DECEMBER 2002

REPORT
OF
THE SMITHSONIAN INSTITUTION
SCIENCE COMMISSION

PRESENTED
TO

THE BOARD OF REGENTS
OF THE SMITHSONIAN INSTITUTION

THE SECRETARY
OF THE SMITHSONIAN INSTITUTION

Smithsonian Institution

TRANSMITTAL OF REPORT

BY

THE SMITHSONIAN SCIENCE COMMISSION

DECEMBER 2002

TO:

THE CHIEF JUSTICE OF THE UNITED STATES, CHANCELLOR
AND MEMBERS OF THE BOARD OF REGENTS OF
THE SMITHSONIAN INSTITUTION
THE SECRETARY OF THE SMITHSONIAN INSTITUTION

THE SMITHSONIAN INSTITUTION SCIENCE COMMISSION
UNANIMOUSLY ENDORSES THIS REPORT AND URGES ITS ADOPTION.

RESPECTFULLY SUBMITTED,

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EXECUTIVE SUMMARY

Smithsonian science is facing the most critical time in its 156-year history. Despite continuing financial pressures, much of the Smithsonian scientific enterprise is flourishing, as documented by recent National Academy of Sciences and National Academy of Public Administration reports. But, without inspired leadership and careful strategic planning, it might slip - like a building without maintenance - into a state of mediocrity from which it will be hard to recover. This report offers a series of fiscally responsible recommendations that the Science Commission believes will lead to significant improvements in Smithsonian science.

In order for Smithsonian science to achieve the highest levels of accomplishment, the senior administration of the Smithsonian Institution (SI) must reverse the long-term trend of declining support and relative neglect of scientific Units. To reverse this trend, senior administration must convince the Office of Management and Budget (OMB) (and ultimately the Congress) of the compelling case for financial support of science at the Smithsonian. As a first step, OMB must fund yearly salary increases, so that fundraising efforts for new initiatives can build on a secure foundation. The cannibalization of staff positions to fund these mandated increases must stop.

The backbone of science at the Smithsonian is research. This applies to all science Units. The Institution's rich array of ongoing research projects requires increased attention to both production and dissemination. This report indicates ways this can be accomplished within existing fiscal constraints. It also stresses the great importance of the collections of the National Museum of Natural History (NMNH) (approximately 124 million items), and the need to maintain this vital and unique national resource.

The Commission recommends that the Under Secretary for Science, in close consultation with Unit and Center Directors, focus SI science on four general research themes: the origin and nature of the universe; the formation and evolution of the Earth and similar planets; discovering and understanding life's diversity; and the study of human diversity and culture change. The Institution-wide integration of these themes is especially important. Through such connectivity - defined here as ***Science Smithsonian*** - the Institution can be more than the sum of its parts and can increase its contributions to both pressing national and international needs and geometrically advance science in general.

This report, following the charge of the Smithsonian Board of Regents, focuses on issues of leadership, structure, performance evaluation, education, outreach, budget, and implementation of recommendations. The general thrust of the Commission's recommendations in these areas can be summarized as follows:

- **Leadership:** Beyond the erosion of funding support, the lack of effective, long-term leadership has been the single most important factor in the weakening of SI science (as witnessed, for example, by the high turnover of Directors and Acting Directors at the NMNH over the last 2 decades). All leadership positions above

the level of Department Chair should be filled through nationwide searches. Plans need to be implemented to more effectively integrate public programs and exhibits with ongoing research. A full-time Director should be appointed at the Smithsonian Environmental Research Center.

- **Structure:** While there is little need to change the Institution's basic science structure, a modest restructuring of the Office of the Under Secretary of Science to facilitate planning, communications, and performance assessment is recommended. SI scientists should be detailed on a temporary, rotating basis as Special Scientific Advisors to the Under Secretary, and mechanisms put in place to engage scientists in strategic planning and management of science. Retirement incentives would allow infusion of new blood and revitalize some Units.
- **Performance evaluation:** The Commission recommends that performance evaluations be made more effective by having clear, concise, and consistent standards for the review process (such standards should be developed by members of the staff, as well as administration.) Annual reviews and Professional Accomplishment and Evaluation Committee (PAEC) reviews should be more closely meshed. All science staff subject to PAEC should be reviewed at regular intervals, and results communicated and implemented in a timely manner. Exceptional performance must be rewarded. On the Unit level, the implementation of a system of external Visiting Committees for all science Units will provide evaluations and guidance.
- **Education:** As outlined in the Smithsonian's original charter, education and outreach are integral parts of the SI science program. They should include exhibits, seminars, workshops, Web sites, publications, internships, fellowships, and research training programs. Despite their importance, these activities are diffuse and lack coordination. They have sustained major budget reductions, loss of infrastructure, and program terminations. The Commission recommends the immediate development of an Institution-wide strategic management and fund-raising plan for science education. The goal is to make the SI a world-class leader in research-based science education, accelerate the renewal of exhibitions and Web-based learning, rejuvenate Scholarly Studies and Fellowships programs, establish a biannual Smithsonian Conference series, and develop a high-level pan-Institutional Education Council to encourage coordination and collaboration.
- **Outreach:** The SI must update and put into action the science and research communication plan drafted 2 years ago. The Under Secretary for Science and all the Units must work more closely with the Office of Public Affairs to promote SI research. The Regents, Secretary, Under Secretary, and Office of Government Relations should create a committee to better inform Congress and the federal establishment about the many contributions to the public good made by SI scientists.
- **Budget:** Critical budget items for Smithsonian science include correcting the base erosion produced by unfunded mandatory salary increases; maintaining the Major Scientific Instrumentation and Research Equipment Funds; and, funding Fellowships and Scholarly Studies programs. Recent cuts have produced negative effects on scientific productivity, out of proportion to the fiscal gain.

- **Implementation:** The Board of Regents should establish a 3-year benchmark period for this report. By July 2003, the Under Secretary for Science should create a plan for carrying out the Commission's recommendations, including explicit metrics for success and a timetable for completion. This plan will be implemented through the Scientific Directors Council, comprised of the heads of each major science Unit. The Under Secretary will also assemble a distinguished Visiting Committee to review the Institution's progress, on a yearly basis, in a brief report to the Smithsonian Regents (in December 2003, 2004, and 2005).

After careful examination of the issues and constraints facing the seven science Units, the Commission concludes that visionary leadership, tightening program operation, and selective cost-cutting hold the greatest promise. The Commission does not recommend specific closures or terminations in this report, but recognizes that such action may be necessary within the individual Units. In regard to the Unit and Center slated for closure prior to the Commission's creation, the Commission makes the following recommendations:

- **The Conservation and Research Center (CRC):** This important research program should be continued and fully integrated within the National Zoological Park (NZP). Federal funding for the Front Royal facility should be placed on a 5-year period of notice. The NZP and the supporters of the CRC should be given 2 years to find external funds for Front Royal. If such support cannot be found, the SI should work with Congress and other appropriate constituencies to turn control of Front Royal over to the General Services Administration within the following 3 years.

- **Smithsonian Center for Materials Research and Education (SCMRE):** This unique Unit should focus on its core mission of conservation research in support of Smithsonian museums and their collections. SCMRE should focus on its original mission and coordinate its activities with the conservators at all SI museums. In addition, some of its scientists should be transferred to the NMNH's Department of Anthropology, where their important work will be more appropriately supported.

The Smithsonian can once again become a national leader in science. But, this will require strong leadership, setting of Institution-wide priorities that emphasize the four-theme vision of ***Science Smithsonian***, greater transparency in planning, consultation, and fiscal activities, consistent accountability of scientific Units and individuals, and reversal of years of declining support through better communication of the importance of scientific research at the SI to the Congress and OMB.

Last, but most important, it is clear that the most significant problem facing Smithsonian science is funding. The Commission strongly recommends a four-pronged approach to solving this fiscal challenge. The Smithsonian should:

- **significantly increase its efforts to find private and foundation funding for its scientific activities;**

- **work with Congress to obtain direct federal funding for scientific research at the Smithsonian;**
- **work with the National Science Foundation to avail all Smithsonian scientists of the opportunity to apply for NSF research funding; and,**
- **work with Congress to increase the Smithsonian's base funding to fully cover mandated annual salary increases.**

1. INTRODUCTION[1]

a. Background

Science was the principal activity of the Smithsonian Institution (SI) for more than a century after its founding in 1846. Until 1994, all of the Secretaries of the Smithsonian were prominent scientists, including the greatest American scientist of his time, Joseph Henry, who served as Secretary from 1846 to 1878 and whose statue stands outside the Smithsonian Castle on the Mall to this day. As recently as 1963, most non-science activities at the Smithsonian were restricted to the old Arts and Industries Building and the Freer Gallery of Art. The Smithsonian was the United States' leading scientific institution for many decades. More than any other institution, the Smithsonian exemplified American science.

But, science expanded dramatically during the first half of the 20th century, and, beginning in the 1960s, the Smithsonian increasingly became home for America's public art treasures and artifacts. More than ten art and cultural museums were founded at the Institution since the 1950s, while basic scientific research has been increasingly neglected. Financial responsibility for these new enterprises eroded funding for the Smithsonian's science mission. Thus, it is hardly surprising that the Smithsonian today is largely perceived as a collection of art and cultural museums. Many people are surprised to learn that the Smithsonian has any science mission at all!

This decline of public and Congressional awareness of Smithsonian science poses a grave threat to the future of the Institution as a whole, because it undermines the reputation on which the Institution's educational and outreach programs are based. Despite decreasing visibility and financial support, the scope of Smithsonian science still extends across a vast range of subject matter, from astrophysics to tropical biology, from estuarine ecosystem science to paleobiology, from systematics and biological conservation to anthropology, planetary science and the conservation of precious and threatened museum materials and collections. Diversity has been a unique strength of Smithsonian science and should be the basis for its resurrection. But, as the recent National Academy of Sciences (NAS) and National Academy of Public Administration (NAPA) reports emphasize, neglect of Smithsonian science over many years has seriously compromised its mission.

b. Charge to the Science Commission

The Science Commission was appointed in July 2001, by the Smithsonian Board of Regents, to review the status of Smithsonian Science and to make recommendations for its future. The text of the charge is as follows:

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[1] The Commission is deeply grateful for the administrative support of many people at the Smithsonian, too numerous to mention individually. However, the Commission wishes to single out for special thanks the former Under Secretary for Science, Dr. J. Dennis O'Connor, the current Under Secretary, Dr. David L. Evans, Ms. Vera Chase, Ms. Elizabeth Tait, Mr. Carey Winfrey, and most particularly, Mr. Michael A. Lang.

"For 155 years, the Smithsonian Institution has had as its mission "the increase and diffusion of knowledge." Given the important questions facing the scientific world today, the existing level of Institutional financial and physical resources, the strengths of the Institution's people and its collections, how should the Smithsonian set priorities for scientific research in the years ahead and, in general, carry out its historic mission most effectively?

- *What should be the qualifications of those chosen to lead key scientific research Units of the Smithsonian?*
- *How should the performance of scientific research by individuals and research departments be evaluated?*
- *How can the relationship between research and public programming be enhanced?*
- *What should be done to enhance public recognition of Smithsonian science?*
- *How should scientific research be organized to optimize the use of the Institution's human, physical and financial resources?*
- *What suggestions, of any type, might the Science Commission have to strengthen research at the Smithsonian?*

The Commission's findings will be submitted to the Regents for their consideration."

c. Challenges to Smithsonian Science

The challenges confronting SI science today in many cases date back 2 decades and more, but are not insurmountable. Among the problems addressed in this report are:

- eroding financial support for science in the broad sense, including staff and the maintenance of the Smithsonian's facilities and irreplaceable collections;
- lack of broad Institution-wide strategic planning for Smithsonian science and lack of significant links between Division or Unit planning and central planning;
- poor communications in administrative operations between top Smithsonian officials ("the Castle") and Units and within the Units themselves; and,
- lack of involvement of Unit Directors and senior administrators in financial decision-making.

There has not been a Smithsonian-wide focus on science for more than 20 years. Coupled with declining support, the absence of a strategic plan for science has led to unplanned cutbacks that have distorted and undermined the scientific enterprise. Thus, while the overall SI budget has increased significantly during this period, most budgetary increases have been directed towards capital construction and deferred maintenance. Despite a rising budget for the Smithsonian as a whole, the overall science budget has steadily declined (see Appendix G). These losses have affected Smithsonian science in at least three critical ways:

- decrease in the number of research scientists and staff, especially at the National Museum of Natural History (NMNH);

- reduction of program support (*e.g.,* fellowships, grants, libraries, and publications); and,
- reduced flexibility, which has inhibited new initiatives and appointments by limiting the funds available for major scientific instrumentation, research equipment and for staff renewal that are the life blood of any vibrant scientific enterprise.

In spite of these problems, certain Units and programs maintain high quality science staff and research programs. The ingredients of these successes must be built into strategic planning for Smithsonian science as a whole. This report recommends steps that the Science Commission believes will result in a more focused, efficient, and productive scientific enterprise at the Smithsonian. The Commission resolutely believes that these steps can, and should, provide the foundation for a careful, Institution-wide strategic planning effort, which will provide the Smithsonian with a long-term framework for action. But, as also clearly emphasized by the NAS and NAPA reports, unless the overall erosion in scientific support can be stemmed in the very near future, change and modernization will be very difficult to implement and the Smithsonian will suffer irreparable and irreversible damage.

d. Developing the Science Commission Report

During the course of the Science Commission's fact-finding phase, many individuals were interviewed (either in person or via email), including: the current and past SI Under Secretary for Science and all Directors/Deputy Directors and Associate Directors of SI Science Units, former NMNH Directors and Department Chairs, and nationally and internationally recognized leaders of scientific institutions. The Commission benefited from discussions with expert consultants (see Appendix D) from the American Museum of Natural History, the Getty Museum, the Brookfield Zoo and the San Diego Zoological Society. It obtained information from the Smithsonian Office of the General Counsel and the Office of Human Resources about Institution guidelines, expectations, and legal aspects of personnel review. Interviews also were conducted with selected Smithsonian Unit public affairs specialists and those at the Smithsonian Office of Government Relations and Office of Public Affairs. The Commission also consulted with several Congressional staffers.

Input from Smithsonian scientists proved invaluable. Commission subcommittees made site visits to all science Units and conducted open meetings with staff. The Commission received individual research statements from essentially all Smithsonian scientists, as well as strategic vision statements from the science Units, and many documents and reports from bodies such as the Congress of Scholars, the NMNH Senate of Scientists and external review committees. Budgetary data were provided by the Office of the Under Secretary for Science, Research Units, Office of Management and Budget (OMB) and other offices. The NAS and the NAPA were consulted (see Appendices K and J), as were OMB, and the Office of Science Technology and Policy.

Extensive discussions were held in executive session by this Commission over a 15-month period of time (see Appendix B).

2. VISION – *"SCIENCE SMITHSONIAN"*

The science mission of the Smithsonian is vital to the future of the Institution. At the start of a new millennium, it is vitally important to re-dedicate the Smithsonian to the full exercise of its original charter, as an establishment for the increase and diffusion of knowledge. However, in renewing this charge, there needs to be greater clarity of purpose. The Smithsonian cannot do everything, but it can do (and does) some kinds of science extremely well, better than any other institution or organization in the world. This new commitment to the Smithsonian's mission requires not only strengthening the science that the Smithsonian does best, but also successfully communicating the results of this science to the public.

One great asset of U.S. science is that first-rate work can be done with a different flavor and different approaches in different settings. The Smithsonian is different from universities, which is good and important. The Smithsonian can undertake research programs that universities cannot.

One great strength of Smithsonian science is its ability to take a long-term, synthetic, big-picture perspective. The importance of such a perspective cannot be over-emphasized; without it, many of the most profound scientific questions cannot be adequately answered.

Another major strength of Smithsonian science is the concentration of resources that can be brought to bear on large questions. The Smithsonian Astrophysical Observatory (SAO) is the largest and broadest astrophysical research institute in the U.S., and the Smithsonian Tropical Research Institute (STRI) is the world's premier tropical research institute. Furthermore, there are important synergies to be gained in combining the efforts of different Smithsonian science Units. For example, the combined resources of the National Museum of Natural History (NMNH), STRI, the Smithsonian Marine Station at Fort Pierce, the Smithsonian Caribbean Coral Reef Ecosystems Program, and the Smithsonian Environmental Research Center (SERC) comprise unrivalled expertise on the ecology of coastal marine ecosystems, while biologists at STRI and NMNH constitute the greatest concentration of specialists in tropical American forests in the world.

A further key strength is the unique and irreplaceable collections housed at the NMNH and the National Zoological Park (NZP), and the unrivalled physical facilities (*e.g.,* STRI) built up over many decades. These resources make the Smithsonian an internationally important research center in certain areas.

