

**APPROVED MINUTES  
PLENARY OPEN SESSION  
461<sup>ST</sup> MEETING  
NATIONAL SCIENCE BOARD**

National Science Foundation (NSF)  
Alexandria, Virginia  
February 12, 2019

**Members Present:**

Diane L. Souvaine, *NSB Chair*  
Ellen Ochoa, *NSB Vice Chair*  
John Anderson  
Roger N. Beachy  
Arthur Bienenstock  
Vicki L. Chandler  
Maureen Condic  
W. Kent Fuchs  
Suresh Garimella  
Robert M. Groves  
James Jackson\*\*  
Steven Leath  
W. Carl Lineberger  
Victor R. McCrary  
Emilio F. Moran  
Sethuraman Panchanathan  
G.P. Bud Peterson  
Julia M. Phillips  
Geraldine L. Richmond  
Anneila Sargent  
Alan Stern  
Stephen Willard\*\*

France A. Córdova, *ex officio*

\*\* Participated via telephone

**Members Absent:**

Maria Zuber

There being a quorum, the National Science -Board (NSB, Board) convened in Open Plenary Session at 8:00 a.m. on Tuesday, February 12, 2019, with NSB Chair Dr. Souvaine presiding.

## NSB Chair's Opening Remarks

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Dr. Souvaine welcomed everyone to the NSB's 461<sup>st</sup> meeting.

Dr. Souvaine began the meeting by expressing the Board's gratitude to Director Córdova and the entire NSF staff for their tremendous work before, during, and after the extended lapse in government appropriations from December 21, 2018 to January 25, 2019. She also thanked the Board Office staff for their efforts in organizing this February Board meeting on a dramatically condensed schedule.

In a slight deviation from the traditional meeting opening, Dr. Souvaine announced that the day would start with a panel discussion by former Board members to kick off the Board's information gathering efforts to inform its Vision 2030 project. The panel participants were Dr. Barry Barish (NSB 2002-2008), Anita Jones (NSB, 1998-2004; Vice Chair, 2000-2002), and Vinton Cerf (NSB 2012-2018). Dr. Souvaine noted that Dr. Jones and Dr. Barish had been asked to offer their perspectives on where science and engineering would be in 15 years and what role NSF would likely play. Dr. Souvaine then tuned the floor over to Dr. Cerf, who moderated the panel discussion.

Following brief introductions of Dr. Jones and Dr. Barish, Dr. Cerf invited Dr. Jones to begin with her presentation. Dr. Jones began by observing that her experience has provided her with numerous opportunities to not only think about how best to manage a research program, but also how to put in place the constructs and organizational infrastructure to enable and empower the real performers, the research community.

Dr. Jones offered two external forces that are affecting the U.S. economy and scientific enterprise. The first was the economic dislocation of mid-skill workers due to technological innovations since the mid-20<sup>th</sup> Century. She suggested that NSF may be well placed to do research on how best to mitigate the impacts of this phenomenon. The second external force was the increase in competition in research globally. She cautioned that the historical U.S. pattern of go fast, try things, fail, and then move on to the next experiment, while conducive to fostering an entrepreneurial spirit, may also lead the U.S. to overlook opportunities created by the research of others outside the U.S.

Dr. Jones then discussed a model construct for what she identified as a key challenge: How to conduct science openly and transparently in a competitive global environment while not sacrificing advantages for the U.S. She described the Computing Community Consortium (CCC) and its ability to help facilitate innovative, high-impact research through workshops, conferences, and policy trainings. She particularly highlighted the ability of the CCC, as an NSF partner, to serve as an agile and innovative enabler of action to promote the community's best to successfully engage in global research while adhering to the core values of openness, transparency, and collaboration. She stated that organizations like CCC offer opportunities that NSF's more deliberative processes may find difficult to provide.

Dr. Jones concluded by turning to two issues dealing with NSF directly; merit review and access to big data. Her remarks on the merit review were two-fold. First, she recommended that the merit review process serve a function beyond deciding who gets funded and who does not. She suggested that NSF should provide additional feedback to investigators whose proposals did not receive support as a way of helping them improve their next submission. She also stated that she

felt the evolution to more peer review by panels should be rethought. On the subject of data access, Dr. Jones, suggested that the focus on research infrastructure and instruments should begin with a discussion of how best to disseminate the data these facilities produce to ensure the widest possible access by researchers.

Before turning the floor to Dr. Barish for his remarks, Dr. Cerf commented that NSF needs to ensure that the computational capacity is available to analyze the volumes of data produced by its instruments and facilities. He also commented on what he called the “creeping nationalism” in science which is creating a resistance to information sharing and, as a result, inhibiting the rate at which scientific progress can be made. With that, he passed the floor to Dr. Barish.

