

**APPROVED MINUTES<sup>1</sup>  
OPEN SESSION  
358<sup>th</sup> MEETING  
NATIONAL SCIENCE BOARD**

The National Science Foundation  
Arlington, Virginia  
May 4, 2000

Members Present:

Eamon M. Kelly, Chairman  
Diana S. Natalicio, Vice Chair  
John A. Armstrong  
Pamela A. Ferguson  
Mary K. Gaillard  
Sanford D. Greenberg  
M.R.C. Greenwood  
Stanley V. Jaskolski  
Anita K. Jones  
George M. Langford  
Jane Lubchenco  
Eve L. Menger  
Joseph A. Miller, Jr.  
Claudia T. Mitchell-Kernan  
Robert C. Richardson  
Vera Rubin  
Maxine Savitz  
Luis Sequeira  
Bob H. Suzuki  
Richard Tapia  
Chang-Lin Tien  
Warren M. Washington

Rita R. Colwell, NSF Director

Members Absent:

Robert M. Solow  
John A. White, Jr.

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<sup>1</sup> The minutes of the Open Session of the 358<sup>th</sup> meeting were approved at the 359<sup>th</sup> meeting, August 3, 2000

The National Science Board (Board) convened in Open Session at 11:35 a.m. on Thursday, May 4, 2000, with Dr. Kelly, Chairman of the Board, presiding (Agenda NSB-00-67). In accordance with the Government in the Sunshine Act, this portion of the meeting was open to the public.

AGENDA ITEM 3: Presentation by Dr. Michael Turner

**a. Presentation**

Dr. Kelly called on Dr. Richardson to introduce the guest speaker. In introducing Dr. Michael Turner, Chairman of the Department of Astronomy and Astrophysics and the Bruce V. and Diana M. Rauner Distinguished Service Professor at the University of Chicago, Dr. Richardson commented that recent discoveries in astronomy and astrophysics supported by the National Science Foundation contradict arguments in a currently popular book that the best and most exciting scientific discoveries are past. He pointed to reports in the *New York Times* and *Washington Post* the previous week on recently obtained detailed images of the universe as it existed nearly 15 billion years ago. He stated that Dr. Turner would speak on the topic of new developments in astrophysics.

Dr. Turner began his presentation by stating that the most exciting science is being done at the boundaries of disciplines and is fundamentally interdisciplinary. Dr. Turner discussed five recent discoveries and how these discoveries link to an understanding of the origin and evolution of the universe, the unification of the forces and particles, and how objects in the universe work. He noted the following important discoveries: (1) A recent experiment revealed that some neutrinos have mass and that they contribute as much to the total mass of the universe as do stars. (2) Data from telescopic observations indicate that the expansion of the universe is accelerating despite the effects of gravity, indicating the existence of dark energy, which has repulsive gravity. (3) Recent analyses reveal that the mass and gravity of known matter in the universe are insufficient to hold galaxies together. Most of the mass in the universe is dark matter. (4) Observations using a National Aeronautics and Space Administration (NASA) satellite detected a cosmic microwave background, the echo of the Big Bang, from the universe at 500,000 years of age. The intensity of the microwave background was remarkably the same in all directions, but slight variations indicated areas with more or less matter. (5) An experiment at the South Pole looked at the structure of the microwave background from above the atmosphere and determined that the curvature of the universe is basically flat, like a piece of paper.

Dr. Turner summarized the impact that these and other discoveries will have on research in astrophysics. The universe is approximately one-third matter and two-thirds dark energy in a form that has not yet been identified. In the next ten to twenty years, researchers will attempt to determine what constitutes dark matter, how dark matter is linked to the unifying forces and particles, where the lumpiness that seeded the structure of the universe came from, and whether there are unseen spatial and temporal dimensions.