But, its very diversity can make Smithsonian science appear diffuse and lacking in focus. To combat this perception, a few major science themes must be articulated as core scientific missions. These themes should capitalize on existing research strengths, the collective expertise of its scientific staff, the Institution's unique and irreplaceable collections, and the physical facilities that have developed over the course of its history.

The Commission feels that four key themes will provide a strategic platform for both the short- and long-term growth of science at the Institution, none of which require costly, large-scale administrative reorganization. Rather, they require a change in approach to encourage different Units and groups to work more effectively together.

The four broad research themes the Commission has identified are:

- **the origin and nature of the universe;**
- **the formation and evolution of the Earth and similar planets;**
- **discovering and understanding life's diversity; and,**
- **the study of human diversity and culture change.**

These four themes should form the core scientific mission of the Institution. Increased emphasis on exploring these themes, further refining their focus and developing the interconnections among them, provides a powerful basis to allow the Institution to realize its full potential and deliver improved public benefit in both science and education.

a. The Origin and Nature of the Universe

The Smithsonian is preeminently positioned to harness new technology to study the Universe. Astrophysics is still a young field, advancing by discovery as much as from experiment, building a picture of the cosmos that lets us look toward our own origins. At field stations of the SAO, every branch of astronomical observation is being pushed forward: in Hawaii at the Submillimeter Array, in Arizona at the 6.5-meter MMT optical telescope, and in orbit with the CHANDRA X-ray Observatory. This breadth of approach, wider in scope than that at any other institution in the world, creates opportunities to understand deep connections among many threads of evidence. The SAO vision is to develop a fundamental understanding that ranges from the structure and evolution of the universe to the planetary systems around stars and to share these discoveries with the widest possible audience.

b. The Formation and Evolution of the Earth and Similar Planets

Since its beginning, the Smithsonian has been a leader in understanding the physical and chemical processes that form and shape the Earth's surface. Over the past 40 years of space exploration, it has become clear that the forces that shape planetary surfaces, and often dramatically affect the development of life, can also be illuminated through a broad study of all the planets in our solar system. Examples include a greater understanding of greenhouse warming from Venus data and the recognition of extinctions related to large meteorite impacts. The Smithsonian is already a world leader in volcanology and the study of meteorites. With the growing national and international interest in the exploration of Mars, the depth of Smithsonian expertise in remote sensing and planetary surface processes have made it a leader in this exciting new research area as well.

Two research groups within the Institution (National Air and Space Museum's Center for Earth and Planetary Studies and NMNH's Department of Mineral Sciences) study the physical and chemical processes at work on the Earth and similar planets. These groups

pursue complementary research focused on four areas in which the Smithsonian has unique depth of expertise: Planetary Volcanism, Mars Evolution, Early Solar System Processes, and the Formation and Behavior of Earth's Minerals.

c. Discovering and Understanding Life's Diversity

A focus on the science of life's diversity - biodiversity science – is an urgent area for research investment because of the current rate and magnitude of biodiversity loss, and because the Smithsonian's unique collections and facilities provide competitive advantages. Research in this area should be organized around three interrelated questions:

1. What biodiversity do we have, how did it come to be, and how is it distributed in space and time?
2. How does biodiversity contribute to the functioning of ecosystems?
3. How can biodiversity be conserved, managed, and used in sustainable ways for human benefit?

These questions need to be the primary focus of research for many of the scientists at NMNH, STRI, SERC, and NZP. This work also needs to utilize modern methods to manage and disseminate biodiversity information with a degree of urgency appropriate to the speed and magnitude of current environmental change.

d. The Study of Human Diversity and Culture Change

A key continuing objective of science at the Smithsonian should be to expand our understanding of the processes that shape human biological, cultural, and linguistic diversity and change, from the earliest origins of the human species through the present day. In the face of rapid globalization and the steady loss of languages and traditional lifeways, anthropological research in all its aspects (archaeology, biological anthropology, cultural anthropology, and linguistics), has never been more critical for providing deep historic perspectives on human impacts on, and responses to, modern environmental and social change. By building upon the Smithsonian's long history of anthropological research and using its unique collections of artifacts, photographs, and archival documents, Smithsonian scientists can make significant contributions to understanding the complex inter-relationships among humans, the planet, and its biota that are central to the future of our species.

3. RESEARCH – GENERAL RECOMMENDATIONS

The Smithsonian plays a unique role in the scope of American science. Because of its vast collections beyond those of any other institution, its collections-based research is unprecedented. Its field stations support and complement that research.

As a federally supported institution, the Smithsonian has a responsibility to make its collections available to scientists across the nation, to maintain the collections in top condition for study now and into the future, to train the next generation of scientists in museum-based research, and to support field programs, exhibits, education, and public outreach. But, that same federal support also imposes restrictions. Many Smithsonian scientists currently can apply only covertly (through collaborations with university scientists) for grants from the National Science Foundation. This constraint greatly restricts the scope, sophistication, and productivity of Smithsonian research and limits scientists' ability to move into more modern, often expensive, research areas. Since the Smithsonian does not offer educational degrees, except in fortunate circumstances, it lacks the pool of students available at universities. Smithsonian scientists are limited by research funds available directly from the Institution while they are, at the same time, unable to compete for national funds. The declining Smithsonian research budget (see Appendix G) has only exacerbated the problem. It is interesting to note that, over the last decade, the science budget has become a smaller fraction of the total Smithsonian budget, as the costs of adding new Museums have mounted. The Smithsonian cannot continue to divert funds from research if it hopes to maintain its reputation and original scientific mission.

The following recommendations address the erosion of the science budget over the last decade and seek to redress the adverse impact this has had on the morale of staff and the scope and excellence of scientific research:

Recommendation 3-a

The Commission fully endorses the National Academy of Sciences' and the National Academy of Public Administration's report recommendation that SI scientists be allowed to compete directly for federal funding. The Smithsonian administration should actively pursue all means to implement this recommendation.

Recommendation 3-b

The Fellowships and Scholarly Studies programs must be reinstated as soon as possible. The cannibalization of these funds for other Smithsonian programs has greatly weakened the scientific enterprise. Pre-doctoral and post-doctoral fellowships infuse the Institution with new, energetic scientists and provide a means of training the next generation. Scholarly Studies funds (distributed competitively based on research merit) must provide seed money for the development of external proposals along with incentives and support for the best and

brightest Smithsonian scientists. Once re-established, funds within this program must not be redirected out of the science Unit.

Recommendation 3-c

Mandated salary increments have for too long been funded by scavenging positions, to the detriment of SI science excellence and staff morale. Steps must be taken immediately to obtain full funding for annual salary increments, including within-grade increases and promotions, in the Smithsonian budget.

Recommendation 3-d

Development efforts for SI science in the private sector and among foundations should be significantly increased in the face of growing federal budget constraints.

Recommendation 3-e

Greater support for Library resources, including access to the Web of Science and other Internet search engines, and support for journals and book purchases, is essential to maintain the quality of research at the Smithsonian.

Recommendation 3-f

The Institution needs to maintain its programs of Major Scientific Instrumentation and Research Equipment. It should develop a coordinated plan for the acquisition, maintenance, and use of large scientific instruments. Equipment purchased with Institutional funds should be available to all.

Recommendation 3-g

The Institution should move more aggressively to make use of digitization and Internet technology to expand the reach of Smithsonian science and to make Smithsonian collections more available to scientists and the public.

Recommendation 3-h

The publication of book-length monographs, particularly in the social sciences, is a part of the dissemination of the results of scholarly research. If the SI Press decides to limit or even eliminate its traditional program of publishing such monographs, effective alternatives must be identified and funded.

4. WHAT SHOULD BE THE QUALIFICATIONS OF THOSE CHOSEN TO LEAD KEY SCIENTIFIC RESEARCH UNITS OF THE SMITHSONIAN?

a. The Need for Scientific Leadership

The Smithsonian Science Commission concluded that neither the science Units nor the Institution as a whole can maintain their national and international reputation without effective leadership. With the departure of the Under Secretary for Science, Dr. J. Dennis O'Connor, the Commission strongly recommended that this key position always be filled by a scientist with an international reputation and urged that it be filled immediately. This recommendation was *de facto* put into place with the recent appointment of Dr. David Evans as the Under Secretary for Science. The Commission is optimistic that Dr. Evans will provide the necessary overall leadership, restore scientific leadership at the National Museum of Natural History (NMNH) and the Smithsonian Environmental Research Center (SERC), and develop plans for the transition in leadership at the Smithsonian Astrophysical Observatory (SAO), to prepare for the retirement of the current Director in the coming years, while energizing the Institution's scientists and scientific research.

While discussions of scientific leadership often focus on traditional management hierarchy, the Commission believes that a willingness of Smithsonian scientists to assume informal leadership positions in national and international scientific organizations and panels is equally important for Institutional success. Such activities include participation through specialist scientific organizations (at which many SI scientists excel) as well as in broader organizations, National Research Council panels, and other forums (SI science leadership has generally failed to nurture and promote participation in these key arenas). Some SI scientists have achieved great success individually via these forums, but this is no substitute for SI management's active promotion of such involvement. SI scientists must work to increase their broader national and international influence through these venues.

b. Current Status of Scientific Leadership

SAO and the Smithsonian Tropical Research Institute (STRI) have benefited greatly from long-term leadership stability. Both have a focused mission and both enjoy considerable autonomy. Without doubt this increases the attractiveness of leadership positions at these Units. STRI is in the midst of a planned transition to a new Director and there are comparatively few concerns about its scientific leadership. As noted, SAO faces the imminent challenge of the transition to a new Director, and likely a different management style, but the prognosis for future leadership at SAO is good. But, the situation at the other SI science Units is more problematic. With a relatively new Director who has instituted some changes in scientific management, morale problems and tensions persist at the National Zoological Park (NZP). The current head of SERC is not a scientist and also serves as Associate Director for Research and Collections and Acting Deputy Director at NMNH. Despite his capabilities, this triple commitment short-changes both Units over the long term. SERC needs a full-time Director. Problems with the leadership and direction at SCMRE are discussed in Section 9.e. below.

The most critical problems are at the NMNH, where long-term instability in the Office of the Director has had a bad effect on every aspect of the Museum's work. The frequent turnover of Directors[2] appears to be at least partly attributable to the failure of previous SI leadership to delegate the degree of authority and responsibility necessary to attract the most highly qualified candidates. Until the current Interim Director was appointed, there was not one scientist at an administrative level above that of Department Chair. There was no voice for science in the inner councils of the Director's Office. The Commission understands the difficulty, but sees the need to bring vigorous scientific direction to NMNH. (This requires not only a vision for the future of science, but also the ability to develop strategies for collections management, the capacity to develop exhibit, educational and outreach strategies, and the skill to raise significant external funding.)

c. Criteria for Scientific Leaders

1. Personal criteria

- Only a scientist with an international reputation can provide the requisite internal and external credibility at the top leadership positions. Directors of science Units should also be respected scientists; and,
- A rational, common-sense approach to problem-solving that effectively balances the Smithsonian's responsibilities in science and public education is also obligatory.

2. Leadership criteria

- Demonstrated commitment to excellence, including the fortitude and determination to hold scientists accountable for performance given the relative freedom they enjoy, the support they receive, and the diverse resources (*e.g.*, collections) available to them;
- Ability to identify and articulate clear Institutional vision and goals; and,
- Support for, and understanding of, basic research.

3. Management criteria

- Outstanding communications skills. The ability to listen to, and work with, staff at all levels;
- Awareness of the greater Smithsonian context;
- Experience working in the Washington science policy arena; and,
- Excellent organizational skills and multi-tasking ability.

d. Selection of Scientific Leaders

With the exception of internal rotating appointments such as Department Chairs, selection of leaders at all other levels should involve national searches by an appropriate committee of Smithsonian scientists, Smithsonian administration managers and, where appropriate, external representatives.

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[2] Recent NMNH Directors: James Mello (Acting, 1979-1980); Richard Fiske (1980-1985); James Tyler (Acting, 1985); Robert Hoffmann (1985-1988); James Tyler (Acting, 1988-1989); Frank Talbot (1989-1994); Donald Ortner (Acting, 1994-1995); David Pawson (Acting, 1996); Robert Fri (1996-2001); Dennis O'Connor (Acting, 2001-2002); Douglas Erwin (Interim, 2002).

1. Under Secretary for Science

The Under Secretary for Science must be an outstanding scientist of international reputation, unquestioned scholarship, and outstanding management skills.

2. Directors for Scientific Units

Unit Directors must be outstanding scientists. They must develop greater expertise in fund-raising, have an appreciation for scholarship, a curiosity about science, and an understanding of the demands of leading a scientific organization. Candidates should have demonstrated leadership in developing and communicating a vision to the staff and the management skills to ensure effective implementation of this vision. Recruitment of such individuals will require the central SI administration to delegate appropriate authority and support to make these positions attractive.

3. Directors of Research within Units

The primary roles of the Director of Units will be fund-raising and general administrative oversight. These may necessitate the delegation of primary research responsibility to a Director of Research. The Director of Research must be a noted scientist, with management expertise and the ability to articulate the scientific goals for the Unit. The Commission recognizes a variety of possible management models, including, for example, appointment of a Chief Scientist from within the ranks of an organization, which may not be a full-time administrative position. Such a position must, however, be part of the senior executive staff of the Unit.

4. Chairs of Departments

Chairs must be credible and active scientists, chosen whenever possible from within the Unit. Departments usually benefit from long-term stability of Chairs, but senior Unit management may have to provide sufficient administrative support (in the form of GS 12-14 Departmental Administrators or Management Service Officers) to allow the Chair to provide effective leadership while maintaining an active research program. Without strong support from higher-level administrators, including their commitment to excellence and ability to follow through on commitments, chairing a Department will be seen as a thankless task.

e. Findings and Recommendations

Beyond the erosion of funding support, the lack of effective leadership has been the single most important factor in the weakening of Smithsonian science over the last 2 decades. The Institution must adhere to a policy of appointing highly respected scientists at all levels of administration in science Units. In an environment where Directors may have to concentrate on fund-raising, some primary administrators may not be scientists, but they should have an appreciation of science and have as part of their team an Associate Director who is a scientist. Leaders should be able to articulate the need for scientific research at the Institution. Stability in leadership is vitally important. Leaders must be given the autonomy they need to guide the scientific enterprises they serve within a collegial, collaborative, and supportive environment. The importance of science and scientific excellence must be encouraged and recognized as important for the Smithsonian as a whole.

Recommendation 4-a

All searches for scientific leaders above the level of Department Chair should involve an appropriate group of SI scientists and management, with appropriate non-SI involvement. Searches should be nationwide.

Recommendation 4-b

SI science leaders should develop a plan to advance SI scientists in a variety of forums. Senior scientists on Unit Advisory Boards and Councils should mentor and advocate for younger SI scientists. Career development should include expectations of participation and influence within the broader scientific community.

Recommendation 4-c

The intellectual credibility, strength, coherence and vitality of the Institution's exhibits and educational programs depend upon the activities of its scholars. The integral involvement of SI scientists in Institutional outreach programs should therefore be encouraged by both the Secretary and the Under Secretary for Science.

Recommendation 4-d

As a significant component of the SI scientific enterprise, SERC must have a full-time, on-site Director with strong scientific credentials.

5. HOW SHOULD THE PERFORMANCE OF SCIENTIFIC RESEARCH BY INDIVIDUALS AND RESEARCH DEPARTMENTS BE EVALUATED?

As should now be clear, the Smithsonian Institution (SI) must hire and retain excellent people and provide incentives for their performance and their growth. Success should be judged by international standards and, as in major U.S. universities, key positions should be filled by the best scientists in the world, representing the greatest possible diversity, especially under-represented U.S. populations.

a. Performance Evaluation of Individuals

Most SI scientists believe that the Professional Accomplishment and Evaluation Committee (PAEC) process works, and the Commission believes that it is flexible enough to meet the needs of nearly all Units. Still, there is widespread concern about:

- a "disconnect" between federally-mandated annual reviews and PAEC reviews, particularly in regard to materials candidates provide to each;
- a lack of timely communication about review results;
- a lack of consistency within Units; and,
- an absence of assessment criteria.

Not only are annual reviews not precluded from consideration in PAEC reviews, legislation explicitly encourages their inclusion. In addition, metric review instruments are not mandated; each science Unit is free to develop its own means of evaluation. However, the SI administration does have guidelines (dated 1987), and it is apparent that the current administration likes metrics.

Recommendation 5-a

Annual performance reviews should include past performance goals, the reviewee's self-assessment, the reviewer's assessment and 'grading', and future goals. Goals should be mutually arrived at. Both the reviewee's self-assessment and that of the reviewer should be independent. Summaries should be provided to the reviewee within a 1-month period. A single individual (Head of Unit or Department) should review all scientists under his/her aegis, to ensure that all assessments are equitable.

Recommendation 5-b

Performance goals and assessments should be written with the expectation that they will be included in PAEC reviews. Review procedures for all staff (*e.g.*, collections managers, and other categories of scientists and staff) should be established and/or clarified.