Dr. Barish began by stating that he was going to make his remarks solely from his own perspective of what he has seen and experienced. He complimented NSF on its vision statement but asserted that he felt NSF has approached the running of its science program with too much reactivity. He also noted that he would contrast with Dr. Jones in that she used the word “compete” whereas he would focus on collaboration. He added that this difference highlighted the simple fact that the science and engineering studies today are more global in nature and the engineering capability is more distributed. These characteristics lead to both competitive and collaborative opportunities.

Dr. Barish also commented that technological advances, more so than ideas, are enabling more and more research. He pointed to three examples, discovery of the Higgs Boson at the LHC in Switzerland, identification of properties of the neutrino at photo detectors in Japan, and the confirmation of gravitational waves at LIGO in the United States.

Dr. Barish then transitioned to the topic of people and training. He stated that his most important message was that the U.S. has become as important as it is in the global science enterprise because it has been and continues to be the place of choice for future scientists to get their education and do their science. The key to the future of U.S. science and engineering will be the ability to remain the magnet for the world’s best minds. He added that it is also important to the economic health of the U.S. as science and engineering developments become a larger driver of overall health. In the search for maximizing benefits of the science and engineering enterprise, he added that global cooperation and collaboration will be more critical if individual nations are to avoid wasteful duplication of resources and effort to arrive at the same innovation.

Dr. Barish concluded his remarks with the observation that NSF needs a strategic plan for the future that will guide its future commitments in an era in which limited resources will prevent doing everything. Choices will need to be made about where to lead and where to be a collaborative partner at the table. He explained that it was this idea of strategic planning that makes the difference between being reactive versus proactive. He also pointed to the peer review system and worried that it may be driving the processes to be overly risk averse. He noted that the willingness to take calculated risks, fund science that may fail, is the engine of innovation and scientific progress.

Dr. Cerf then offered each panelist the opportunity to react to the comments of the other. Dr. Jones picked up on Dr. Barish’s focus on collaboration, noting that it was indeed important. She added, however, that the challenge is to balance collaboration with the need to maintain U.S. advantages in light of rising competitors such as China. She asked that NSF help define what it means to collaborate with researchers from countries that are considered competitors to the U.S.

Dr. Barish took on the challenge of data preservation and advocated for the creation of a national library in which to house the volumes of research data that are produced every year.

During the question and answer session, Dr. Souvaine asked Drs. Jones and Barish to address two issues. Her first question was about the appropriate time scale for strategic planning and how to balance the typical government 5-year plan with the bolder moves that Dr. Córdova has undertaken with the Big Ideas and Convergent Accelerators. Her second question asked the panelists for recommended modifications to the current peer review system, about which both had made remarks.

Dr. Jones responded to the peer review question by suggesting that NSF does a mix of internal reviews for smaller proposals and more direct community engagement with larger proposals, rather than relying on review panels. Dr. Jones stated that she was concerned about the potential for a group think dynamic that can influence panel recommendations.

Dr. Barish stated that he was not as allergic to panels as Dr. Jones but did see room for diversity in the review process. He shared Dr. Jones' advocacy for a continuing empowering of program officers in making award recommendations based on their own knowledge and experience rather than over-relying on peer review recommendations. [Neither panelist addressed the strategic planning question.]

Dr. McCrary asked how the U.S. could better develop the domestic science and engineering workforce.

Dr. Barish responded that it is really a question of diversification of the student body that studies in the STEM fields. He noted that there are large segments of the population that are not part of the science and engineering enterprise.

Dr. Jones added that improvements are needed in the quality of education across the country, not just in areas with high minority populations. Student access to STEM facilities, such as science labs, are very inconsistent.

Dr. Richmond commented that she agreed that the panel model of peer review had weaknesses, for the reasons stated earlier but also because the topical expertise of the panel can prejudice the panel against proposals that are on the fringe of the expertise "bucket." On the issue of STEM education, she lamented the high cost of higher education and its effect on who can afford to get an undergraduate or graduate degree in a STEM field. Lastly, she made a pitch for more women in STEM.

Dr. Beachy asked how to devise a system that rewards the curiosity of the young researcher while also continuing to fund the "old-timers," so they have some funding stability in their research program.

In response, Dr. Jones emphasized the inherent value in the university research system that combines long term funding for career researchers with an educational element to train the next generation.

Dr. Barish noted that one challenge for NSF is unwinding from large program investments. While NASA has a natural end to a program when the mission is complete, NSF's endings are frequently less precise.