## **b. Comments by Dr. Eileen Friel**

Dr. Richardson asked Dr. Eileen Friel, Executive Officer of the Division of Astronomical Sciences, to comment on some of the NSF projects designed to study the areas discussed by Dr. Turner. Dr. Friel discussed the role played by many NSF programs and facilities, including several divisions in the Directorate for Mathematical and Physical Sciences, as well as the Office of Polar Programs and the Directorate for Geosciences. In addition, the Major Research Equipment (MRE) projects and the large facilities like Gemini, Laser Interferometer Gravitational-Wave Observatory (LIGO), and Alma support this kind of research. NSF activities use such facilities as the very large array, optical infrared telescopes, Gemini, national observatories, satellites supported by NASA, and gamma ray and cosmic ray detectors. The NSF supports neutrino experiments at the South Pole and gravity experiments like LIGO and has partnerships with the Department of Energy, NASA, private organizations and industry, and international collaborators.

After discussion, Dr. Kelly thanked Dr. Turner for his enlightening presentation and recessed the Open Session.

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At 2:21 p.m. Dr. Kelly welcomed NSF staff and guests to the Open Session. He noted the recognition of recipients of the Alan T. Waterman Prize, the Board's Public Service Award, and the 2000 Vannevar Bush Award at the Annual Awards dinner of the previous evening. He thanked Mrs. Susan Fannoney and other Board staff for their fine job in organizing the event. In addition, Dr. Kelly acknowledged that this was the final Board meeting for Drs. Greenberg, Mitchell-Kernan, Menger, and Solow. He then reconvened the Open Session.

### AGENDA ITEM 5: March 2000 Open Session Minutes

The Board APPROVED the Open Session minutes of the March 2000 meeting, as amended (NSB-00-69, Board Book Tab B).

### AGENDA ITEM 7: Closed Session Items for August Meeting

The Board APPROVED the Closed Session items for the August 2000 Board Meeting (NSB-00-68, Board Book Tab C).

### AGENDA ITEM 8: Chair's Report

#### **a. Announcement of Honors**

Dr. Kelly congratulated NSF Director Colwell on her election to the National Academy of Sciences. He announced that Dr. Tapia received a unique honor from Cornell University, which established the David Blackwell and Richard Tapia Distinguished Lecturer Series in the Mathematical and Statistical Sciences to highlight the contributions

of African American, Latino, and Native American scientists working in the mathematical and statistical sciences.

#### **b. Status of Board Nominations**

Dr. Kelly reported that on May 1 the White House announced its intent to nominate Dr. Mark Wrighton, Chancellor and Professor of Chemistry at Washington University, St. Louis, Missouri, as the final member of the class of 2006. Three additional current Board members have been renominated to the class of 2006: Drs. Lubchenco, Washington, and White. Drs. Michael G. Rossman and Daniel Simberloff, nominated earlier, still await Senate confirmation. Each nominee will be appointed to serve as a Board consultant after May 10, until confirmation. Dr. Kelly congratulated each nominee for the class of 2006. [See NSB-00-69, page 2, for other nominees for the class of 2006.]

#### **c. 50<sup>th</sup> Anniversary Event**

Dr. Kelly reported that he, Dr. Colwell, and Dr. Langford participated in an event on April 27 celebrating the 50<sup>th</sup> anniversary of the NSF, which received media attention. Dr. Colwell added her commendation to the committee and the Office of Legislative and Public Affairs for an inspirational morning with school children from Washington, DC.

#### **d. Cosmology Prize**

Dr. Kelly congratulated Dr. Rubin for her participation in the Advisory Board of the Peter Gruber Foundation's new Cosmology Prize to be given to an outstanding astronomer, cosmologist, physicist, or mathematician in recognition of fundamental scientific advances that shape the way we see and comprehend our universe. The first annual \$150,000 award will be announced in August and presented in November at the Pontifical Academy of Sciences at the Vatican.

#### **e. Discharge of Committee**

Dr. Kelly discharged the Ad Hoc Committee on the 2000 Vannevar Bush Award, with thanks to the chair, Dr. Menger, other members Drs. Jones, Langford, Richardson, and Tien, and executive secretary Mrs. Susan Fannoney of the Board staff.

