces a more generous budget for science, that may be one of the lasting benefits of the past year's noisy recriminations. **–ELIZABETH PENNISI**

With reporting by Andrew Lawler, David Malakoff, and Erik Stokstad.

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