Dr. Garimella asked what was necessary for the U.S. to continue to be the place to go for science and engineering research.

Dr. Barish said that the U.S. is currently doing well in this regard and the challenge is to not lose that advantage. Dr. Jones added that the ability to do research in the context of universities and education is a positive factor.

Dr. Phillips asked the final question, which was about the role of NSF in expressing the U.S. values and expectations for research openness and collaboration as we engage in an increasingly global scientific world.

Dr. Barish stated that NSF needs to play a bigger role in setting the expectations for open data in international collaborations. He argued that agencies have a stronger hand than universities alone. Dr. Jones agreed with Dr. Barish that the power of agencies can set the tone and establish standards to be followed by those receiving funding from them.

Dr. Souvaine thanked the panelists for their enlightening presentations and discussion. She then passed the floor to Dr. Córdova for her Director's report.

## NSF Director's Remarks

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Dr. Córdova began her remarks by providing a brief summary of the impacts of the lapse in appropriations.<sup>1</sup> Dr. Córdova noted that having facilities draw down their obligated funds to get them through mid-January and exempting IPAs were good steps that mitigated impacts of the lapse in its early stages. When the lapse was resolved, there was an orderly resumption of operations with a Town Hall held on Day 2 of the reopening to inform the staff of the immediate priorities. She applauded the professionalism of the staff and thanked those who worked throughout the lapse without pay for their dedicated service.

Dr. Córdova then reported on the official notification of the FY 2018 Financial Statement Audit from Kearney and Company. She stated that NSF received its 21<sup>st</sup> consecutive clean opinion and, for the first time in nine years, received consecutive audit results with no material weaknesses, significant deficiencies, or noncompliance findings.

Dr. Córdova continued by announcing the December 4, 2018 release of the White House Federal STEM Education Plan. She stated that the Board will receive a briefing on the plan in May from Dr. Karen Marrongelle, Assistant Director for the Directorate for Education and Human Resources. Dr. Córdova continued by stating that she had highlighted the NSF INCLUDES program during the rollout of the Plan, emphasizing that 5 other agencies have joined the initiative. In summarizing Dr. Marrongelle's reflection on the Plan, Dr. Córdova stated that the Plan charges educators to deeply focus on how we prepare all students for jobs of the future and how we keep America's competitive edge in innovation. It challenges educational institutions to operate in robust ecosystems rather than in isolation and include in these ecosystems employers and community partners.

During her roundup of engagements in the Washington, D.C. region, Dr. Córdova announced that she attended the State of the Union Address. She reported that she was particularly struck by President Trump's call to invest more in cutting edge industries. She also referred Board members to an OSTP-produced fact sheet that was included in their Board Books that further

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<sup>1</sup> A full briefing was presented to the Plenary during closed session and the minutes of that session provide the details of data related to NSF operations.

defined these industries. Included among them are ones in which NSF is seeding fundamental research such as artificial intelligence, advanced manufacturing, quantum information science and high speed, high capacity networks (5G).

Dr. Córdova also reported on a number of events she attended in December that complement the themes of the State of the Union Address. On December 6, she attended a CEO Innovation Summit hosted by the Business Roundtable. She stated that she joined the CEOs of Qualcomm and Blackstone on a panel entitled *Transitioning Innovations from Lab-to-Market*. The AI Select Committee of the NSTC held its 2nd meeting in December in which the focus continued to be the updating of the national strategic plan for R&D in artificial intelligence. Dr. Córdova noted that she attended the signing of an Executive Order on AI at the White House the day before this Board Meeting.

Dr. Córdova continued her remarks by reporting on the December 21 signing into law of the National Quantum Initiative Act. She stated that the Act establishes a National Quantum Coordination Office in OSTP, supports quantum information science research and standards development at NIST, and authorizes quantum-related research and education by the Department of Energy and NSF.

Closer to home, Dr. Córdova announced that NSF celebrated the 10<sup>th</sup> anniversary of the Expeditions in Computing program in the Directorate for Computer and Information Science and Engineering. During the event, NSF recognized a decade of investments in ambitious computing research that has included big data, computational neuroscience, quantum computing, computer vision and robotics. Dr. Córdova also unveiled the new NSF branding signage at the LIGO facilities. She thanked Amanda Greenwell for her leadership in the branding initiative and former Board member Dr. Vinton Cerf for funding the new signs.

Transitioning to the publicity NSF has garnered for its work, Dr. Córdova highlighted three items recognized in *Science* magazine's Breakthrough of the Year edition. *Science* recognized NSF's IceCube's detection of a neutrino that apparently came from a blazar, the heart of a galaxy centered on a supermassive black hole. Additionally, *Science* recognized the attention being paid to sexual harassment in science, especially noting NSF's new policy that universities must tell the Foundation when a grantee is placed on leave during a harassment investigation or found guilty of sexual harassment.