#### **f. Board Elections**

Dr. Kelly reported his reelection as Chair for an additional two years and the election of Dr. Jones as Vice Chair. Dr. Kelly thanked Dr. Natalicio on behalf of the Board and personally for her service and contributions as Vice Chair during the past two years. He announced that two new members of the Executive Committee would be elected at the August meeting.

## AGENDA ITEM 8: Director's Report

### **a. Staff Introductions**

Dr. Colwell introduced several recently appointed NSF staff members: Dr. Costello Brown, interim Division Director for Educational System Reform; Dr. Aubrey Bush, Division Director for Advanced Networking Infrastructure and Research; Mr. Donald G. McCrory, Deputy Chief Financial Officer and Director, Division of Financial Management; and Mr. Eric Hamilton, interim Division Director for Research, Evaluation and Communication in the Education and Human Resources (EHR) Directorate.

### **b. Congressional Update**

Dr. Colwell provided an update on Congressional actions. On March 30, Dr. Margaret Leinen, Assistant Director of the Directorate for Geosciences, testified before the Senate Energy Committee on NSF's role in climate change research and how the research activities of various federal agencies are coordinated through the National Science and Technology Council.

On April 4, Drs. Colwell and Kelly testified on NSF's fiscal year 2001 budget request before the House Veterans Affairs, Housing and Urban Development, and Independent Agencies Appropriation Subcommittee and on May 4 before the Senate Appropriations Subcommittee. Dr. Colwell reported that early indications suggest the budget allocation will be less, perhaps substantially less, than the Administration's request. First mark-ups of the bills are expected in late May, and full committee mark-ups in early or mid June.

Dr. Colwell reported on three bills affecting NSF. House Science Committee Chairman Sensenbrenner introduced H.R. 3904 to prevent the elimination of *Science and Engineering Indicators* and six other NSF publications, which was passed by the House on April 4 and referred to the Senate Committee on Government Affairs. No Senate hearings have been scheduled. Representative Ehlers introduced H.R. 4271, the National Science Education Act, on April 13, which would amend NSF's organic act to authorize a number of activities, including a master teacher program, educational software development, and professional development in educational technology. The bill has been referred to both the Science Committee and the Education and the Workforce Committee. No hearings have been scheduled. Senators Frist and Rockefeller introduced S.B. 2046, the Next Generation Internet Act, on April 13. This bill would authorize NSF to spend \$352 million over the next three years and would require that 10 percent of appropriated amounts be spent on research to make high-speed networks available in rural areas.

## AGENDA ITEM 9: Executive Committee Annual Report

Dr. Kelly called on Dr. Colwell to present the Annual Report of the Executive Committee, summarizing activities for the preceding year. The Board received the report as distributed (NSB/EC-00-09, Board Notebook Tab D).

## AGENDA ITEM 10: NSB 2001 Meeting Calendar

Dr. Kelly reminded the Board of previous discussions concerning the location and timing of the annual off-site policy meeting and retreat. Although the 2001 retreat will be held in February, in future years the Board may wish to consider a different month to expand the range of locations where weather would not be a factor in travel considerations. Suggested locations for the 2001 meeting include Tucson, in conjunction with a visit to the National Optical Astronomy Observatories; Florida State University, in conjunction with a visit to the National High Magnetic Laboratory; the University of Virginia and Virginia Tech, in conjunction with a visit to the Greenbank Observatory; and the Scripps Institute of Oceanography in La Jolla.

During discussion, several Board members supported the idea of considering the District of Columbia area as a retreat location because it would increase access to speakers involved in the transition to a new Administration. It was noted that coherence between the site selected and the theme of the retreat is a consideration.

The Board unanimously APPROVED the meeting calendar for 2001 (NSB-00-97, Board Book Tab E).