Recommendation 5-c

Evaluation criteria should be established by a science committee, with guidelines from the administration. Unit and Department Heads should participate in Office of Personnel Management training.

Recommendation 5-d

Methods for PAEC review should be established by each SI Unit, with general 'consistency with flexibility' guidelines following the Smithsonian Directive 204, which includes recommendations that:

1. **External scientists participate;**
2. **Review materials should include:**
   - **a current c.v. and bibliography;**
   - **recent annual performance evaluations;**
   - **a statement of achievements in research, teaching, outreach, exhibits, service to professional societies, etc., during the review period;**
   - **a statement of goals; and,**
   - **a list of four or more prospective external peer reviewers (the candidate should have input into the review process by identifying experts in his/her area(s) of research; the SI Unit should seek their assessments, but also those of additional peer reviewers for objectivity);**
3. **Clear criteria for review should be established and agreed-upon; these could include, but not be restricted to:**
   - **research prominence and productivity;**
   - **service to the Smithsonian Institution;**
   - **curatorial activity;**
   - **professional service;**
   - **public speaking, outreach and educational activities; and,**
   - **exhibit development.**

   Performance maintenance is insufficient for advancement. Leadership in the greater scientific community, especially for senior-level scientists, is expected. A metric system is not required; however, a clear and consistent set of criteria for evaluation must be articulated. The input of outside reviewers should be considered in context;
4. **The Chair's or Director's review should be thoughtful, cogent, and analytical rather than subjective;**
5. **A report of the results of PAEC review should be promptly made to the candidate, the Unit and SI administration. It should specify recommendations for salary/grade increases or performance improvement. The administration's response to the review should be promptly transmitted to the SI Unit, the candidate, and the candidate's Chair; and,**
6. **Recommendations for increases or for improvement should be enacted promptly.**

Recommendation 5-e

Both annual and PAEC reviews should reward excellent performance. Rewards in addition to salary must be established. These might

include nomination for recognition by professional societies or by the SI (prizes, medals, lectureships, etc.)

b. Performance Evaluation of Research Departments

Recommendation 5-f

Review of Science Units and their programs appears to be *ad hoc* and infrequent. Regular oversight and review of programs and Units must be established. In addition, Visiting Committees should:

- **be composed of objective, distinguished scientists and established for each Unit to evaluate programs, provide guidance on venues, and 'sunset' programs as appropriate. Committee members should be appointed based upon the advice and recommendations of members of the Unit. Visiting Committees are not the same as external review committees, convened once to do a specific review; also, they are distinctly separate from the Director's Advisory Boards;**
- **consist of members with multi-year appointments, whose terms are staggered;**
- **evaluate the science, and the components that contribute to it - space, facilities, funding, personnel (at a general level), new and old programs, review procedures, etc;**
- **meet yearly or biennially at the Unit, and do a careful review of the Unit and its programs, offering clear and constructive advice. Recommendations should be provided with measurable, quantitative goals and terms;**
- **report to the Director of the Unit served; the Director and the Under Secretary for Science should respond to the Committees' reports and recommendations;**
- **be structured with guidelines that are sufficiently flexible to include joint committees (*e.g.,* SAO-Harvard), with appropriate lines of reporting; and,**
- **be linked to boards and similar bodies as appropriate.**

6. HOW CAN THE RELATIONSHIP BETWEEN RESEARCH AND PUBLIC PROGRAMMING BE ENHANCED?

a. Introduction

Since its founding, the Smithsonian Institution (SI) has been guided by dual missions: research and education. Throughout its 156-year history, these missions have defined the Institution's unique nature, combining national museum, research center, and university functions. Smithsonian curators and researchers expand the frontiers of science while they educate the public about the nature and history of the universe, the Earth, its peoples, and cultures.

In the early days, the Smithsonian's educational mandate was simpler, amounting to little more than a visual catalogue of physical objects, organisms, and artifacts, as well as publications that disseminated that knowledge. Today, its educational programs explore relationships among environments, plants, animals, and cultures; forces that shape our world, our galaxy, and our universe; and mechanisms that determine the developmental life cycles of insects and microorganisms. Science can help solve problems facing humanity today and those we will face in the future. The Smithsonian is uniquely positioned to educate the public about important issues in an increasingly stressed, changing, and interconnected world.

Despite this need and these capabilities, the Institution is not fulfilling its educational mandate. While research advances, the Smithsonian Astrophysical Observatory (SAO), the Smithsonian Environmental Research Center (SERC), and the Smithsonian Tropical Research Institute (STRI) lack exhibition facilities and the National Museum of Natural History (NMNH) can exhibit only a small percentage of its research. Funds and staff ear-marked specifically for education, including exhibitions, educational programs, popular publications, and media, represent only a fraction of the Institution's research budget, and both have declined drastically in the past decade. During the same period, the elimination of senior leadership and educational infrastructure, including the Office of the Assistant Secretary for Education, the Education Outreach Fund, and the interdisciplinary Office of Seminars and Symposia, along with major reductions in the Office of Museum Programs and in fellowship and research funding, has had disastrous effects.

Increasingly decentralized, the Institution's various components have largely failed to solve the perennial shortage of educational resources, limited facilities, poor coordination, and insufficient or under-trained staff. As a result, the Institution and its constituent museums and research facilities are poorly-equipped to fill the role that James Smithson envisioned. Today's education programs are a hodge-podge of miscellaneous offerings. Although some programs are of superior quality, they exist as isolated islands in a sea of unfulfilled opportunity.

In short, the Smithsonian needs to strengthen its education capabilities. This will require a strong central administrative commitment, increased levels of funding, enhanced communication and coordination, greater attention by management to

education goals and performance, greater involvement by curators and researchers, new techniques and technologies, and strengthened outreach to underrepresented U.S. populations in order to have these students brought into the pipeline of training for future scientists.

b. The educational environment

1. Credibility

The Smithsonian boasts large and well-documented collections, extensive archives and libraries, training programs, superb physical facilities (including exhibit halls), and its location in the heart of the nation's capital. Its greatest assets, however, are its enormous, deeply-rooted public credibility and its extraordinarily gifted staff.

2. Collections-based Research

Collections-based research and field studies greatly increase our ability to understand the world in which we live. Transmission of this knowledge is best done by those who produce it. It is they who make Smithsonian exhibitions and other educational offerings so memorable.

3. Integrating Art, History, and Science

Many of the best Smithsonian programs blend art, history, and science. This capacity to go beyond traditional boundaries is crucial for the kind of humanized science required to solve today's complex problems and should be embraced and encouraged.

4. Program Diversity

Strength flows from diversity. Many research programs overlap in important ways. For instance, NMNH (collections-based), SERC (coastal ecology), and STRI (tropical ecology) all contribute to an understanding of complex biological systems. While there can be debate about the amount of overlap needed, the Institution's constellation of resources offers unique opportunities to educate society about natural history and global systems.

5. Program Inventory

Smithsonian science education is produced by centrally-administered and Unit-based programs. Unit programs include:

- NMNH;
- SAO;
- the Smithsonian Center for Materials Research and Education (SCMRE);
- SERC;
- the National Zoological Park (NZP) and its Conservation and Research Center (CRC);
- the National Air and Space Museum (NASM); and,
- the National Museum of American History's (NMAH) "Hands On Science" and Lemelson Center.

In addition, there are four major programs located in the Office of the Under Secretary for American Museums and National Programs:

- the SI Office of Education (SIOE);
- the Smithsonian Institution Traveling Exhibition Service (SITES);
- the SI Affiliations Office (SIAO); and,
- the Smithsonian Associates (TSA).

The National Science Resources Center (NSRC), the Smithsonian Internet site, the Office of Exhibits Central, and the Smithsonian Institution Office of Fellowships (SIOF) are also important central operations for science education and outreach.

As in the Institution at large, Unit education programs may be administered by the Unit, Center, Departments, programs, or research offices. One of the surprising findings of this study is that most educational offerings – some 400 in 2001 - are grass-roots rather than centrally- or Unit-administered programs.

c. Findings and Recommendations

1. Central Programs

Despite the Institution's charter, funding for science education and outreach is small compared to funding for research and collections. This was not always the case. From the 1970s to the early 1990s, the Institution maintained a special outreach fund for Units and facilitated the training of museum professionals. These no longer exist and Unit programs are left to their own resources with drastic consequences.

> **Recommendation 6-a**
>
> **The central administration should encourage innovative education development within and across Units and make education a responsibility of the Under Secretaries for Science and American Programs. The proposed Unit scientific advisors detailed to the Under Secretary for Science could coordinate education programs across Units and assist in presenting SI-wide seminars and exhibitions (see Rec. 8-a). SI Fellowships and Scholarly Studies programs should be funded. The central administration must raise funds for cross-Unit education programs.**

2. Science Education Management

By favoring special exhibits and creating new museums, the Institution has weakened existing Units. Units tend to emphasize exhibits over education and with funding decreases new programs like Internet development and digital collection access have been curtailed. The Smithsonian magazine and SI Press are not doing enough to publicize Smithsonian research.

> **Recommendation 6-b**
>
> **Increase funds (federal) to science Units for exhibition and educational program development and develop a strategic management and fund-raising plan for maximum education impact. Enlist Smithsonian magazine and SI Press support to help get the word out.**

3. Staffing Issues

Too many Smithsonian science-education staffers have little specialized training and are poorly paid. Getting the best science-education staff is just as important as getting the best scientific staff.

4. Science and Education Coordination and Visibility

Most Unit science-education programs suffer from lack of coordination among researchers and educational personnel and enterprises, and there is a general lack of inter-Unit collaboration where such cooperation would be mutually beneficial, for instance, in providing SERC, STRI, and SAO with exhibition space on the Mall, or participating in Mall biological exhibit projects. Similar collaboration would be beneficial among SAO, Center for Earth and Planetary Sciences (CEPS), and NMNH in geological and planetary sciences. There also exists a need for more collaboration between science and art and history Units. Lack of coordination and planning among education offices at the science Units has been a major impediment to developing funding for these efforts, resulting in each museum or research Unit pursuing its own goals and projects. There needs to be a closer tie between Smithsonian science and the programs of the NSRC, for example. Interrelations among biodiversity, conservation biology, sustainable development, human dimensions, and global change, in both historical and contemporary contexts, offer possibilities for producing synergy and added value through inter-Unit collaboration. Recent surveys and inventories of pan-Institutional education programs by the SIOE, with assistance from the SI National Board, have begun to pave the way for better inter-Unit collaboration and development efforts.

> **Recommendation 6-c**
>
> **Broaden the membership of the pan-Institutional Education Council to include scientists and central administration personnel. Charge this group with strategic planning, fund-raising and development. Charge it with establishing a biannual pan-Institution "Smithsonian Conference" to highlight emerging issues of public interest. Greater use of SITES by STRI, SAO, SERC, and SCMRE would help provide these organizations with needed exhibition venues.**

5. Internet Programming

The Institution's Web presence varies widely and the lack of a cohesive plan diminishes its educational value. Clearly, the Smithsonian could benefit from some degree of central Web planning and coordination, as well as foundation and philanthropic funding.

> **Recommendation 6-d**
>
> **An SI-wide Web index and guide could facilitate use of the SI Internet and help plan its further development. Thematic road-maps would better assist students and teachers in identifying educational pathways. Smithsonian collections and exhibitions could become focal points of curricula and Web site development, which could transform Smithsonian science outreach in the coming years.**

6. Teacher Training

Many Smithsonian science Units train teachers and deliver subject matter to target audiences. For instance, NSRC and SAO curriculum materials reach thousands of students and school districts across the country, as do the publications *Smithsonian in the Classroom* (SIOE), *AnthroNotes* (NMNH), and products of the Lemelson Center (NMAH). SCMRE publications and videos provide training materials for private collectors, conservators, and museum professionals. More could be done, however, to provide teachers with materials, internships, and in-service training.

> **Recommendation 6-e**
>
> **Develop nationally competitive teacher training opportunities in science, following SAO and NSRC models. (Once again, a closer tie to NSRC would improve training opportunities.) Consider implementing a grass-roots national, Internet-based program in natural history field studies, in concert with the GLOBE Project or similar programs.**

7. Managing the Emerging Trust Fund Environment

Because financial realities have required many education programs to become dependent on grants and philanthropy, curatorial staff is increasingly reluctant to get involved in unfunded activities. Dependence on trust funds predisposes Units against developing long-term plans and program evaluation.

8. Scientists and Exhibit Developers

The production of high-quality educational programming and exhibits requires involvement of scientists, educators, and designers in every phase of a project. Lack of communication among Education and Exhibition Departments and the scientific staff is a chronic complaint. Striking a balance between the interests of educators and scientists in exhibit production is a difficult process. While educational project development can be stressful, the dynamic tension within the core team between scientists and educators is a vital and necessary aspect of the museum educational process.

> **Recommendation 6-f**
>
> **Scientists must be included in the development of all science-education programs and should receive appropriate credit in their professional evaluations.**

9. Conclusion: National Leadership in Science Education

The Smithsonian's science mandate demands better science education, though the educational role varies from Unit to Unit.

Should the Institution concentrate on vibrant exhibition programs, or should it focus on producing national curricula and educational materials? How much emphasis should be placed on museum educational theory and technique versus improving delivery of content? Should it shift directions or maintain its current course? These questions are not easy to answer, but answering them could lead to great opportunities.

These issues have been raised repeatedly in the past and have largely been laid aside. The tighter focus advocated in this report - the origin and nature of the universe; the formation and evolution of the Earth and planets; the understanding of life's diversity; and the study of human diversity and culture change - offers realistic targets. Building coherent, state-of-the-art educational programs around these themes would be an appropriate goal for *Science Smithsonian*.

7. WHAT SHOULD BE DONE TO ENHANCE PUBLIC RECOGNITION OF SMITHSONIAN SCIENCE?

There is a need for the Smithsonian Institution (SI) to adopt an overall Science and Research Communications Plan. As the Smithsonian Science and Research Communications Draft Report indicates, "the Smithsonian is not well known as a leader in science and research. This comprehensive plan is to improve awareness and knowledge of science and research at the Smithsonian among the general public, and with specific audiences such as the Congress, State and local officials and major donors, actual and potential. Implementation of a comprehensive plan will ensure that every museum, Unit and program has a chance to tell its story."

In July 1998, the Office of Public Affairs (OPA) hired a public affairs specialist dedicated to science and research. The Smithsonian Astrophysical Observatory (SAO), the National Museum of Natural History (NMNH), the National Zoological Park (NZP), the Smithsonian Tropical Research Institute (STRI), and the National Air and Space Museum (NASM) have public affairs officials. The Smithsonian Environmental Research Center (SERC) and the Smithsonian Center for Materials Research and Education (SCMRE) rely on the OPA science and research specialist. Despite her capabilities, she cannot change the perception of SI research by herself. Many researchers have made media contacts or contacted Congressional Committees on their own. In order to create a more integrated system to promote science at the Smithsonian, the Commission recommends the following:

Recommendation 7-a
The Under Secretary for Science and the Director of the OPA should review the Smithsonian Science and Research Communications Plan drafted in 2000, update it, and put it into action.

Recommendation 7-b
An SI-wide council of public affairs specialists and Unit Directors should convene to establish operational protocols to maximize communications about scientific research and practice. OPA will need the full support, cooperation and participation of the Museum and Research Directors and their public information managers and staffs.

Recommendation 7-c
The Smithsonian leadership should create opportunities – through workshops and/or training - for Smithsonian scientists and researchers to interface with the OPA.

Recommendation 7-d
The OPA should be charged with achieving the following:

- **work with the Under Secretary for Science to make sure that s/he can play a strong symbolic role for science at the Smithsonian;**
- **establish and maintain regular channels of communication with Museum and Research Unit staff to identify story ideas and keep abreast of ongoing or future projects;**
- **meet regularly with the Directors and public relations managers of the NZP, STRI, SERC, SCMRE, NASM, NMNH, and SAO, to review plans and identify projects of potential interest to the media. Develop separate, but coordinated, public relations plans for each Unit;**
- **write a statement describing the Smithsonian's re-invigoration of science, articulating the Institution's emphasis on scientific coordination, direction and clarity;**
- **develop ideas for news and feature stories about the science and research activities of the Smithsonian to disseminate to the media via advisories, releases, pitch letters and direct, personal contact. Seek opportunities to showcase interdisciplinary and inter-agency projects; and,**
- **promote coverage of Smithsonian science and research beyond the Beltway through a concerted effort aimed at media outlets around the country, as well as wire services (Associated Press, United Press International, Reuters, etc.), news services, newspaper chains (Scripps Howard, Knight Ridder, Hearst, etc.), and the Washington bureaus of metropolitan dailies. The subjects of these features will be derived from the behind-the-scenes aspects of the Institution that have broad, general interest, such as the stewardship and conservation of icons of American popular culture, the role of Smithsonian scientists in identifying and dating forensic evidence, and the quest for new discoveries about the universe.**

<u>Recommendation 7-e</u>
Conduct behind-the-scenes media tours of the Smithsonian's conservation facilities, including the Museum Support Center, the SCMRE, the Cultural Resources Center, and the Paul E. Garber Preservation, Restoration, and Storage Facility. The May 1999 press preview of the Star-Spangled Banner Conservation laboratory is an excellent model for this type of media event.