Dr. Córdova concluded her remarks by congratulating former Board member and Vice Chair Dr. Kelvin Droegemeier for his swearing-in to be the next Director of OSTP. Board Chair Dr. Diane Souvaine and the senior NSF leadership joined Dr. Córdova at the ceremony.

The Chair thanked Dr. Córdova for her report and asked if there were any questions. Dr. Bienenstock noted that the AI Initiative that Dr. Córdova referred to reminded him of a book, "AI Superpowers" written by Kai-Fu Lee. He said that Dr. Lee made the observation that if there is a competition between weak algorithms and lots of data, compared to strong algorithms and much less data, the data are going to win. Dr. Bienenstock said that in Dr. Lee's calculation, Dr. Lee picks China to win. Dr. Bienenstock then asked the question about the Executive Order from several years ago that required all data to be made public and wanted to know how NSF is progressing in implementing this directive. Dr. Córdova responded that NSF is working on it, there is another Executive Order on the subject expected in the not too distant future and recommended that a fuller discussion be planned for the May 2019 Board meeting as the topic

could not be covered satisfactorily in a brief question and answer session. Dr. Bienenstock agreed that a briefing by NSF in May would be very welcome.

## Summary of DC Meetings

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Dr. Souvaine continued the meeting by summarizing her activities since the last Board meeting. She stated that she had had several meetings on Capitol Hill following the CISE anniversary of its Expeditions in Computing program, which was previously highlighted by Dr. Córdova. One of those meetings was with Representative Daniel Lipinski [D-IL, and member of the House Science, Space and Technology Committee]. Dr. Souvaine stated that Rep. Lipinski shared his priorities for the House Science Committee and emphasized his interest in NSF activities around convergence and AI. She said that he also saw more partnerships between academia and the private sector as an important driver to commercialize basic research in the U.S.

In addition to Rep. Lipinski, Dr. Souvaine reported that she met with staffers of Senator Brian Schatz [D-HI and member of the Senate Appropriation Committee's Subcommittee on Commerce, Justice, Science, and Related Agencies]. Dr. Souvaine stated that they were also very interested in convergence research and the need to break down disciplinary siloes to encourage collaboration across research fields.

Dr. Souvaine's last meeting was with the staff of Senator Lamar Alexander [R-TN, Chair of the Senate Education Committee, and member of the Senate Appropriations Committee]. Dr. Souvaine reminded everyone that Senator Alexander has announced that he is retiring at the end of his current term in 2020. She reported that one of Senator Alexander's priorities will be the reauthorization of the Higher Education Act. Dr. Souvaine added that she highlighted the Board's work on the Skilled Technical Workforce. She said the Senator's staff shared that Senator Alexander considers R&D to be a key component of the America First agenda, and that he has conveyed this to the White House.

Dr. Souvaine concluded her report noting that she had presented a briefing on the Board's *Science and Engineering Indicators 2018* to a new committee of the National Academies of Science, Engineering and Medicine focused on safeguarding the bio-economy. She said the new committee was interested in how they could use *Indicators* data in their work.

Following the lunch break, Dr. Souvaine announced that the planned presentation by Mr. Christopher Liddell, White House Deputy Chief of Staff for Policy Coordination, was unexpectedly cancelled due to an unforeseen scheduling change for Mr. Liddell. As a result, Dr. Souvaine took a vote to alter the planned agenda and resume the Committee on Awards and Facilities Closed Session. This change was approved.

## Session 2

### Chair's Remarks

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Dr. Souvaine welcomed the NSF staff, guests, and members of the public listening via webcast. She began the session by inviting Dr. Alan Stern to the front of the room for his swearing-in to the Board.

Following the swearing-in, Dr. Souvaine acknowledged the contributions of African-American scientists and engineers in recognition of Black History Month. She also reminded everyone that National Engineers' Week was the week following the Board meeting. She recognized the contributions of the many distinguished engineers who have dedicated themselves to the advancement of technologies and innovations that have led the U.S. to its place of leadership in today's global research enterprise. Dr. Souvaine continued by congratulating Dr. Córdova for receiving the Council of Scientific Society Presidents' Support of Science Award.

Dr. Souvaine then gave an official welcome to Dr. Joanne Tornow as the new Assistant Director for the Directorate for Biological Sciences. She also thanked Dr. Matthew Wilson for his many years of service to the Board Office and wished him well as he undertook a new detail assignment to serve as an advisor to the new Director of OSTP, Dr. Kelvin Droegemeier.