## ADENDA ITEM 11: Committee Reports

### **a. Audit and Oversight Committee (A&O)**

Committee chair Dr. Jaskolski reported that the committee reviewed the fiscal year 1999 report on the Merit Review System as presented by Dr. Nathaniel G. Pitts, Director of the Office of Integrative Activities, and discussed how goals were addressed with respect to the Government Performance and Results Act (GPRA). During discussion, it was noted that the diversity in approaches used by NSF programs is consistent with the Board's recommendations in its March 1997 report on merit review. There was considerable interest in the predictive effects on scientific outcomes of the various approaches to merit review.

Mr. McCrory and Ms. Jannifer C. L. Jenkins, liaison to the Office of Budget, Finance and Award Management in the Office of the Inspector General, reported that the Congressional House Government Reform Committee on Government Management, Information and Technology gave NSF for the second year a grade of A for high-quality federal financial management. Only 2 of 24 organizations received an A.

Audit plans are in place for fiscal year 2000. The current audit contract expires this year, and preparations are being made for a new contract.

The committee discussed the change in review criteria for major awards, namely, that review will be based on a percent threshold system rather than on absolute amounts. The committee discussed and accepted the Inspector General's Semiannual Report to the Congress for the period ending March 31, 2000. A spokesperson for the Office of the

Inspector General provided information on internal and external outreach efforts and several active investigation and audit projects. In addition, the committee approved its revised charge for consideration by the Board.

**b. Committee on Programs and Plans (CPP)**

Committee chair Dr. Armstrong asked Dr. Lubchenco, chair of the Task Force on the Environment, to announce the just-released study *Environmental Science and Engineering for the 21<sup>st</sup> Century*. Dr. Lubchenco presented copies to the Board and thanked Board members and NSF staff who contributed to the report. She noted that the report has been posted on NSF's website. Dr. Armstrong reported that the committee has asked for an update at every other meeting on this important initiative.

Dr. Armstrong reported that the committee also discussed the draft interim guidelines that NSF will use in managing the MRE account. The need for guidelines for MRE is driven by the evolution of infrastructure, especially information technology, and the need to insure that the MRE account is used for substantial steps forward. Dr. Bordogna led a discussion of items that might appear on the MRE list in the future. Committee discussion of the Director's report on the Merit Review system for FY 1999 focused on how to make sure that the NSF sponsors the best set of projects and takes the right level of risk. In addition, the committee approved its draft charge for consideration by the Board.

**c. Committee on Education and Human Resources (EHR)**

Committee chair Dr. Suzuki began his report with budget issues. He stated that Dr. Judith Sunley, Interim Assistant Director of the EHR Directorate, reviewed the directorate's fiscal year 2001 budget, explaining some of the major program expansions, including the 21<sup>st</sup> Workforce Initiative. The EHR Directorate education activities are complemented by initiatives in other directorates that also include education and human resource aspects. In discussions with Dr. Sunley, the committee defined priority areas as (1) preparing the instructional workforce, (2) attacking minority achievement gaps, (3) instructional technology as a driver for change, (4) scientific, mathematical, engineering, and technological education, (5) research on education, and (6) bridging the gap between teacher education and the disciplines. Dr. Sunley will continue to develop the framework and relate that framework to priorities and budget allocations.

The committee heard a report from Dr. Norman Fortenberry, Acting Division Director for Human Resource Development in the EHR Directorate, on the NSF programs that have been developed to promote diversity; the report will be continued at the August meeting. Dr. Toni Clewell, the Executive Director of the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development, reported to the committee on the work of the commission. The committee revised a draft statement on openness of science and engineering communication for presentation to the Board (Agenda Item 11, Continued, below). In addition, the committee discussed a plan for exploring NSF's future role in K-16 education by convening an expert panel to review

NSF programs and materials related to K-16 education and meet with the EHR Directorate to suggest future directions for NSF. The committee also approved its draft charter for recommendation to the Board.

Dr. Suzuki thanked Dr. Mitchell-Kernan, chair of the Subcommittee on Science and Engineering Indicators, for her contributions to *Science and Engineering Indicators* 3/4 2000. He announced the appointment of Dr. Tapia as the new chair of the Subcommittee.