<u>Recommendation 7-f</u>
Enlist the Secretary, Under Secretary for Science, museum Directors and other high-level Institution officials to conduct semiannual briefings for science reporters and staffers.

Recommendation 7-g

Continue to dedicate the entire spring issue of "Research Reports" to a single topic. "Research Reports" reaches some 80,000 people including such key audiences as Contributing Members, Members of Congress, and journalists. The annual special editions should be promoted in advance to science writers and editors, through the OPA Newsdesk Web site, targeted press release distribution, and direct contact.

Recommendation 7-h

Offer media training seminars for key scientists, researchers and administrators.

Recommendation 7-i

The Office of Government Relations should be more proactive in advancing Smithsonian Science to Congress. It should:

- host a reception at the SI or on the Hill to celebrate science;
- develop an exhibit or display on the Hill in the Cannon or Russell Rotunda. Plan a briefing along with it. Invite a Member to sponsor it;
- volunteer to have Smithsonian scientists assist key committees and Members on important national scientific issues;
- keep track of AAAS Congressional Scholars, Knauss Grant Fellows, and Congressional Grant Fellows and recruit them to spend time at the Smithsonian. Hold Smithsonian events and involve them;
- invite Congressional Members and staffers to attend decision-makers' field courses (STRI or SERC could do this). SI would have to raise money for scholarships for some of them to attend;
- organize fieldtrips to SAO, STRI, and SERC. Plan such trips during House and Senate recess;
- help Members to follow science issues to stay in tune with their constituencies (environment, conservation, bio-terrorism, etc.);
- bring Members and staffers from the Hill to SI to talk with scientists about issues of importance to both groups. Build Members and staffers into SI programs;
- bring relevance and a "just-in-time" context to the people in Congress. Encourage them to think of the Smithsonian as a resource place - the "go-to" place for scientific inquiry and research within Smithsonian expertise;
- develop a briefing book on Smithsonian science for Members on Capitol Hill; and,
- create brochures to explain science projects to non-scientists. Provide updates on issues. Regularly circulate brochures and inserts on the Hill.

8. HOW SHOULD SCIENTIFIC RESEARCH BE ORGANIZED TO OPTIMIZE THE USE OF THE INSTITUTION'S HUMAN, PHYSICAL, AND FINANCIAL RESOURCES?

a. Analysis of the Present Structure

Earlier analyses of Smithsonian science organization are presented below with this Commission's findings:

- Lack of a coherent strategic plan for Smithsonian science activities.
  Finding 1: There is no strategic plan for Smithsonian science, and planning at the Unit level is minimal;
- Inconsistencies in performance evaluation and staffing actions among Units.
  Finding 2: There are widely varying policies for evaluation of staff scientists, and for demoting/removing poor performers;
- A disconnect between scientists and Institutional planning efforts.
  Finding 3: Scientists play little role in formulating Institutional policy and tend not to be well represented even at the Unit level;
- Lack of visibility of Smithsonian science to the Secretary, Congress and the public.
  Finding 4: Smithsonian science is largely invisible to Congress and the public and has been inadequately communicated to the Secretary;
- Potential redundancy or inefficiencies in operation of many small Units.
  Finding 5: There is little evidence that Units are carrying out unnecessary, inefficient, or redundant work; and,
- Potential failure to exploit opportunities for "multi-disciplinary" collaboration.
  Finding 6: While clear opportunities for greater cooperative work exist within the SI science efforts, assessment of Smithsonian scientists must also include their external (non-SI) collaborations.

These findings reflect weakness in strategic planning, communications, and personnel policy development. These weaknesses exist from "grass-roots" levels - the various research Units – to senior management, including the Office of the Under Secretary for Science.

b. Guiding Principles for Evaluating Structure

The Commission used the following criteria to evaluate potential restructuring of Smithsonian science:

- Science must inform Smithsonian public programs. To separate them would be counter to the stated mission of the Institution;
- The authority of the Museum or Unit Directors over their Units must be maintained;
- Administrative barriers between scientists and the Under Secretary for Science should be reduced;
- Interactions among Units separated by large geographic distances cannot be forced;
- Scientists should play a major role in developing a science vision for the Institution; and,

- Better communication of the accomplishments and activities of Smithsonian science to the central administration, Congress, and the public is required.

c. Reorganization Plan

There appears little need for change in the structure of the major Smithsonian Science Units. Combining or reorganizing Units would not solve problems and could delay progress. There is, however, a need for greater openness and transparency in the development of research priorities and budgets, encouragement of cooperative investigations, and better communication of research results to the Secretary, Congress, and the public. To this end, the Commission recommends:

- modifying the Office of the Under Secretary for Science to use Special Scientific Advisors, Smithsonian scientists detailed on a rotating basis from Units;
- adding administrative and management-level staff positions to the Under Secretary's office;
- that scientists become more engaged with strategic planning, collections management and preservation issues;
- that the Under Secretary establish a group to take an Institution-wide view of scientific collections, collections management, and conservation of collections;
- that periodic review of programs be improved, including establishment of a Visiting Committee structure; and,
- that Directors of science Units be scientists, with specific responsibility for no more than one Unit.

Reorganization need not be sweeping. Minimal changes in structure, effective implementation of existing policies and lines of authority, and visionary leadership of key Units can suffice. A modest restructuring with an emphasis on planning, communications, and performance assessment is recommended, along with a strong planning and advisory staff within the Office of the Under Secretary for Science and more active engagement of SI scientists in strategic planning and management of science.

Recommendation 8-a

The Under Secretary for Science should set SI science strategy. Three advisory staff scientists should be appointed on a rotating basis (*e.g.*, 2-year terms) from the major disciplines. These Special Scientific Advisors would help the Under Secretary assess scientific progress and identify scientific highlights at the Units, encourage collaboration across Units, and prepare material for the Under Secretary, Secretary, or Congress as requested. They would organize seminars and meetings, coordinate educational and outreach efforts among the Units, act as liaison to the Congress of Scholars or other advisory groups, provide guidance on sources of science content for exhibit planning, and provide advice and information to the Under Secretary. These Advisors should receive a modest stipend in addition to their SI salary (and additional research support from the Institution) for serving in these positions. These positions should be considered prestigious and only the most respected members of the SI science

community should fill them. The National Aeronautics and Space Administration's management of research programs for space science - "discipline scientists" are drawn from the communities they serve – makes a good model. This structure would greatly increase the role of Smithsonian scientists in central administrative operations while avoiding the creation of a new (and expensive) management tier.

Recommendation 8-b

The Under Secretary for Science should retain the two existing high-level staff positions, Scientific Programs and Budget. These two Executive Officer positions require additional administrative staff assistance. There may also be a need for greater coordination of public programs, education, collections, and preservation across various Units. While the Special Scientific Advisors may fill these roles, the Commission supports the addition of new Executive Officer positions if deemed necessary by the Under Secretary.

Recommendation 8-c

The Under Secretary should solicit plans and performance descriptions from science Unit heads and from these forms annual goals, defends requests to the SI administration and Congress, and benchmarks accomplishments. Science staff across the Institution should have input in this process and in strategic planning. Scientists and scientific curators of the Council of Scholars should form a subcommittee within the Council to bring important issues before the SI administration and facilitate dialogs on policy, budget, and organizational issues affecting SI science.

Recommendation 8-d

The Under Secretary should establish a broad-based group, led by a Special Scientific Advisor, to take an Institution-wide view of scientific collections, collections management, and collections conservation. Appropriate SI art and cultural museum experts should participate. Greater collaboration among Units is needed to develop effective means of dealing with Institution-wide problems of management and collections preservation.

d. Revitalization of Smithsonian Science

The health of any institution depends on an appropriate mix of well-established and entry-level scientists. To maintain such a mix, the Smithsonian administration should examine its policy on enhanced retirement incentives as a budgetary strategy, given the points raised in this section. The average age of federally supported scientists at some Units is high, largely because many senior Smithsonian scientists do not retire until they are in their 70s. The Institution has very few federal scientists under the age of 40. While senior-level scientists provide valuable and valued perspectives, entry-level

scientists can infuse an institution with fresh, creative ideas, energy, enthusiasm, and greater familiarity with new technologies.

The high number of late-career Smithsonian scientists is also costly. Late-career scientists tend to have much higher salaries than those just starting out. In some cases, two entry-level scientists could be hired for the cost of retaining a single senior-level position. Many scientists say they are postponing retirement because they believe with some justification that their position will be eliminated. Over the last 10 years, NMNH alone has lost 30 federal scientist positions (23%). The replacement of a significant number of late-career scientists by lower-level counterparts would free up substantial funds and invigorate the Institution. Table 1 illustrates the potential annual savings.

Table 1: Savings and cost of replacement of salaries of scientists eligible to retire. Numbers reflect a 12% benefit rate for retiring scientists and a 30% benefit rate for replacements.

Unit	Amount saved if all eligible retired[3] ($)	# of Federal staff scientists	Number eligible to retire	Cost of replacement at GS 13 ($)	Yearly Savings ($)
NASM	0	5	0	0	0
NMNH	3,177,506	101	24	2,066,345	1,111,161
NZP	0	22	0	0	0
SAO	2,314,290	67	16	1,403,392	910,898
SCMRE	113,419	11	1	86,097	27,322
SERC	113,419	13	1	86,097	27,322
STRI	0	26	0	0	0
TOTAL	5,605,215	234	41	3,555,834	2,076,703

e. Plan to Revitalize Smithsonian Science

The Commission sees the following plan as the cornerstone of a revitalized Smithsonian science. It assumes that the Smithsonian science budget suffers no further erosion. Future appropriations requests should ask to put any savings toward scientific programs and to fund positions lost over the last decade.

Recommendation 8-e

The Institution must irrevocably commit to replacing all retiring scientists, regardless of age, with GS 13 entry-level researchers in the same science Unit within 2 years. Savings from retirements should remain within science directorates.

Recommendation 8-f

Retirement, within federal regulations, should be incentivized. It provides the most productive and risk-free means of turnover within the Institution.

[3] Eligibility to retire is a function of age and years of service

Recommendation 8-g

Demotion in rank and salary should be considered for unproductive scientists of all levels within the Smithsonian. Mediocrity should not be rewarded; the consequences of poor performance should be clearly spelled out. Distribution of Scholarly Studies funds, fellowships and other internal resources should be based solely on merit. Firm personnel actions will increase morale and clarify expectations for all.

If successfully implemented, this plan will result in a revitalization of Smithsonian science by infusing it with new blood and additional funds. It will help rebuild Departments. It may also have unforeseen benefits. For instance, an infusion of new workers may increase overall grant funding and overhead income. With their different priorities, new researchers are likely to change the directions of some programs. Revitalization will allow the Smithsonian, particularly the NMNH, to continue as one of the premier scientific institutions in the nation.

9. WHAT SUGGESTIONS, OF ANY TYPE, MIGHT THE SCIENCE COMMISSION HAVE THAT STRENGTHEN RESEARCH AT THE SMITHSONIAN?

a. Smithsonian Astrophysical Observatory (SAO)

1. Introduction

Located on the Harvard campus in Cambridge, Massachusetts, and in far-flung research stations in Arizona, Hawaii, and the South Pole, the SAO has built a remarkable record of scientific achievement over a very broad range of astrophysical topics. Current programs range from studies of atoms to studies of planets and stars, including our own Sun, to the truly grand scale of galaxies, galaxy clustering and the universe as a whole. Methods of investigation include observational techniques using radio, infrared, optical, ultraviolet, X-ray, and gamma-ray astronomy.

2. Strengths

a. SAO's close association with the Harvard College Observatory, doing business as the Harvard-Smithsonian Center for Astrophysics (CfA), has been beneficial to the development of both entities. A joint Visiting Committee reports regularly to the Dean of the Harvard Faculty of Arts and Sciences and to the Under Secretary for Science at the Smithsonian Institution (SI);
b. The 19-year leadership of Irwin Shapiro has helped the SAO thrive;
c. SAO enjoys a remarkable volume of outside support and an extraordinary ratio of outside funding ($73 million in FY 2002) to federal dollars from the SI budget ($28 million in FY 2002);
d. The CfA staff includes 12 members of the National Academy of Sciences and a Nobel Prize winner. A second Nobel Prize, in Physics, was awarded in 2002 to Riccardo Giacconi, in part for work carried out during his years on the SAO staff; and,
e. Major scientific initiatives: The Submillimeter Array in Hawaii, the MMT 6.5-meter telescope in Arizona, and the CHANDRA X-ray Observatory are all coming to fruition at the same time. These provide SAO astronomers with powerful state-of-the art instruments for research.

3. Areas of Concern

a. The Harvard-Smithsonian relationship is not without its tensions, some of which concern joint appointments;
b. Director Shapiro is now 73, and the SAO needs to plan for a smooth transition to a new Director;
c. While successfully obtaining external funding as a key source of SAO support, such funding cannot replace the federal core appropriation of the SAO. As at other SI science Units, a lack of funding has led to an era of austerity and obsolescence at SAO, particularly those in areas that rely on federal support;
d. The federal staff is aging, appointments have been few, and new fields, such as the study of planets around distant stars, are ripe for exploration. The SAO needs to renew its staff and development of a stronger theoretical division; and,

e. Today's state-of-the-art instruments will soon be obsolete. SAO must find a way to participate in the next round of telescope building.

4. Recommendations

Recommendation 9-a1
The long-range planning process now underway at the CfA needs to be carried through, with an emphasis on the resources required to maintain current areas of expertise, and the impact of initiating new programs. In addition, SAO should address and implement, where possible, the recommendations in the 2001 Visiting Committee report. The Institution's Major Scientific Instrumentation and Research Equipment pools, upon which many of SAO's previous successes have been based, should be maintained as an open, competitive resource within the SI science enterprise.

Recommendation 9-a2
Harvard University and the Smithsonian should begin to plan for Irwin Shapiro's departure.

Recommendation 9-a3
SAO should pursue opportunities to present its achievements at the National Air and Space Museum and through the Smithsonian traveling Exhibition Service (SITES).

b. Smithsonian Tropical Research Institute (STRI)

1. Introduction

Most of the Earth's biological diversity as well as most of its people are located in the tropics, and the interests of the two are in increasing conflict - with unknown implications for the future health of global ecosystems and the quality of human life. As one of the world's great research institutes, and the premier center for tropical biological research worldwide, STRI is ideally poised to contribute to our basic understanding and potential resolution of these vital questions. STRI is a strong institution that needs to grow even stronger. The basic structure is excellent, but there are also areas that should be strengthened. STRI is particularly strong in tropical forest science, and support for this program should be continued, including an interest in soil biology. Some areas of global leadership have suffered due to departing staff and by the strains on resources caused by the need for massive administrative reorganization during the year 2000 transition in the Republic of Panama. In addition, STRI needs to interact more with the National Museum of Natural History (NMNH) and the Smithsonian Environmental Research Center (SERC) science programs.

2. Strengths

STRI was reviewed in detail in October 2000 by an external committee. The Commission has not tried to replicate the excellent document resulting from that review, which found:

a. an outstanding community of well-supported resident scientific staff who are free to pursue fundamental questions;
b. strong review of scientific performance and standards for publication;
c. a management style that identifies important and appropriate areas of research and strives to establish and maintain them;
d. superb geographic location as the bridge between two continents and the barrier between two oceans;
e. strong commitment to long-term research;
f. vigorous support of visiting scientists and students from around the world; and,
g. development of new and rigorous training programs through ties with major universities.

All of these strengths combine to produce a vibrant research community with a strong sense of identity and belonging. STRI has also succeeded in building and maintaining a generally excellent set of buildings and other facilities to support its various research activities.

3. Areas of Concern

a. Research Priorities and Areas of Focus

STRI is unsurpassed in broad areas of tropical forest science, especially plant and insect ecology, life histories, and behavior. These basic activities, as well as the internationally renowned Center for Tropical Forest Science and outstanding innovations such as forest canopy cranes, have resulted in a vigorous and successful research community. Other areas that need to be better addressed with due consideration for potential collaboration with NMNH and SERC are:

1. ***Marine Ecology:*** The maintenance of excellence of marine research at STRI requires the appointment of staff scientists to replace vacancies of departing or retiring staff. The closure in 1998 of the San Blas marine station, which was the base for much of STRI's important contributions to marine science, dictated the development of new facilities. Development of the Bocas del Toro Field Station has been protracted, but an April 2003 opening is anticipated. Excellent work has continued in evolutionary biology, biogeography, behavior, life histories and development of marine organisms, as well as environmental monitoring. However, marine ecology should be developed at a level comparable to forest ecology. This opportunity is of particular concern for coral reefs - the most diverse communities in the oceans and a source of fundamental concern due to anthropogenic stress worldwide. Closer integration of facilities and programs of the Smithsonian Marine Science Network will increase the efficiency and services rendered by the marine stations and research vessels (see Section 9.h.)