### Director's Remarks

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Dr. Córdova began by referring the Board to the written update from Amanda Greenwell on Legislative and Public Affairs (OLPA) that was in the Board Book. She noted that even with the temporary lapse in funding, the office was busy with Congressional inquiries.

Dr. Córdova then announced new senior staff moves and additions across the Foundation. She announced the arrival of Dr. Anjuli Bamzai, who serves as the Division Director of the Division of Atmospheric and Geospace Sciences in the Directorate for Geosciences. Mr. Patrick Breen is the new Division Director for the Division of Acquisition and Cooperative Support in the Office Budget, Finance and Award Management. Dr. Sylvia James serves as the new Deputy Assistant Director in the Directorate for Education and Human Resources. Dr. Lina Patino is the new Division Director for the Division of Earth Sciences in the Directorate of Geosciences. Dr. Robert Stone is the new Division Director for the Division of Civil, Mechanical and Manufacturing Innovation in the Directorate for Engineering. Dr. Joanne Tornow is the new Assistant Director in the Directorate for Biological Sciences. Finally, Dr. Kon-Well Wang is the new Division Director for the Division of Engineering Education and Centers in the Directorate for Engineering.

### Approval of Prior Minutes

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Dr. Souvaine presented the minutes of the November Open Plenary for approval. Those minutes were approved as presented.



## Open Committee Reports

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Dr. Souvaine then turned to the open committee reports. Since most of the committees did not meet in open session due to the condensed schedule, Dr. Souvaine asked each Chair to provide a brief overview of the issues before their committee.

Dr. Phillips reported for the Committee on National Science and Engineering Policy (SEP). She stated that the NCSES staff estimate the partial lapse in funding will delay the schedule for thematic chapters release by 4-5 weeks. The summary report for *Indicators 2020* will be delivered on or before the due date of January 15, 2020. She also noted that criteria for the cover artwork was in the Board Book. Dr. Phillips also asked members to review the list of expert reviewers for the first three thematic reports and raise any concerns about missing expertise to her or the Executive Secretaries for the Committee. She concluded by thanking Matt Wilson for his many years of service to the *Science and Engineering Indicators* enterprise.

Dr. Sargent reported for the Committee on Oversight (CO). She began by bringing to the Board's attention a document in the Board Book that outlines the effects of the temporary lapse in appropriations on the Office of the Inspector General. She then reported on the Merit Review Report, stating that the past seven months have been focused on discussions with NSF about how best to modernize the report and make the data more accessible. She added that the current work is building on the work of her predecessor, Dr. Anderson, and the working group he set up on the Committee to consider the future of the Merit Review Report. The goals of that working group were: to promote transparency about the merit review process, to ensure the report is useful and readable to all stakeholders, to demonstrate the integrity of the merit review process, and to illustrate agency accountability in conducting the review of proposal submitted to NSF. Dr. Sargent emphasized that the committee under her leadership was continuing to pursue these four goals. Dr. Sargent then summarized her recent meetings with NSF staff on the subject of the Merit Review Report.

Dr. Lineberger reported that the Committee on Awards and Facilities (A&F) had to postpone its scheduled retreat due to the temporary lapse in funding and that it would be rescheduled for later in the spring.

Dr. Richmond represented the Committee on External Engagement (EE) and reported on a newly published NSB one-pager on the state of foreign-born students and workers in the U.S. Dr. Richmond stated that this document was produced at the request of Congressional offices and other stakeholders. She noted that the main message of the one-pager was that foreign-born individuals have long been a major contributor to science and engineering in the U.S., and the share of estimated workers and students in the U.S. who are foreign-born has been growing with time. She noted that in 2015, just over half of the first-year full-time graduate students in the natural sciences and engineering were foreign-born.

Dr. Beachy reported for the Committee on Strategy (CS). He stated that the CS was working hard on the NSB Vision and he hoped that the scheduled Vision retreat to be held the day following the current Board meeting would be very fruitful.

Dr. McCrary reported for the Skilled Technical Workforce Task Force. He reported that the Task Force had met with Dr. Anthony Carnevale, Director of Georgetown University's Center on Education and Workforce to discuss his group's work with the skilled technical workforce. Dr.

McCrary stated that the main effort of the Task Force in the coming weeks would be to finalize the final report of the Task Force's work.

After thanking everyone for putting together a very fruitful meeting in a very compressed time period and there being no further business, Dr. Souvaine adjourned the meeting at 4:45 p.m.

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Dr. Brad A. Gutierrez  
Executive Secretary, NSB  
Signed by: BRAD A GUTIERREZ