#### *Subcommittee on Science and Engineering Indicators (S&EI)*

Subcommittee chair, Dr. Mitchell-Kernan, reported that the two-volume *Science and Engineering Indicators* 3/4 2000, a “companion piece,” and a compact disk await clearance by the White House for release, a process that takes approximately one month. Dr. Mitchell-Kernan thanked the Science Resources Studies (SRS) Division; Ms. Jennifer Bond, Director of the Indicators Unit; Dr. Daryl Chubin, Senior Policy Officer in the Board Office; Ms. Mary Poats, Executive Secretary; and subcommittee members for their excellent work. She noted that, while Ms. Bond is on detail as a legislative fellow, Mr. Rolf Lehming will serve as Acting Program Director for the S&EI Program.

Dr. Mitchell-Kernan reported that Dr. Lynda Carlson, SRS Division Director, presented five draft data cards that highlight specific S&EI data, and the subcommittee recommended that the cards be printed and distributed as a set. Dr. Carlson also discussed three reports from different stakeholder groups on science and engineering indicators.

Dr. Mitchell-Kernan reflected on recent experience and offered recommendations on future assessment of the S&EI. She further noted that legislation to eliminate the sunset provision for *Science and Engineering Indicators* has been introduced in the House, and reported that Mr. William Noxon, Acting Section Head of the Media and Public Information Section in the Office of Legislative and Public Affairs, provided information on the rollout process and plans to publicize the report.

#### **d. Task Force on the NSF’s 50<sup>th</sup> Anniversary**

Task force chair Dr. Rubin reported that the 50<sup>th</sup> anniversary commemorative booklet should be ready for external review on May 26. Reviewers being considered include historians, long-time employees, and former Chairs of the NSB. The task force discussed the celebratory event to be held on December 12 at the headquarters of the Carnegie Institution of Washington. Dr. Rubin reported that the 24 winners of the Jumpstart competition have been notified and will be announced in the May 14 *Parade Magazine*. Winners will come to Washington on May 17 for scheduled activities.



#### **e. Task Force on International Issues in Science and Engineering**

Task force chair Dr. Natalicio announced that Drs. Armstrong and Lubchenco have joined the task force. Based on the Board's recommendation at the last meeting, the task force has accepted the challenge to prepare an interim report for Board approval at the October meeting. The goal is to have a report ready for dissemination during the transition to a new Administration. The interim report will focus on specific areas of current policy interest. The task force intends to identify key issues, present the role of science in addressing those issues, and make specific recommendations. If possible, the task force will have a draft report available for discussion at the Board's August meeting.

#### **f. Committee on Science and Engineering Policy Issues**

Committee chair Dr. Kelly stated that Dr. Maxine Singer, chair of the National Academies' Committee on Science, Engineering and Public Policy (COSEPUP), reported on the benchmarking experiments that the committee had recently completed; the findings were published as *Experiments in International Benchmarking of U.S. Research Fields*. Former Board Vice Chair, Dr. Marye Anne Fox, also with COSEPUP, joined the committee discussion by telephone. The discussion focused on the utility of this methodology for priority setting across fields of scientific research. The executive secretary of the committee, Ms. Jean Pomeroy of the Board staff, reviewed the status of current activities and questions remaining to be addressed. Dr. Donna Fossum, manager of the RaDiUS project at RAND's Science and Technology Policy Institute, presented information on the ambiguities in definitions and data measuring federally funded research and development. The committee agreed to continue discussions by telephone conference, with the goal of having a report ready in December for the transition to a new Administration.

#### **g. Committee on NSB Nominees**

Committee chair Dr. Jones reported that the committee held its first meeting on May 3 and reviewed the time-line for developing nominations and the selection process. The intent is to provide a list of nominations to the White House in January for consideration for the next appointment cycle. Dr. Jones encouraged Board members and others to submit nominations through the Board Office. Dr. Jones noted that the current number of candidates is relatively small and there may be a shortage of candidates in some diversity areas and disciplines.

#### **h. Standing Committee Charges**

Dr. Kelly noted that the process of reviewing committee charges was complete. He accepted the charges as recommended by the committees.