2. ***Paleobiology and Archeology*****:** The Center for Tropical Paleoecology and Archeology (CTPA) was established about 10 years ago to increase understanding of past tropical environments, plant and animal communities, and peoples, and to provide a better framework for recent ecological and

evolutionary studies. The CTPA enjoyed outstanding success in marine paleoecology (Panama Paleontology Project), the long-term dynamics of tropical forest climates and plant communities based on pollen records, Panamanian archeology, and origins of tropical agriculture. Archeological research is still vigorous and successful. STRI needs to re-evaluate its role in paleoecological research.

3. ***Biodiversity and Conservation*:** STRI has recently begun to develop goals in biodiversity and conservation that increasingly impinge on all aspects of basic ecological research. This includes the addition of research on the effects of fragmentation and deforestation on tropical forests, as well as restoration thereof. This is an area of potentially fruitful collaboration with NMNH and SERC.

b. Research Support

The Commission cannot overemphasize that stable federal support for science is what allowed STRI to grow and prosper as the premier tropical biological research institution in the world. Long-term research needs to be protected from the fads and fancies of research funding. Nevertheless, internal funding for core scientific programs should undergo regular formal review and be awarded through internal competition. (This funding should leverage additional outside research support.) STRI scientists have successfully obtained support from the Smithsonian Scholarly Studies program, but have not been so successful in obtaining access to National Science Foundation support. However, the reduction in Scholarly Studies funding has impacted STRI research. (STRI has obtained considerable private foundation support, particularly in tropical forest science and plant ecology, to offset diminished federal funding.)

c. Communication

STRI science's profile is increasingly rising in the broader science community, as seen by 21 papers published in *SCIENCE* and *NATURE* in 2001. But, there is too little communication among STRI, NZP, NMNH and SERC scientists. STRI needs to make an even greater effort to increase its visibility to a level commensurate with its exceptional accomplishments in research. This should include a greater presence on the Mall, in the media, and in outreach programs beyond the Republic of Panama.

d. Administrative Infrastructure

Administrative staff strength has not kept pace with the phenomenal growth in scientific staff and facilities in the 1980s and 1990s. The level of support provided by the Office of Scientific Support Services needs to be re-examined as part of the current administrative reorganization plan at STRI.

4. Recommendations

The basic structure and functioning of STRI should not be changed. STRI should address research weaknesses and become more fully integrated into the Smithsonian scientific community.

Recommendation 9-b1
STRI should continue as an autonomous research Unit reporting directly to the Under Secretary for Science. Its major scientific programs should remain intact.

Recommendation 9-b2
STRI should develop a comprehensive science plan within 1 year to address the current balance of all scientific activities, including attention to the decline in strength in marine ecology, the future of paleoecology, and policy and goals for biodiversity and conservation activities.

Recommendation 9-b3
STRI should review its ability to provide state-of-the-art scientific support to resident staff, including the extension of electronic communication to all of its widespread facilities, renewal of laboratory equipment, field support at all of its facilities, and the re-organization and role of the Office of the Assistant Director for Scientific Support Services.

Recommendation 9-b4
STRI should strengthen its communications and outreach efforts, and increase its presence in the central administration and on the Mall, perhaps including rotating residence of appropriate staff scientists in Washington on a 1-year cycle and collaborating with NMNH, the National Zoological Park (NZP) and the National Museum of American History (NMAH) on exhibits and public outreach.

c. Smithsonian Environmental Research Center (SERC)

The Environmental Research Center supports a group of cohesive and interactive research scientists sharing a common goal to be the premier institution in the nation in the area of integrative and landscape ecology of the coastal zone, focusing on terrestrial as well as marine ecosystems. Past accomplishments have laid the groundwork for potential growth at SERC in microbial ecology, invasive species biology, global change, human/biological interactions, food web structure, modeling, and remote sensing. SERC scientists and educators have been successful in obtaining external competitive grants/contracts (including substantial NSF funding), developing philanthropic support, strengthening partnerships with collaborators, and in reassessing priorities in response to decreasing federal funding,. Educational outreach activities at the site are vigorous and successful. Leadership and management issues demand the attention of a full-time Director at SERC, who should continue to report directly to the Under Secretary for Science.

SERC would also benefit from pan-institutional collaboration and inter-unit cooperation. Currently few mechanisms exist within the Smithsonian to encourage pan-

institutional, integrative, and collaborative research. Such programs would generate more multidisciplinary research and more competitive proposals to external funding sources. For example, SERC, along with NMNH and STRI, is actively promoting the formation of the Smithsonian Marine Science Network among the five permanent field research facilities. The Network will be an excellent way to build on Smithsonian synergies.

Recommendation 9-c1
SERC should have a full-time Director (see Section 4).

Recommendation 9-c2
The pay scale for SERC research scientists and technical staff is considerably lower than scientists and technicians with similar records at other Smithsonian units. Funding should be sought to bring the salaries of SERC scientists and technical staff to equity with other Smithsonian units.

Recommendation 9-c3
SERC's laboratory and office facilities are inadequate, with more than half of the offices and many of the laboratories in trailers and temporary buildings. Six of SERC's 14 laboratories lack any federal staff support. Facilities are also inadequate for students and visiting researchers. New funding should be sought to maintain and improve SERC facilities. New facilities would allow for growth of grant-funded scientific positions.

Recommendation 9-c4
The leadership of SERC and the Undersecretary for Science should promote greater collaboration between Smithsonian marine science programs.

d. National Museum of Natural History (NMNH)

1. Introduction

The Museum of Natural History is one of the world's great museums of natural and cultural history. The importance of the Museum's science and educational missions in the 21st century cannot be overstated, given the rapidity of global change and the worldwide biodiversity crisis. The NMNH is ideally positioned to assume a global leadership role in research and education about the natural world and the relationship of humans to it. However, to do so, the Museum must restructure and reinvent itself.

NMNH employs the largest number of scientists of any institution in the world devoted to natural and cultural history through collections- and field-based research. The Museum's incomparable collections, comprising over 124 million biological, geological, archaeological, and ethnological specimens, are among the world's most extensive and valuable. Nearly a century of research on these collections has contributed greatly to the global knowledge of the geological, biological, and cultural history of Earth.

Despite these strengths and its past performance, the NMNH has not maintained the national and international scientific recognition and leadership that one would expect given the Museum's substantial resources. The Museum's budget and curatorial strength have been steadily eroding for several decades. Although there are a variety of contributing causes for this state of affairs, the Science Commission finds the main ones to be a chronic lack of both funding and consistent, long-term scientific leadership to guide, foster, and demand excellence and societal relevance in science, exhibits, and outreach. These causes are linked - the Museum can maintain adequate funding only by maintaining scientific excellence. The Museum has also failed to develop a direction. These failures have led to an erosion of staff morale, a lack of coherence of programs, turf battles, strategically poor hiring decisions (including administrative positions), lowered productivity, uneven standards for evaluating performance, and a bunker mentality of entitlement in the face of shrinking budgets.

These findings go back more than a decade. After reviewing several outside reports, in January 2000, the Integrating Committee, co-chaired by Drs. May Berenbaum and Jack Gibbons, recommended improving the NMNH's scientific leadership as the highest priority. The Integrating Committee also recommended establishing an internal science advisory board to frame a science plan for the Museum. The Integrating Committee also made specific recommendations for increasing external funding, improving science administration policy and personnel procedures, and addressing long-standing infrastructure and space issues (see Appendix H). In response to the Integrating Committee's recommendation, an NMNH Science Council was created to formulate a mission statement and a vision for future basic science directions of the Museum.

The October 2000 NMNH Science Council report (see Appendix I) is the most comprehensive statement of the Museum's research interests and directions to date (see Appendix C). The Science Council identified the NMNH's research strengths in three broad areas: (1) Earth and Planetary Sciences, (2) Evolution, Diversity, and Dynamics of Life, and (3) Human Dimensions of Diversity and Change. This led to a mission statement *to increase understanding of geological, biological and cultural patterns and processes that shape our world from the beginning of the solar system into the future*.

The Science Commission concurs with many of the findings of the Integrating Committee and respects the considerable effort of the Science Council to identify the NMNH's strengths and future directions in basic research. Still, many of the problems identified by the Integrating Committee remain unresolved. Moreover, the research agenda outlined by the Science Council report was overly broad, inclusive to a fault, and did not adequately define research priorities at the whole Museum level in the face of budget constraints.

A lack of leadership and insufficient funding are only the most visible manifestations of deeper Museum dysfunction. There are problems with the Museum's conception of itself, with its organizational complexity and lack of coherence, with its relationships with external science institutions, and with its public appeal through exhibits and educational outreach. There are also significant constraints on the NMNH imposed by

the Museum's budget and physical plant. Finally, there are significant managerial challenges in revitalizing the Museum.

2. Findings and Recommendations

- **Finding 1:** There is a clear need for improved scientific leadership to address questions of identity and direction, not only within the universe of natural history museums, but also within the larger universe of science and science education in general.

  Recommendation 9-d1
  The NMNH must have a distinguished scientist as Director who, in consultation with the scientific staff and outside experts, will chart and champion a new, more focused mission for the Museum. The next Director must develop a clear, integrated vision that will re-energize Museum science, increase public benefits, expand partnerships and collaborations with other institutions, and drive a long-term development campaign.

- **Finding 2:** The science mission of the NMNH is too diffuse, too poorly articulated and insufficiently prioritized to guide any successful revitalization of the Museum. Revitalizing the Museum will require a clearer, more focused research mission and will demand difficult decisions about focus and priorities. But, revitalization can produce tangible results that will strengthen the case for increased federal and private funding.

  Recommendation 9-d2
  The NMNH must articulate a vision that better focuses and integrates its three major research themes (see Appendix I). Each Department in the Museum must participate in the development of this vision and must identify how its research, exhibits, and outreach programs can best support it. To encourage the interdisciplinary research at which the Museum should excel, the Director should reward it.

- **Finding 3:** The collections are an essential, defining feature of the Museum. They are the unique and irreplaceable samples of cultural, biological, and geological diversity upon which the Museum's research is based. However, support for the collections has been steadily declining, threatening the future of these irreplaceable resources as well as their research and educational value. It is important that many of the collections continue to grow, and that new kinds of collections be considered, even though this further exacerbates problems of storage and maintenance. Answering fundamental scientific questions requires having actual specimens in hand. Exhaustive collections also make possible new research to answer new questions. For example, 40 years ago few scientists would have predicted that Smithsonian collections would prove to be invaluable sources of DNA for a great variety of purposes.

Recommendation 9-d3

- **The Museum must maintain and increase support for its collections. There is also a need for a more efficient use of its space, including compactorization where possible. The Museum must aggressively pursue collections-related science.**
- **The Museum should reassert its position as an international leader in bioinformatics. In order to meet the rapidly growing needs for collections-based information, especially about global biodiversity, the NMNH should be a world leader in the integration of information into databases so structured that they provide the information users need. Only by doing this can the Institution function as a repository and provider of information about the fields of knowledge that it seeks to support.**

- **Finding 4:** The NMNH educates and engages the public through exhibits on the Mall, off-Mall traveling exhibits, and the Internet. At present, however, the exhibits are not adequately integrated with the Museum's scientific research. Many of the exhibits are not up-to-date, well organized, or well connected to the science done in the Museum. Major efforts to revitalize the exhibits and outreach should be accelerated.

  Recommendation 9-d4

  The Museum should strengthen the connection of its science to exhibits. This will build greater public interest in, and awareness of, science and help build financial support of the Museum. Scientists must be directly involved in the design and implementation of exhibits, and programs should be integrated with Museum development efforts.

- **Finding 5:** In spite of excellence in many areas of education, the declining support for grants, fellowships and Scholarly Studies has severely damaged the education and training of young scholars. Smithsonian scientists identify the loss of these funds as the most urgent problem they face. The importance of graduate and post-doctoral trainees to the vitality of Museum science cannot be overstated. A potentially large contribution by the collections to education and training is not currently realized.

  Recommendation 9-d5 (also see recommendation 3-b)

  The Museum should also explore options for an expanded educational role for collections by rethinking how they can be made more accessible, especially through Internet access. The goal should be to put the tools of Museum scientists into the hands of the public to answer questions about geological, biological, and cultural diversity.

- **Finding 6:** Three of the four Departments in the Museum work satisfactorily (Anthropology, Mineral Sciences, and Paleobiology). Systematic Biology, a

recent creation of the merger of Botany, Invertebrate Zoology, Vertebrate Zoology and Entomology, is not functioning smoothly. Creation of this Department has not resulted in economies of scale, the number of administrative layers has multiplied, and there is little interaction among the research subgroups. The sheer size of the Department may be problematic, but the problems run deeper and reflect different cultures among scientists. Facilities and equipment are also an additional 'structural' problem for the Museum (see recommendation 3-f.)

Recommendation 9-d6

The Director of NMNH is urged to address the dysfunction of the current structure of the Department of Systematic Biology. Possible actions would include further restructuring into smaller, more homogeneous and cohesive Departments, or improving and strengthening the current structure. Mechanisms should also be put in place to promote interactions among administrative departments.

- **Finding 7:** With some exceptions, the Museum lacks a culture of excellence. Failure to promote excellence has resulted in a loss of morale, a number of strategically poor hiring decisions, failure to attract or retain the best scientists, failure to seize new research opportunities, failure to rejuvenate Departments with new appointments, and increasing insularity and declining national and international prominence.

Recommendation 9-d7

The Museum must link its Professional Accomplishment and Evaluation Committee (PAEC) review process with annual reviews, and a consistent pursuit of excellence should involve rewards for outstanding service, research, and outreach activities (see Sec. 5). The Director should explore pay-for-performance options that encourage those who exhibit high achievement, as well as recognition of these achievements through nominations for internal and external awards. Future Museum hires at all levels should be made within the context of a strategic plan. All positions vacated by retirements or resignations should revert to the NMNH Director - given a static budget, the ability to reassign positions is an important source of fiscal flexibility. A number of endowed curatorships should be funded and senior hires made to establish nuclei for growth in research excellence. Mechanisms to remove poor performers and incentives to promote retirement should be put in place, and replacement efforts need to focus on reinvigorating the Museum through appointments of excellent young scientists. Joint appointments with universities should be encouraged, as they are less costly, foster greater collaboration with university science, and create a conduit for students and fellows.

- **Finding 8:** The Center for Earth and Planetary Sciences (CEPS) at NASM and the Department of Mineral Sciences at NMNH share broadly similar interests in the evolution of the Earth and solar system and already have a strong collaborative relationship. Increasing the integration between these two groups would provide focus for their activities, and provide a foundation for increased support.

  Recommendation 9-d8
  The Under Secretaries for Science and American Museums and National Programs should work with the Directors and scientists in CEPS and Mineral Sciences to provide productive scientific oversight of their joint activities and coordinate their hiring and evaluations. The Commission sees no need for the physical integration of the two groups into a single location. The current configuration maximizes the presentation of science to the public.

- **Finding 9:** The placement of the molecular laboratories and their scientific staff at distant locations from NMNH (*i.e.,* MSC and NZP) has led to negative consequences. There has been insufficient interaction between scientists knowledgeable about molecular methods and curators who need to apply these methods to their research. Students and postdoctoral fellows of more traditional scientists in NMNH have had difficulties in developing and applying these methods. NMNH is falling behind other natural history museums in part because too few curators use these modern tools in their research programs. The molecular labs and their core scientists need to be physically adjacent to encourage collaboration among all NMNH scientists, and to gain a mutual understanding of the diverse methods of systematic biology and to create the kind of synergistic environment needed to gain national prominence in systematic and evolutionary biology.

- **Recommendation 9-d9**
  The NMNH Director should make funding for the centralization at NMNH of the Laboratory for Analytical Biology, including molecular laboratories and core facilities (SEM, DNA sequencing, and isotope analysis) a high priority. All molecular lab staff from NZP and MSC should be relocated to NMNH. The Commission endorses the Museum's plan to provide general access to modular laboratory space, facilities, baseline funds, and human resources for major projects that use molecular methods, on the basis of need, current funding and merit. Similarly, consideration should be given to providing limited funds to facilitate collaborative and pilot ventures on the part of traditional NMNH scientists who want to apply molecular tools to their research.

e. Smithsonian Center for Materials Research and Education (SCMRE)

1. Introduction

The Smithsonian has a responsibility to collect, study, and interpret the national collections and to protect and conserve them for the future. Lacking this capability in its individual museum conservation programs (which today employ over 30 conservators), the Smithsonian created the Conservation Analytical Laboratory (CAL) in 1963. In 1996, CAL's mission was broadened to include education, and its name was changed to Smithsonian Center for Materials Research and Education (SCMRE). Today, the professional staff of 24 (down from 36 a few years ago) hold degrees in archaeology, conservation and preservation science, materials science, metallurgy, botany, chemistry, biochemistry, and other fields. Such diversity enables SCMRE to assemble research teams to tackle complex multi-disciplinary problems in many areas of materials science, conservation, and preservation.