## AGENDA ITEM 12: Director's Merit Review Report

Dr. Kelly referred Board members to the NSF Director's FY 1999 Report on the NSF Merit Review System (NSB-00-84, Board Book Tab F) and stated that the Board had officially received the report. At Dr. Colwell's request, Dr. Pitts highlighted for the Board the merit review process in the context of GPRA. The NSF is developing systems, setting uniform guidelines, and changing committee structure in order to increase accountability for its actions. A critical element in agency success is a credible, efficient merit review system. Two GPRA goals specifically focus on the merit review system: expending at least 90 percent of funds using a credible merit review system (95 percent of NSF funds are expended in this fashion), and implementing the two merit review criteria (What is the intellectual merit of the proposed activity? What are the broader impacts of the proposed activity?). The NSF is trying to improve in the second area by highlighting the criteria in solicitations, presentations, and communications with college and university presidents.

During the past 15 years, the total number of proposals submitted has remained fairly constant, varying from 28,000 to 31,000 proposals per year. The success rate has varied from 30 to 33 percent per year, with slight variations among programs. Success rate profiles by demographic characteristics reveal that the most significant difference occurs between prior principal investigators (39 percent success rate) and new investigators (23 percent success rate). Figures for minority and female principal investigators are close to the average. The average award is \$93,000; the median is \$73,000. An NSF goal is to increase the average award to \$108,000.

Dr. Pitts explained that NSF uses three types of review—mail review, panel review, and a combination of mail and panel review—and that reviewers are all volunteers, regardless of the process used. Although panels are more time consuming for the reviewers than mail reviews, panels have a better completion rate than mail reviews. On the other hand, mail reviews have the advantage of enabling broader input. The trend during the past 10 years has been to move toward panel review. If the trend continues at the current rate, in approximately five years there will be no more mail review. Dr. Pitts suggested that the Board may want to consider the implications of this trend. The goal is to complete reviews within six months. Data show that 65 percent of proposals reviewed by panel only and 50 percent of proposals reviewed by mail only meet the goal. Last year there were 246,000 reviews, ranging from excellent to poor. The relative number of declinations of excellent proposals has remained sizable during the past several years.

### *Board Discussion*

Board discussion following the presentation focused on modes of review and highlighted that the most important concern is the quality of the decisions under any method used. Members suggested the possibility of a combined virtual panel review by teleconferencing and a mail review process, and also suggested that FastLane might be used to support electronic proposal reviews. It was noted, however, that many users complain about the FastLane proposal submission system and that NSF is working to

develop a better system by the end of the calendar year. Members also observed that, considering the small size and short duration of many grants, the process is inefficient: too much time is spent writing and reviewing proposals for the money involved.

Final discussion focused on the second merit review criterion, especially the integration of research and education, the integration of diversity into programs, and ways to measure progress in these areas. Dr. Suzuki noted that the primary reason for integrating research and education and diversity is to enhance the quality of education. He observed that the way integration aspects of proposals are measured does not appear to enhance the quality of education, and he expressed concern that integration aspects are evaluated in a superficial manner. Dr. Tapia added that the criterion is problematic because it is basically a guideline that is difficult to enforce and does not motivate change. He requested that minority data be disaggregated by gender, ethnicity, and other measures of diversity, not just in merit reviews but also in any analysis NSF undertakes. Dr. Suzuki asked for data comparing performance by institutional category, such as research institutions, liberal arts colleges, and comprehensive universities. Dr. Kelly stated that merit review issues would be discussed again in August.

#### AGENDA ITEM 13: NSB Report on Communication and Outreach (NSB-00-99, draft)

Committee chair Dr. Greenwood recalled that the committee was established a year ago to provide guidance on the role that the Board and the NSF should play in expanding public awareness of science and engineering as part of the NSF mission. After reviewing a variety of communication and outreach issues, the committee offered findings and recommendations in three areas: (1) need for increased advocacy for science and engineering to increase the American public's appreciation for science, engineering, and fundamental research, (2) need for increased collaboration among NSF communication efforts, especially the efforts of the Directorate for Social, Behavioral and Economic Sciences, the Directorate for EHR, and the Office of Legislative and Public Affairs, and (3) need for an expanded role of Board members in communicating science and engineering to the public. Dr. Greenwood noted that the status, knowledge, and visibility of the board put it in a unique position to promote the understanding and appreciation of science and engineering.

Dr. Greenwood stated that the committee will post the report on the Board's website for comment. She asked for Board comments by early July. Any suggested changes will be discussed during a teleconference before the August meeting. The committee will present its final report for approval at the August meeting. Dr. Greenwood requested that in the same time frame the NSF indicate who will be its contact with the Board for providing members with speaking materials. She thanked committee members Drs. Suzuki, Tien, Menger, Savitz, and Langford and committee staff, Executive Secretary Mary Lou Higgs and Dr. Robert Webber, for their diligent and excellent work.

Dr. Kelly commented that this report covered a most important issue and urged Board members to submit their comments by July 1. The report will be formally considered for approval at the August meeting.

## AGENDA ITEM 11, CONTINUED: Statement on Openness in Science

On behalf of the EHR Committee, Dr. Suzuki distributed the statement on openness in science. After a brief discussion, the Board APPROVED the Statement on Open Communication and Access in Science and Engineering (NSB 00-106) as distributed, leaving final editorial authority to the chairman of the EHR Committee.

## AGENDA ITEM 14: NSF Budget and Planning

Dr. Colwell reminded Board members that they had requested more discussion on several budget topics and noted that two—national science and engineering infrastructure, and analysis of NSF award size and duration goals in relation to diversity activities—would be discussed at the August meeting.

### *NSF Implementation of Recommendations from the Board's Environment Report*

Dr. Colwell provided an update on actions taken to implement the recommendations of *Environmental Science and Engineering for the 21<sup>st</sup> Century* in three categories: (1) organization of NSF staff to carry out a program of research, education, and knowledge assessment, (2) resources and funding to support an expanded program of environmental activities, and (3) the current priority areas and a means of establishing future priority areas. With respect to organization, she reported that Dr. Leinen coordinates the environmental portfolio across the NSF and chairs an internal advisory group. She is assisted by Dr. Margaret Cavanaugh, Staff Associate in the Director's Office. The NSF is in the process of establishing a new advisory committee on environmental research and education, expected to begin work in the fall. With regard to the second category, resources and funding, an internal process has been initiated to help identify interdisciplinary opportunities in environmental areas and to shape long-term priorities. In the next few years it will be necessary to increase the priority given to strategic enabling technologies for the incorporation of human and societal factors in the development of infrastructure for environmental activities. With respect to current priorities, the NSF had strong response to its Biocomplexity in the Environment competition this year.

### *The NSF Budget*

**21<sup>st</sup> Century Workforce Initiative:** Dr. Colwell explained that the NSF has framed the initiative around three key areas in which it has special interest, capability, and responsibility: (1) the instructional workforce for science, math, and engineering technology, (2) the science and engineering workforce, and (3) the technological workforce. Rather than focusing on programs at this point, the NSF is delineating the strategic directions from which the programs will be developed. These directions include (1) the science of learning, (2) activities that link research and education from high school through graduate studies, (3) insuring diversity through access mechanisms and building linkages between minority and majority serving institutions, (4) information

technology, and (5) NSF partnerships with other agencies and sectors. She noted that NSF's most important product is people and that the agency touches 200,000 lives every year, including 80,000 teachers and 35,000 students. The NSF provides the scientists and engineers employed in industry, academia, and government.

**Mathematics Initiative:** Dr. Colwell noted that NSF intends to pursue an aggressive agenda in mathematics, pure mathematics, applied mathematics, and statistics, and cited a recent report by COSEPUP that showed the Nation faces a dangerous situation in mathematics.