The Center for Material Research and Education's last program review in 1995 gave its research programs good marks but pointed out a number of problems: a need for more collaboration with SI museums; for more attention to care and preservation of natural history specimens and modern materials; and, for an expanded national training program. Staff dissension and management issues also needed attention, and a regular system of program review and staff evaluation was lacking. The Science Commission found that many of the problems noted in the 1995 review still exist today.

2. Findings and Recommendations

- **Finding 1:** In addition to its primary mission of supporting Smithsonian collections and providing scientific knowledge concerning these materials, SCMRE has an important role as a national and international laboratory for the study and care of museum objects. SCMRE has been very effective in serving this need, and its work is held in high esteem by the national and international conservation, materials science, and archaeological communities for innovative research, development of new conservation techniques, and research on preservation and museum-storage techniques. No other laboratory or group in the United States has such broad interdisciplinary capability in this area or has accomplished more for the care of a wide variety of museum objects and materials (outside the field of fine arts conservation). The loss of this unique Smithsonian contribution to the national conservation effort would have a very negative impact on the preservation of the nation's heritage, and on the Smithsonian itself as the leading institution holding America's national heritage.

  Recommendation 9-e1

  SCMRE's principal mission should be to provide museum conservators, curators, and administrators with technical information and advice that enhance conservation, preservation, and knowledge of Smithsonian collections. Collaborative research with curators on these kinds of collections-based projects should be a primary activity. SCMRE should also continue to provide national leadership in

analytical conservation and preservation studies in areas where it has unique capabilities, while still recognizing its primary role in support of Smithsonian collections.

- **Finding 2:** SCMRE recently began to explore the serious problem of conservation and preservation of natural history collections. The NMNH collection holds some 124 million specimens, many of which were collected more than 100 years ago. Only the anthropological portion of this collection is currently receiving professional conservation and preservation care. The NMNH preservation problem is a microcosm of natural history collection neglect world-wide. In addition to addressing Smithsonian problems, creation of a natural history conservation and preservation research program in SCMRE would serve as a national resource to aid other museums in providing care for their endangered collections.

  Recommendation 9-e2
  SCMRE should intensify its research on conservation and preservation of natural history collections and disseminate its results to the wider museum community.

- **Finding 3:** SCMRE has developed a broad series of training and outreach programs, including internships, fellowships, traveling exhibits, workshops, Web- and media-based courses, and literature providing conservation and preservation information to various sectors of the public. Some of these programs consume large amounts of researchers' time and interfere with the Unit's primary research mission.

  Recommendation 9-e3
  Education programs mandated by Congress should be continued as a secondary function of the SCMRE research mission. SCMRE's off-site and non-SI education commitment should be reduced to a more manageable size, allowing research staff to concentrate primarily on research and service functions. More efficient methods should be explored for delivery of educational programs through use of contractors and remote delivery systems using the Web and video programming, funded, where possible, by user fees, grants, and collaboration with outside educational groups. Exhibitions should be done collaboratively with Mall museums and with SITES.

- **Finding 4:** SCMRE has been operating largely as an independent research institute without sufficient collaboration and interaction with Smithsonian museums and their curators and collections. While SCMRE has continued to conduct analyses and projects with Smithsonian museum staff, this collaboration has been much reduced in recent years and has not been of central concern to SCMRE management.

Recommendation 9-e4

SCMRE should re-focus its activities on the original CAL mission, providing research in support of Smithsonian collections and their long-term care and providing analytical data and information needed by the Units to understand and interpret the significance of Smithsonian collections. SCMRE should work closely with the Smithsonian Conservation Council and museum curatorial and conservation programs, as well as central administration, to help identify institutional needs and match SCMRE's capabilities with Smithsonian museums and collections. Because most of SCMRE's museum clients report to American Museums and National Programs rather than to Science, there needs to be close cooperation at the Under Secretary level to maximize benefits to all Smithsonian collections.

- **Finding 5:** The Commission believes that SCMRE's archaeological programs are of high quality and serve as national resources for collaborative study of archaeological materials. SCMRE staff provides SI and non-SI researchers with access to a variety of analytical services including neutron-activation analysis of archaeological materials at the National Institute of Standards and Technology reactor, just as SCMRE's analytical facilities and staff expertise provide resources for internal and external archaeologists. But, the Commission concludes that SCMRE's archeological programs operate largely independently from SCMRE's conservation and preservation mission. They compete with, and distract from, this mission and should be managed as part of a Unit with a larger anthropological research focus.

Recommendation 9-e5

Management of archaeometry programs should be transferred to the NMNH, where archaeological research is a major activity of the Department of Anthropology.

- **Finding 6:** SCMRE staff demonstrates a high degree of professional skill and commitment to the Institution. However, SCMRE and Smithsonian staff decry the Unit's isolation from the museums and the lack of central administration interest in its programs. This sense of isolation has been compounded by morale problems, significant staff departures, factionalism, internal dissension, complaints about management, leadership and poor communication with central administration.

Recommendation 9-e6

SCMRE requires reorganization and the appointment of a new management team, improving communication with the central administration and the museums, re-building staff, re-balancing the research and education missions, replacing out-of-date instrumentation and equipment, instituting new procedures and

performance targets for staff and Unit evaluation, and developing a fund-raising and development capability.

- **Finding 7:** SCMRE is a major Smithsonian Unit with a budget of $3.5 million, a large professional staff, and a complex mission that includes national responsibilities for conservation and preservation research. Despite this, SCMRE has been operating for many years without periodic advice or structured review.

  Recommendation 9-e7
  SCMRE needs regular reviews by a Visiting Committee of prominent leaders in the fields of museum conservation, preservation, and materials research, charged with reviewing scientific output, response to Smithsonian needs, and relations with the broader professional community. Committee membership should be largely external but should include representatives from Smithsonian museums.

f. National Zoological Park (NZP) and Center for Research and Conservation (CRC)

1. Introduction

The Commission strongly endorses the NZP Director's goals to focus on conservation of a limited number of animal species, and to aspire to be the foremost zoo in the world in the area of endangered species diversity, physical facilities, veterinary medicine, reproductive biology, and visitation. This focus would bring the visitor closer to the animals, create a sense of the natural habitat of each species and show science and research in action. Current examples are a "Think Tank" that features orangutans, and the popular Panda Exhibit. This focus can also serve to unite the staff in the Department of Animal Programs and the CRC around a common goal. Such a focus on habitat protection provides an immediate and clear link to other SI conservation biology efforts. In particular, the Science Commission advocates a focus on the challenges of preserving biodiversity in human-dominated ecosystems and the adaptations of animals to such habitats. Much existing Zoo research is already related to these issues, but lacks focus.

The CRC is a unique program currently composed of two departments: Conservation Biology and Reproductive Sciences, plus additional staff for facilities upkeep. It is important to note the difference between the programmatic Center and the physical Front Royal facility. The Front Royal facility of the CRC sits on 3,200 acres of land and has 20 miles of jeep trails, 30 miles of fencing and nearly 100 buildings. Before the Commission was established, closure of the Front Royal facility was proposed in the interest of saving money and the Zoo Director has advanced a strategic and integrative vision for the Zoo that focuses on conservation-oriented research. The Science Commission finds that while some of the scientific activities at the Front Royal facility are of high-caliber and important to the mission of the NZP, others are not keeping pace with realistic SI expectations. Further, the Commission finds that the facility as a whole has been under-performing. This finding substantially agrees with the findings of previous reviews. The Commission does not, however, suggest immediate closure of the facility because we find that it may have the potential for substantial contribution to SI

and national science goals. Nevertheless, such closure may ultimately be necessary, as discussed below.

2. Findings and Recommendations

- **Finding 1:** The Commission agrees with the recommendation of the Secretary and the Director of NZP that the Zoo must set priorities, focus on areas of excellence, and de-emphasize non-focal areas. Shrinking resources and deteriorating exhibits dictate that business as usual is not an option. Specifically, the Commission supports keeping the CRC-Front Royal facility under the NZP Director, who has full responsibility for CRC staff and the Front Royal facility.

- **Finding 2:** Science has not been successfully integrated into the public exhibit area at NZP. The reasons for this include lack of dedicated staff and the absence of any ongoing evaluation of these kinds of exhibits. Staff excitement about developing a stronger exhibit development program is encouraging.

  Recommendation 9-f1

  The Science Gallery in Amazonia does an excellent job of bringing science into its exhibit and also does an impressive job of showcasing links to other SI science Units. This should be used as a model for future integrative exhibits at NZP.

- **Finding 3:** The current organization of the scientific and professional staff at the NZP and CRC-Front Royal facility does not optimize use of the staff. One major challenge in bringing the staff of the NZP together across programs is to combine the conservation and science activities to produce greater impact on the public experience.

  Recommendation 9-f2

  a. Consistent with recommendations below regarding the CRC-Front Royal facility, the scientific and professional staff, and associated support staff, should be combined into a single directorate encompassing conservation, research and training;
  b. Support for this directorate would involve continuation of current federal support, but the Commission strongly supports the expansion of current efforts to attract external funding for research, education and training and other programs;
  c. The Director of the NZP should form a task force to begin to plan both short-term and long-term strategies to unite the currently disparate staffs around a common vision, mission, goals and projects;
  d. The Reproductive Biology groups (at both Front Royal and Rock Creek) should be developed as a unique national resource. Few, if any other zoos in the world, have the capability to study reproductive aspects of so many different species, yet detailed

knowledge of such issues is critical to the success of species conservation plans. The joint reproductive biology group should be developed and showcased as a national conservation resource. Every effort should be made to generate political and financial support, both public and private; and,

e. **Several programs at Front Royal and Rock Creek are currently engaged in science/policy interactions, and have expressed a desire to develop these interests further. The NZP senior staff will have to determine the extent to which these should be expanded, consistent with Unit goals and priorities. A working group should be established to develop a more effective policy. This group should involve experts from other government agencies involved in resource economics or land use (*e.g.*, Department of Interior), as well as non-governmental organizations.**

- **Finding 4:** The evaluation of scientific staff is not perceived to value applied research and service, interdisciplinary or cross-departmental work, and collaboration in general. For example, some staff noted specifically that conservation biology and associated training and research do not receive the same recognition as basic research.

  Recommendation 9-f3
  As part of the review of the evaluation process discussed in Section 5, review performance evaluation standards to ensure that applied research, collaborative work and training are incorporated and appropriately weighted based on the particular position descriptions.

- **Finding 5:** Both NZP and CRC-Front Royal rely heavily on Friends of the National Zoo (FONZ) to handle development, to raise money for research and conservation activities, and to oversee other activities. Our review suggests that donors are not receiving a clear message about the new integrative vision for the Zoo.

  Recommendation 9-f4
  A working group of development staff, scientists, and other staff under the direction of the NZP Director should craft a common vision and mission statement to articulate to donors and other external constituencies.

- **Finding 6:** The Front Royal facility requires significant resources to maintain, and at present is not utilized to its full potential.

  Recommendation 9-f5
  Maintain core support for NZP scientific staff (salaries and benefits, basic all-other support) presently assigned to the Front Royal facility, while eliminating federal funding for operational staff and facilities

maintenance over a 5-year period. The Commission recognizes the potential to create a National Conservation Resource Center with the active collaboration of outside organizations. Recognizing the time required for an orderly shutdown of the facility, the Under Secretary for Science and the NZP Director should be provided with a 2-year opportunity to seek such support. If sufficient external funding is not forthcoming, the facility should be returned to the General Services Administration at the end of the 5-year period. Full-time equivalent (FTE) positions and support 'saved' by the phased reductions in federal support at Front Royal should be applied to avoid base reductions at NZP, or to increase operations there. The NZP Director and the Under Secretary for Science should also educate legislators and the general public about how this new direction can reinvigorate the Zoo and the research programs of the CRC.

- **Finding 7:** NZP needs to more effectively communicate its message to external constituencies.

  Recommendation 9-f6
  NZP must evaluate its effectiveness in delivering its central message to the public. It must learn how to better influence public views. It must also learn from the leaders in its profession, both nationally and internationally.

- **Finding 8:** NZP has great potential for collaboration with both SI and non-SI Units.

  Recommendation 9-f7
  a. **NZP must expand its networks to address common problems. For example, it should join forces with the Department of Systematic Biology at NMNH and other natural history museums in bioinformatics, to exchange information, and perhaps to craft a national or international message on the role of zoos and museums in world conservation of endangered species. In addition, they should take the opportunity to tap into the network of conservation organizations such as The Nature Conservancy, the World Wildlife Fund, Conservation International and the Audubon Society and elements of the environmental education movement in this country and worldwide;**
  b. **NZP should build conservation and sustainable capacity into their respective organizations. They can conserve energy, recycle, and generally convey best conservation practices;**
  c. **Participate in *in-situ* conservation programs. In addition to working to conserve the giant panda at the National Zoo by creating or duplicating the natural environment at the Zoo or at Front Royal (*ex-situ*); play a leadership role in educating people**

who live in those natural environments with the animals, how to protect that environment, so the species does not become endangered;

d. Develop a public information campaign and public education program around the shift that the Zoo is making as an environmental resource and conservation center. Promote "the public good" that this shift will have on the City, the region, the nation and the world. Also, promote ways in which the Zoo will be working with other Units of the Smithsonian and with external partners. NZP leadership must train scientists and exhibitors to be official spokespersons for this new direction as well; and,

e. Modern zoos, with the Wildlife Conservation Society in New York as the best model, are increasingly devoted to preserving habitat and studying animals where they exist in the wild. Certainly, the National Zoo has had some activities of this kind, but NZP deals mainly with captive-bred animals. NZP needs to examine the role of overseas research and conservation programs, increasingly a feature of the overall portfolios of modern zoos, determine what role it should play in this arena, and seek the funds to implement it. Collaboration with STRI in this regard seems obvious.

g. Center for Earth and Planetary Studies (CEPS)

1. Introduction

CEPS, at the National Air and Space Museum, has three major responsibilities:

a. Original scientific research into the nature of planetary surfaces, primarily within the focus areas of planetary volcanism and Mars evolution;
b. Curation of two museum galleries, a large-format digital theatre, the NASM moon rocks, and a National Aeronautics and Space Administration (NASA) Regional Planetary Image Facility; and,
c. Development of innovative outreach and educational programs related to planetary exploration.

CEPS staff comprises six geologists and geophysicists, a geographer, three post-doctoral fellows, a science programs manager, physical science technicians, and administrative/fund management specialists. The Center also hosts high-school and undergraduate interns on a rotating basis. Personnel evaluations for permanent staff are performed through a rigorous, scheduled PAEC process involving all the NASM curatorial departments, the Department of Mineral Sciences (DMS) staff at NMNH, and external specialists. The Chair of CEPS is a rotating 4-5 year position.

CEPS plays a significant role in the public outreach mission of the NASM, providing scientific expertise and curatorial management for the Looking at Earth and Exploring the Planets galleries. There is thus considerable advantage to the Institution in retaining the two venues for Earth and planetary sciences (NASM and NMNH).

A key aspect of CEPS scientific and public programs is its considerable support from external sources. On average, the Center raises more than one-half its total operating budget through competitive external funding (NASA grants, corporate donations) - approximately $160,000/yr for each federal scientist. Smithsonian endowments, such as the Becker and Lindbergh funds, provide additional support for research and post-doctoral fellowships.

CEPS research activities have been re-focused over the past 5 years to emphasize depth in the core strengths of planetary volcanism and Mars research, while de-emphasizing remote sensing of terrestrial climate change and human impacts on the environment. These changes were reflected in recent staff scientist and post-doctoral hiring decisions, and in the development of new funding proposals for research and space mission participation. The benefits of this new emphasis are clear, with an increase in group funding, press coverage, a major article in *Science*, and the selection of two staff members for the NASA Mars 2003 and 2005 mission science teams.

2. Recommendation:

Recommendation 9-g

a. Retain the physical location of CEPS within NASM;
b. Continue to improve CEPS-DMS communication in hiring, evaluation, and fund-raising; and,
c. As new planetary mission roles develop, support these initiatives through office space rental and improved financial management systems.

h. Pan-Institutional Research Programs

1. Introduction

The Smithsonian Institution must encourage, promote, and support pan-Institutional programs to foster integration and collaboration among research scientists from different Units. Such programs would generate more multidisciplinary studies and more competitive proposals to external funding sources. These integrative programs provide the ideal framework to support new national scientific initiatives, where success hinges on a multidisciplinary approach. They also provide the support system for measuring patterns of change across latitudinal gradients. Possible new areas of focus include systematics, developmental biology, biogeography, evolution, ecology, climatology, geochemistry, anthropology, and modeling of various ecological systems.

The Smithsonian Marine Science Network (MSN) is an example of a pan-Institutional program. The MSN is an integrated consortium of the five permanent SI field research facilities, each engaged in marine sciences and capitalizing on its unique geographical position: SERC on Chesapeake Bay; NMNH through the Smithsonian Marine Station on the Indian River Lagoon in Florida and the Smithsonian Marine Laboratory at Carrie Bow Cay on the Meso-American Barrier Reef in Belize; and STRI's Marine Laboratories at Bocas del Toro and Naos on the Panamanian Isthmus. The MSN

focuses on major environmental, ecological, and evolutionary questions in the coastal zone, and provides SI research scientists and their collaborators with an organizational structure, facilities, and a mechanism to conduct research and intensive monitoring along the western Atlantic. By virtue of the facilities within the MSN, the Smithsonian is the leading biodiversity center for invertebrates in the Caribbean and western Atlantic. Despite its success and productivity, SI does not currently fund this program. Like other pan-Institutional initiatives at SI, funding is cobbled together by the entrepreneurial spirit of its research scientists. This situation is admirable, but it is not stable or sustainable.

Other pan-Institutional initiatives generated by SI research scientists include the Invasive Species Program, the Migratory Bird Program, the Molecular Analytical Laboratory, and the Conservation Council. The NMNH Arctic Studies Center (ASC) is a different type of pan-Institutional science and education program operating across Smithsonian Units, forming an important link between science and humanities branches of the Smithsonian. SERC has expressed similar interest in developing collaborative programs with ASC/NMNH in Alaska. Other NMNH science programs, like Mexico Norte, operate as Smithsonian Affiliations programs across the Smithsonian's science and humanities boundary.

2. Recommendation:

Recommendation 9-h

a. SI must support and provide funding for its pan-Institutional programs to foster integrative research collaborations and stimulate multidisciplinary studies among its research scientists;

b. SI must develop organizational and administrative support to promote integrative and interdisciplinary programs;

c. SI must provide stable and consistent base funding to support the infrastructure for pan-Institutional programs and research scientists who utilize cross-linked field and laboratory facilities for comparative and synthetic studies;

d. SI must also develop funding mechanisms, such as competitive grants and peer-review panels that promote excellence in research and multidisciplinary studies, foster participation by SI scientists, and fund visitation to the array of the Institution's facilities; and,

e. Each member of a pan-Institutional program, such as the MSN, must develop opportunities for research scientists from other SI Units to use its facilities.

10. PRIORITIZED SUMMARY OF RECOMMENDATIONS

Recommendations are sequentially numbered according to the section of the report in which they are presented. The Commission has divided the recommendations into two classes: those that have no major financial implications for the Smithsonian, and those that will require either new federal allocations, new trust funds, or internal reallocation of funds. Those recommendations with no substantial financial implication are divided into two groups: a smaller, highest priority group for immediate attention, and a larger, priority group. The recommendations with financial implications have been divided into three priority groups: highest priority, high priority, and priority. Within these various priority groups, recommendations are listed in the numerical order they appear within the document.

a. Recommendations WITHOUT Substantial Financial Implications - Highest Priority

Recommendation 3-a

The Commission fully endorses the NAS and NAPA report recommendation that SI scientists be allowed to compete directly for federal funding. We recommend that the Smithsonian administration actively pursue all means to implement this recommendation.

Recommendation 4-a

All searches for scientific leaders above the level of Department Chair should involve an appropriate group of SI scientists and management, with appropriate non-SI involvement. Searches should be nationwide.

Recommendation 4-c

The intellectual credibility, strength, coherence and vitality of the Institution's exhibits and educational programs depend upon the activities of its scholars. The integral involvement of SI scientists in Institutional outreach programs should therefore be encouraged by both the Secretary and the Under Secretary for Science.

Recommendation 8-c

The Under Secretary should solicit plans and performance descriptions from science Unit heads and from these forms annual goals, defends requests to the SI administration and Congress, and benchmarks accomplishments. Science staff across the Institution should have input in this process and in strategic planning. The Commission recommends that scientists and scientific curators of the Council of Scholars form a subcommittee within the Council to bring important issues before the SI administration and facilitate dialogs on policy, budget, and organizational issues affecting SI science.

Recommendation 8-d

The Under Secretary should establish a broad-based group, led by a Special Scientific Advisor, to take an Institution-wide view of scientific collections, collections management, and collections conservation. Appropriate SI art and cultural museum experts should participate. Greater collaboration among Units is needed to develop effective means of dealing with Institution-wide problems of management and collections preservation.

Recommendation 9-d1

The NMNH must have a distinguished scientist as Director who, in consultation with the scientific staff and outside experts, will chart and champion a new, more focused mission for the Museum. The next Director must develop a clear, integrated vision for the scientific research, exhibits, and outreach enterprise of the Museum that will re-energize Museum science, increase public benefits from the Museum, expand partnerships and collaborations with other institutions, and drive a successful long-term development campaign for the science and public programs.

Recommendation 9-d2

The NMNH must articulate a vision that better focuses and integrates its three major research themes (see Appendix I). Each Department in the Museum must participate in the development of this vision and must identify how its research, exhibits, and outreach programs can best support it. To encourage the interdisciplinary research at which the Museum should excel, the Director should reward it.

Recommendation 9-d6

The Director of NMNH is urged to address the dysfunction of the current structure of Department of Systematic Biology. Possible actions would include further restructuring of Systematic Biology into smaller, more homogeneous and cohesive Departments, or improving and strengthening the current structure. Mechanisms should also be put in place to promote interactions among administrative departments.

Recommendation 9-e1

SCMRE's principal mission should be to provide museum conservators, curators, and administrators with technical information and advice that enhances conservation, preservation, and knowledge of Smithsonian collections. Collaborative research with curators on these kinds of collections-based projects should be a primary activity. SCMRE should also continue to provide national leadership in analytical conservation and preservation studies in areas where it has unique capabilities, while still recognizing its primary role in support of Smithsonian collections.

Recommendation 11

The Board of Regents should establish a 3-year benchmark period for this report. By July 2003, the Under Secretary for Science should create a plan for carrying out the Commission's recommendations, including explicit metrics for success and a timetable for completion. This plan will be implemented through the Scientific Directors Council, comprised of the heads of each major science Unit. The Under Secretary will also assemble a distinguished Visiting Committee to review the Institution's progress, on a yearly basis, in a brief report to the Smithsonian Regents (in December 2003, 2004, and 2005).

b. Recommendations WITH Substantial Financial Implications - Highest Priority

Recommendation 3-b

The Fellowships and Scholarly Studies Programs must be reinstated as soon as possible. The cannibalization of these funds for other Smithsonian programs has

greatly weakened the science enterprise. Pre-doctoral and post-doctoral fellowships infuse the Institution with new, energetic scientists and provide a means of training the next generation. Scholarly Studies funds (distributed competitively based on research merit) must provide seed money for the development of external proposals and to provide incentives and support for the best and brightest Smithsonian scientists. Once re-established, funds within this program must not be redirected out of the science Unit.

Recommendation 3-c

Mandated salary increments have for too long been funded by scavenging positions, to the detriment of SI science excellence and staff morale. Steps must be taken immediately to obtain full funding for annual salary increments, including within-grade increases and promotions, in the Smithsonian budget.

Recommendation 3-d

Development efforts for SI science in the private sector and among foundations should be significantly increased in the face of growing federal budget constraints.

Recommendation 3-g

The Institution should move more aggressively to make use of digitization and Internet technology to expand the reach of Smithsonian science and to make Smithsonian collections more available to scientists and the public.

Recommendation 5-f

Review of Science Units and their programs appears to be *ad hoc* and infrequent. Regular oversight and review of programs and Units must be established. In addition, Visiting Committees should:

- be composed of objective, distinguished scientists and established for each Unit to evaluate programs, provide guidance on venues, and 'sunset' programs as appropriate. Committee members should be appointed based upon the advice and recommendations of members of the Unit. Visiting Committees are not the same as external review committees, convened once to do a specific review; also, they are distinctly separate from the Director's Advisory Boards;
- consist of members with multi-year appointments, whose terms are staggered;
- evaluate the science, and the components that contribute to it - space, facilities, funding, personnel (at a general level), new and old programs, review procedures, etc;
- meet yearly or biennially at the Unit, and do a careful review of the Unit and its programs, offering clear and constructive advice. Recommendations should be provided with measurable, quantitative goals and terms;
- report to the Director of the Unit served; the Director and the Under Secretary for Science should respond to the Committees' reports and recommendations;
- be structured with guidelines that are sufficiently flexible to include joint committees (*e.g.,* SAO-Harvard), with appropriate lines of reporting; and,
- be linked to boards and similar bodies as appropriate.

Recommendation 8-a

The Under Secretary for Science should set SI science strategy. The Commission recommends that 3 advisory staff scientists be appointed on a rotating basis (*e.g.,*

2-year terms) from the major disciplines. These Special Scientific Advisors would help the Under Secretary assess scientific progress and identify scientific highlights at the Units, encourage collaboration across Units, and prepare material for the Under Secretary, Secretary, or Congress as requested. They would organize seminars and meetings, coordinate educational and outreach efforts among the Units, act as liaison to the Congress of Scholars or other advisory groups, provide guidance on sources of science content for exhibit planning, and provide advice and information to the Under Secretary. These Advisors should receive a modest stipend in addition to their SI salary (and additional research support from the Institution) for serving in these positions. These positions should be considered prestigious and only the most respected members of the SI science community should fill them. NASA's management of research programs for space science - "Discipline Scientists" are drawn from the communities they serve – makes a good model. This structure would greatly increase the role of Smithsonian scientists in central administrative operations while avoiding the creation of a new (and expensive) management tier.

Recommendation 8-e

The Institution must irrevocably commit to replace all retiring scientists, regardless of age, with GS 13 entry-level researchers in the same science Unit within 2 years. Savings from retirements should remain within science directorates.

Recommendation 8-f

Retirement, within federal regulations, should be incentivized. It provides the most productive and risk-free means of turnover within the Institution.

Recommendation 8-g

Demotion in rank and salary should be considered for unproductive scientists of all levels within the Smithsonian. Mediocrity should not be rewarded; the consequences of poor performance should be clearly spelled out. Distribution of Scholarly Studies funds, fellowships and other internal resources should be based solely on merit. Firm personnel actions will increase morale and clarify expectations for all.

Recommendation 9-c2

The pay scale for SERC research scientists and technical staff is considerably lower than scientists and technicians with similar records at other Smithsonian units. Funding should be sought to bring the salaries of SERC scientists and technical staff to equity with other Smithsonian units.

Recommendation 9-e6

SCMRE requires reorganization and appointment of a new management team, improving communication with the central administration and the museums, re-building staff, re-balancing the research and education missions, replacing out-of-date instrumentation and equipment, instituting new procedures and performance targets for staff and Unit evaluation, and developing a fund-raising and development capability.

Recommendation 9-f5

The Commission recommends maintaining core support for NZP scientific staff (salaries and benefits, basic all-other support) presently assigned to the Front

Royal facility, while eliminating federal funding for operational staff and facilities maintenance over a 5-year period. The Commission recognizes the potential to create a National Conservation Resource Center with the active collaboration of outside organizations. Recognizing the time required as part of the budget process for an orderly shutdown of the facility, we therefore recommend that the Under Secretary for Science and the NZP Director be provided with a 2-year opportunity to seek such support. If sufficient external funding is not forthcoming, the facility should be returned to the General Services Administration at the end of the 5-year period. FTE's and support 'saved' by the phased reductions in federal support at Front Royal should be applied to avoid base reductions at NZP, or to increase operations there. The NZP Director and the Under Secretary for Science should also educate legislators and the general public about how this new direction can reinvigorate the Zoo and the research programs of the CRC.

c. Recommendations WITH Substantial Financial Implications – High Priority

Recommendation 3-e

Greater support for Library resources, including access to the Web of Science and other Internet search engines, and support for journals and book purchases, is essential to maintain the quality of research at the Smithsonian.

Recommendation 4-b

SI science leaders should develop a plan to advance SI scientists in a variety of forums. Senior scientists on Unit Advisory Boards and Councils should mentor and advocate for younger SI scientists. Career development should include expectations of participation and influence within the broader scientific community.

Recommendation 6-a

The central administration should encourage innovative education development within and across Units and make education a responsibility of the Under Secretaries for Science and American Programs. The proposed Unit scientist advisors detailed to the Under Secretary for Science could coordinate education programs across Units and assist in presenting SI-wide seminars and exhibitions. SI fellowship programs and Scholarly Studies should be funded. The central administration must raise funds for cross-Unit education programs.

Recommendation 6-b

Increase funds (federal) to science Units for exhibition and educational program development and develop a strategic management and fund-raising plan for maximum education impact. Enlist Smithsonian magazine and SI Press support to help get the word out.

Recommendation 6-c

Broaden the membership of the pan-Institutional Education Council to include scientists and central administration personnel. Charge this group with strategic planning, fund-raising and development. Charge it with establishing a biannual pan-Institution "Smithsonian Conference" to highlight emerging issues of public interest. Greater use of SITES exhibition services by STRI, SAO, SERC, and SCMRE would help provide these organizations with needed exhibition venues.

Recommendation 8-b

The Under Secretary for Science should retain the two existing high-level staff positions, Scientific Programs and Budget. These two Executive Officer positions require additional administrative staff assistance. There may also be a need for greater coordination of public programs, education, collections and preservation across various Units. While the Special Scientific Advisors may fill these roles, the Commission supports the addition of new Executive Officer positions if deemed necessary by the Under Secretary.

Recommendations 9-c1 and 4-d

SERC should have a full-time Director (see Section 4).

Recommendation 9-c3

SERC's laboratory and office facilities are inadequate, with more than half of the offices and many of the laboratories in trailers and temporary buildings. Six of SERC's 14 laboratories lack any federal staff support. Facilities are also inadequate for students and visiting researchers. New funding should be sought to maintain and improve SERC facilities. New facilities would allow for growth of grant-funded scientific positions.

Recommendation 9-d3

- The Museum must maintain and increase support for its collections. There is also a need for a more efficient use of its space, including compactorization where possible. The Museum must aggressively pursue collections-related science.
- The Museum should reassert its position as an international leader in bioinformatics. In order to meet the rapidly growing needs for collections-based information, especially about global biodiversity, the NMNH should be a world leader in the integration of information into databases so structured that they provide the information users need. Only by doing this can the Institution function as a repository and provider of information about the fields of knowledge that it seeks to support.

Recommendation 9-d5

The Museum should also explore options for an expanded educational role for the collections by rethinking how they can be made more accessible, especially through Internet access. The goal should be to put the tools of Museum scientists into the hands of the public for answering their practical questions about geological, biological, and cultural diversity.

Recommendation 9-d7

The Museum must link its PAEC review process with the annual reviews, and a consistent pursuit of excellence should involve rewards for outstanding service, research, and outreach activities (see Sec. 6). The Director should explore pay-for-performance options that encourage those who exhibit high achievement, as well as recognition of these achievements through nominations for internal and external awards. Future Museum hires at all levels should be made within the context of a strategic plan. All positions vacated by retirements or resignations should revert to the NMNH Director - given a static budget, the ability to reassign positions is an important source of fiscal flexibility. A number of endowed curatorships should be funded and senior hires made to establish nuclei for growth

in research excellence. Mechanisms to remove poor performers and incentives to promote retirement should be put in place and replacement efforts need to focus on reinvigorating the Museum through appointments of excellent young scientists. Joint appointments with universities should be encouraged, as they are less costly, foster greater collaboration with university science, and create a conduit for students and fellows.

Recommendation 9-f7

a. NZP must expand its networks to address common problems. For example, it should join forces with the Systematic Biology department at NMNH and other natural history museums in bioinformatics, to exchange information, and perhaps to craft a national or international message on the role of zoos and museums in world conservation of endangered species. In addition, it should take the opportunity to tap into the network of conservation organizations such as the Nature Conservancy, the World Wildlife Fund, Conservation International and the Audubon Society, and elements of the environmental education movement in this country and worldwide.
b. NZP should model conservation and sustainable capacity building in the way they run their respective organizations. It can conserve energy, recycle, and generally convey best conservation practices.
c. NZP should participate in *in-situ* conservation programs. In addition to working to conserve the giant panda at the National Zoo by creating or duplicating the natural environment at the Zoo or at CRC (*ex-situ*), play a leadership role in educating people on who live in those natural environments with the animals on how to protect that environment so the species does not become endangered.
d. Develop a public information campaign and public education program around the shift that the Zoo is making as an environmental resource and conservation center. Promote "the public good" that this shift will have on the City, the region, the nation and the world. Also, promote ways in which the Zoo will be working with other Units of the Smithsonian and with external partners. NZP leadership must train scientists and exhibitors to be official spokespersons for this new direction as well; and,
e. Modern zoos, with the Wildlife Conservation Society in New York as the best model, are increasingly devoted to preserving habitat and studying animals where they exist in the wild. Certainly the National Zoo has had some activities of this kind, but mainly dealing with captive-bred animals. NZP needs to examine the role of overseas research and conservation programs, increasingly a feature of the overall portfolios of modern zoos, determine what role it should play in this arena, and seek the funds to implement it. Collaboration with STRI in this regard seems obvious.