**Social, Behavioral, and Economic Sciences:** NSF intends to expand its budget in this area during the next several years so that by 2003 it will have a major interdisciplinary initiative. Dr. Colwell argued that every NSF initiative must incorporate investments in understanding the impact of human behavior on the natural world and vice versa. Dr. Norman Bradburn, Assistant Director of the Directorate for Social, Behavioral and Economic Sciences, is heading the conceptual development for this effort and will present a timetable for this initiative at the next Board meeting.

**Grant size and duration:** The agency requires an increase of \$4 billion to bring the average grant size and duration up to the level targeted in the NSF strategic plan. The fiscal year 2002 goals are for grants of \$120,000 and 3.3 years duration. The major reason for the need to increase grant size is that the nature of research has changed and has become progressively more expensive, at the same time that the value of research results has grown even faster than costs. Dr. Colwell also noted that when grant amounts are adjusted for inflation, the grants given today are smaller than the ones awarded in 1963. The NSF will make these points to the Office of Management and Budget, using case studies, facts, and figures.

**Administration and Management (A&M) Support:** For fiscal year 2001, NSF requests an increase for A&M of almost 14 percent, or \$215 million, over the amount for fiscal year 2000. A similar increase will be needed for several years if the NSF is to manage significant increases in program funding and the corresponding increases in complexity and quantity of the workload. Three long-term objectives are guiding NSF's development of the fiscal year 2002 A&M budget request: (1) make the NSF totally electronic in its business operations; (2) align the size, composition, and skill base of our workforce to future needs; and (3) increase diversity within our workforce. Although the NSF must continue its investments in technological infrastructure, it is also critical that the NSF focus on workforce needs for the 21<sup>st</sup> century.

**Tools:** The NSF will spend about \$1.24 billion on tools in fiscal year 2001, about a quarter of the budget. The increase proposed for tools is approximately 13 percent. New developments in nanotechnology, information technology, and biotechnology have changed profoundly the capabilities and even the basic concept of tools. For example, the ability to network facilities, research platforms, high-performance computers, and vast databases together has created both new frontiers of investigation and an unparalleled opportunity to integrate research and education at every level. Dr. Colwell

reminded the Board that it has received draft interim guidelines for planning and managing the MRE account. These draft guidelines will be discussed at the August meeting. Major topics for discussion include the definition of MRE, the kinds of projects that should be eligible for funding, balance and priorities within and across disciplines and directorates, and readiness of projects to be included in the fiscal year 2002 budget request.

In summary, Dr. Colwell noted that a quarter of the NSF budget is people, a quarter is tools, and half is ideas.

### *Board Discussion*

In response to questions, Dr. Colwell made the following points. Each year the NSF gets 30,000 proposals, enlists 50,000 people to review them, and completes 250,000 reviews. Approximately 9,000 proposals are funded. The average grant size is less than it was 40 years ago and the duration is only 2.8 years. The average grant is neither enough money nor long enough to get a Ph.D. student through the Ph.D. program. Dr. Colwell argued that this situation is wasteful of time, a fraudulent way to do science, and abusive of the Nation's young people. She noted that NSF has enlisted the support of 47 captains of industry who have signed a letter to Congress in support of increased funding for NSF.

Dr. Colwell agreed with the desirability of NSF hosting workshops to look at best practices as a way to help institutions incorporate technologies into the classroom and laboratory. She responded to several comments on the rising costs of overhead, noting that these costs are real, driven in part by the need for compliance with growing regulatory requirements.

### AGENDA ITEM 15: National Science and Engineering Infrastructure

Dr. Kelly noted that discussion of this topic has been postponed until the August meeting.

### AGENDA ITEM 16: Other Business

Dr. Kelly concluded the meeting by thanking and saying farewell to Drs. Greenberg, Menger, Mitchell-Kernan, and Solow. Dr. Kelly noted that their contributions are evident in all the Board's recent products, and that their wisdom and creativity will be missed.

Following a standing ovation for departing members, Dr. Kelly adjourned the Open Session at 5:07 p.m.

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Janice E. Baker  
Policy Writer/Editor

Attachments: NSB-00-97  
NSB-00-106