Recommendation 9-h

a. SI must support and provide funding for its pan-Institutional programs to foster integrative research collaborations and stimulate multidisciplinary studies among its research scientists;
b. SI must develop organizational and administrative support to promote integrative and interdisciplinary programs;

c. SI must provide stable and consistent base funding to support the infrastructure for pan-Institutional programs and research scientists who utilize cross-linked field and laboratory facilities for comparative and synthetic studies;
d. SI must also develop funding mechanisms, such as competitive grants and peer-review panels that promote excellence in research and multidisciplinary studies, foster participation by SI scientists, and fund visitation to the array of the Institution's facilities; and,
e. Each member of a pan-Institutional program, such as the MSN, must develop opportunities for research scientists from other SI Units to use its facilities.

d. Recommendations WITHOUT Substantial Financial Implications - Priority

Recommendation 5-a

Annual performance reviews should include past performance goals, the reviewee's self-assessment, the reviewer's assessment and 'grading', and future goals. Goals should be mutually arrived at. Both the reviewee's self-assessment and that of the reviewer should be independent. Summaries should be provided to the reviewee within a 1-month period. A single individual (Head of Unit, Center, or Department) should review all scientists under his/her aegis, to ensure that all assessments are equitable.

Recommendation 5-b

Performance goals and assessments should be written with the expectation that they will be included in PAEC reviews. Review procedures for all staff (*e.g.*, collections managers, and other categories of scientists and staff) should be established and/or clarified.

Recommendation 5-c

Evaluation criteria should be established by a science committee, with guidelines from the administration. Unit and Department Heads should participate in Office of Personnel Management (OPM) training.

Recommendation 5-d

Methods for PAEC review should be established by each SI Unit, with general 'consistency with flexibility' guidelines following the Smithsonian Directive 204, which includes recommendations that:

1. External scientists participate;
2. Review materials should include:
   - a current c.v. and bibliography;
   - recent annual performance evaluations;
   - a statement of achievements in research, teaching, outreach, exhibits, service to professional societies, etc., during the review period;
   - a statement of goals; and,
   - a list of four or more prospective external peer reviewers (the candidate should have input into the review process by identifying experts in his/her area(s) of research; the SI Unit should seek the assessments, but also those of additional peer reviewers for objectivity);
3. Clear criteria for review should be established and agreed-upon; these should include, but not be restricted to:

- research prominence and productivity;
- service to the Smithsonian Institution;
- curatorial activity;
- professional service;
- public speaking, outreach and educational activities; and,
- exhibit development.

Performance maintenance is insufficient for advancement. Leadership in the greater scientific community, especially for senior-level scientists, is expected. A metric system is not required; however, a clear and consistent set of criteria for evaluation must be articulated. The input of outside reviewers should be considered in context;

4. The Chair's or Director's review should be thoughtful, cogent, and analytical rather than subjective;
5. A report of the results of PAEC review should be promptly made to the candidate, the Unit and SI administration. It should specify recommendations for salary/grade increases or performance improvement. The administration's response to the review should be promptly transmitted to the SI Unit, the candidate, and the candidate's Chair; and,
6. Recommendations for increases or for improvement should be enacted promptly.

Recommendation 7-a

The Under Secretary for Science and the Director of the Office of Public Affairs (OPA) should review the Smithsonian Science and Research Communications Plan drafted in 2000, update it, and put it into action.

Recommendation 7-b

A SI-wide council of public affairs specialists and Unit Directors should convene to establish operational protocols to maximize communications about scientific research and practice. OPA will need the full support, cooperation and participation of the Museum and Research Directors and their public information managers and staffs.

Recommendation 7-c

The Smithsonian leadership should create opportunities – through workshops and/or training - for Smithsonian scientists and researchers to interface with the Office of Public Affairs.

Recommendation 7-d

The Office of Public Affairs should be charged with achieving the following:

- work with the Under Secretary for Science to make sure that s/he can play a strong symbolic role for science at the Smithsonian;
- establish and maintain regular channels of communication with Museum and Research Unit staff to identify story ideas and keep abreast of ongoing or future projects;
- meet regularly with the Directors and public relations managers of NZP, STRI, SERC, NMNH, SCMRE, NASM, and SAO, to review plans and identify projects of potential interest to the media. Develop separate, but coordinated, public relations plans for each Unit;

- write a statement describing the Smithsonian's re-invigoration of science, articulating the Institution's emphasis on scientific coordination, direction and clarity;
- develop ideas for news and feature stories about the science and research activities of the Smithsonian to disseminate to the media via advisories, releases, pitch letters and direct, personal contact. Seek opportunities to showcase interdisciplinary and inter-agency projects; and,
- promote coverage of Smithsonian science and research beyond the Beltway through a concerted effort aimed at media outlets around the country, as well as wire services (Associated Press, United Press International, Reuters, etc.), news services, newspaper chains (Scripps Howard, Knight Ridder, Hearst, etc.), and the Washington bureaus of metropolitan dailies. The subjects of these features will be derived from the behind-the-scenes aspects of the Institution that have broad, general interest, such as the stewardship and conservation of icons of American popular culture, the role of Smithsonian scientists in identifying and dating forensic evidence, and the quest for new discoveries about the universe.

Recommendation 7-e

Conduct behind-the-scenes media tours of the Smithsonian's conservation facilities, including the Museum Support Center, the Smithsonian Center for Materials Research and Education, the Cultural Resources Center, and the Paul E. Garber Preservation, Restoration, and Storage Facility. The May 1999 press preview of the Star-Spangled Banner Conservation laboratory is an excellent model for this type of media event.

Recommendation 7-f

Enlist the Secretary, Under Secretary for Science, museum Directors and other high-level Institution officials to conduct semiannual briefings for science reporters and staffers.

Recommendation 7-g

Continue to dedicate the entire spring issue of "Research Reports" to a single topic. "Research Reports" reaches some 80,000 people including such key audiences as Contributing Members, Members of Congress and journalists. The annual special editions should be promoted in advance to science writers and editors, through the OPA Newsdesk Web site, targeted press release distribution, and direct contact.

Recommendation 9-a1

The long-range planning process now underway at the CfA needs to be carried through, with an emphasis on the resources required to maintain current areas of expertise, and the impact of initiating new programs. In addition, SAO should address and implement, where possible, the recommendations in the 2001 Visiting Committee report. The Institution's Major Scientific Instrumentation and Research Equipment pools, upon which many of SAO's previous successes have been based, should be maintained as an open, competitive resource within the SI science enterprise.

Recommendation 9-a2

Harvard University and the Smithsonian should begin to plan for Irwin Shapiro's departure.

Recommendation 9-a3

SAO should pursue opportunities to present its achievements at the National Air and Space Museum and through SITES.

Recommendation 9-b1

STRI should continue as an autonomous research Unit reporting directly to the Under Secretary for Science. Its major scientific programs should remain intact.

Recommendation 9-b2

STRI should develop a comprehensive science plan within 1 year to address the current balance of all scientific activities, including attention to the decline in strength in marine ecology, the future of paleoecology, and policy and goals for biodiversity and conservation activities.

Recommendation 9-b3

STRI should review its ability to provide state-of-the-art scientific support to resident staff, including the extension of electronic communication to all of its widespread facilities, renewal of laboratory equipment, field support at all of its facilities, and the re-organization and role of the Office of the Assistant Director for Scientific Support Services.

Recommendation 9-c4

The leadership of SERC and the Undersecretary for Science should promote greater collaboration between Smithsonian marine science programs.

Recommendation 9-d4

The Museum should strengthen the connection of its science to exhibits. This will build greater public interest in, and awareness of, science and help build financial support of the Museum. Scientists must be directly involved in the design and implementation of exhibits, and programs should be integrated with Museum development efforts.

Recommendation 9-d8

The Under Secretaries for Science and American Museums and National Programs should work with the Directors and scientists in CEPS and Mineral Sciences to provide productive scientific oversight of their joint activities and coordinate their hiring and evaluations. The Commission sees no need for the physical integration of the two groups into a single location. The current configuration maximizes the presentation of science to the public.

Recommendation 9-e2

SCMRE should intensify its research on conservation and preservation of natural history collections and disseminate its results to the wider museum community.

Recommendation 9-e3

Education programs mandated by Congress should be continued as a secondary function of the SCMRE research mission. SCMRE's off-site and non-SI education commitment should be reduced to a more manageable size, allowing research staff to concentrate primarily on research and service functions. More efficient methods should be explored for delivery of educational programs through use of contractors and remote delivery systems using the Web and video

programming, funded, where possible, by user fees, grants, and collaboration with outside educational groups. Exhibitions should be done collaboratively with Mall museums and with SITES.

Recommendation 9-e4

SCMRE should re-focus its activities on the original CAL mission, providing research in support of Smithsonian collections and their long-term care and providing analytical data and information needed by the Units to understand and interpret the significance of Smithsonian collections. SCMRE should work closely with the Smithsonian Conservation Council and museum curatorial and conservation programs, as well as central administration, to help identify institutional needs and match SCMRE's capabilities with Smithsonian museums and collections. Because most of SCMRE's museum clients report to American Museums and National Programs rather than to Science, there needs to be close cooperation at the Under Secretary level to maximize benefits to all Smithsonian collections.

Recommendation 9-f1

The Science Gallery in Amazonia does an excellent job of bringing science into its exhibit and also does an impressive job of showcasing links to other SI science Units. This should be used as a model for future integrative exhibits at NZP.

Recommendation 9-f2

a. Consistent with recommendations below regarding the CRC-Front Royal facility, the scientific and professional staff, and associated support staff, should be combined into a single directorate encompassing conservation, research and training;
b. Support for this directorate would involve continuation of current federal support, but the Commission strongly supports the expansion of current efforts to attract external funding for research, education and training and other programs;
c. The Director of the NZP should form a task force to begin to plan both short-term and long-term strategies to unite the currently disparate staffs around a common vision, mission, goals and projects;
d. The Reproductive Biology groups (at both Front Royal and Rock Creek) should be developed as a unique national resource. Few, if any other zoos in the world, have the capability to study reproductive aspects of so many different species, yet detailed knowledge of such issues is critical to the success of species conservation plans. The joint reproductive biology group should be developed and showcased as a national conservation resource. Every effort should be made to generate political and financial support, both public and private; and,
e. Several programs at Front Royal and Rock Creek are currently engaged in science/policy interactions, and have expressed a desire to develop these interests further. The NZP senior staff will have to determine the extent to which these should be expanded, consistent with Unit goals and priorities. A working group should be established to develop a more effective policy. This group should involve experts from other government agencies involved in

resource economics or land use (*e.g.*, Department of Interior), as well as non-governmental organizations.

Recommendation 9-f3

As part of the review of the evaluation process discussed in Section 5, review performance evaluation standards to ensure that applied research, collaborative work and training are incorporated and appropriately weighted based on the particular position descriptions.

Recommendation 9-f4

A working group of development staff, scientists, and other staff under the direction of the NZP Director should craft a common vision and mission statement to articulate to donors and other external constituencies.

Recommendation 9-f6

NZP must evaluate its effectiveness in delivering its central message to the public. It must learn how to better influence public views. It must also learn from the leaders in its profession, both nationally and internationally.

Recommendation 9-g

a. Retain the physical location of CEPS within NASM;
b. Continue to improve CEPS-Department of Mineral Sciences communication in hiring, evaluation, and fund-raising; and,
c. As new planetary mission roles develop, support these initiatives through office space rental and improved financial management systems.

e. Recommendations WITH Substantial Financial Implications - Priority

Recommendation 3-f

The Institution needs to maintain its programs of Major Scientific Instrumentation and Research Equipment. It should develop a coordinated plan for the acquisition, maintenance, and use of large scientific instruments. Equipment purchased with Institutional funds should be available to all.

Recommendation 3-h

The publication of book-length monographs, particularly in the social sciences, is a part of the dissemination of the results of scholarly research. If the SI Press decides to limit or even eliminate its traditional program of publishing such monographs, effective alternatives must be identified and funded.

Recommendation 5-e

Both annual and PAEC reviews should reward excellent performance. Rewards in addition to salary must be established. These might include nomination for recognition by professional societies or by the SI (prizes, medals, lectureships, etc.)

Recommendation 6-d

An SI-wide Web index and guide could facilitate use of the SI Internet and to help plan its further development. Thematic road-maps would better assist students and teachers in identifying educational pathways. Smithsonian collections and exhibitions could become focal points of curricula and Web site development, which could transform Smithsonian science outreach in the coming years.

Recommendation 6-e

Develop nationally competitive teacher training opportunities in science, following SAO and NSRC models. (Once again, a closer tie to NSRC would improve training opportunities.) Consider implementing a grass-roots national, Internet-based program in natural history field studies, in concert with the GLOBE Project or similar programs.

Recommendation 6-f

Scientists must be included in the development of all science education programs and should receive appropriate credit in their professional evaluations.

Recommendation 7-h

Offer media training seminars for key SI scientists, researchers and administrators.

Recommendation 7-i

The Office of Government Relations should be more proactive in advancing Smithsonian Science to Congress. It should:

- host a reception at the SI or on the Hill to celebrate science;
- develop an exhibit or display on the Hill in the Cannon or Russell Rotunda. Plan a briefing along with it. Invite a Member to sponsor it;
- volunteer to have Smithsonian scientists assist key committees and Members on important national scientific issues;
- keep track of AAAS Congressional Scholars, Knauss Grant Fellows, and Congressional Grant Fellows and recruit them to spend time at the Smithsonian. Hold Smithsonian events and involve them;
- invite Congressional Members and staffers to attend decision-makers' field courses (STRI or SERC could do this). SI would have to raise money for scholarships for some of them to attend;
- organize fieldtrips to SAO, STRI, and SERC. Plan such trips during House and Senate recess;
- help Members to follow science issues to stay in tune with their constituencies (environment, conservation, bio-terrorism, etc.);
- bring Members and staffers from the Hill to SI to talk with scientists about issues of importance to both groups. Build Members and staffers into SI programs;
- bring relevance and a "just-in-time" context to the people in Congress. Encourage them to think of the Smithsonian as a resource place - the "go-to" place for scientific inquiry and research within Smithsonian expertise;
- develop a briefing book on Smithsonian science for Members on Capitol Hill; and,
- create brochures to explain science projects to non-scientists. Provide updates on issues. Regularly circulate brochures and inserts on the Hill.

Recommendation 9-b4

STRI should strengthen its communications and outreach efforts, and increase its presence in the central administration and on the Mall, perhaps including rotating residence of appropriate staff scientists in Washington on a 1-year cycle and collaborating with NMNH, NZP and NMAH on exhibits and public outreach.

Recommendation 9-d9

The NMNH Director should make funding for the centralization at NMNH of the Laboratory for Analytical Biology, including molecular laboratories and core facilities (SEM, DNA sequencing, and isotope analysis) a high priority. All molecular lab staff from NZP and MSC should be relocated to NMNH. The Commission endorses the Museum's plan to provide general access to modular laboratory space, facilities, baseline funds, and human resources for major projects that use molecular methods, on the basis of need, current funding and merit. Similarly, consideration should be given to providing limited funds to facilitate collaborative and pilot ventures on the part of traditional NMNH scientists who want to apply molecular tools to their research.

Recommendation 9-e5

Management of archaeometry programs should be transferred to the National Museum of Natural History, where archaeological research is a major activity of the Department of Anthropology.

Recommendation 9-e7

SCMRE needs regular reviews by a Visiting Committee of prominent leaders in the fields of museum conservation, preservation, and materials research, charged with reviewing scientific output, response to Smithsonian needs, and relations with the broader professional community. Committee membership should be largely external but should include representatives from Smithsonian museums.

11. MONITORING IMPLEMENTATION

The Science Commission strongly urges dynamic and prompt implementation of the recommendations contained in this report. Several previous reports regarding science at the Smithsonian, when making similar arguments for change, have been of little lasting effect due to a lack of assessment mechanisms and criteria for success. To provide a strong basis for evaluation, the Commission recommends the following structure:

Recommendation 11

The Board of Regents should establish a 3-year benchmark period for this report. By July 2003, the Under Secretary for Science should create a plan for carrying out the Commission's recommendations, including explicit metrics for success and a timetable for completion. This plan will be implemented through the Scientific Directors Council, comprised of the heads of each major science Unit. The Under Secretary will also assemble a distinguished Visiting Committee to review the Institution's progress, on a yearly basis, in a brief report to the Smithsonian Regents (in December 2003, 2004, and 2005).

At the end of the 3-year period (December 2005), the Science Commission membership and the Visiting Committee should convene in a joint meeting to prepare a summary of Smithsonian successes and failures in implementation, and submit this report to the Board of Regents.