NSB-2018-49
February 12, 2019

APPROVED MINUTES
PLENARY OPEN SESSION
460TH MEETING
NATIONAL SCIENCE BOARD

National Science Foundation (NSF)
Alexandria, Virginia
November 28-29, 2018

Members Present:

Diane L. Souvaine, *NSB Chair*
Ellen Ochoa, *NSB Vice Chair*
John Anderson****
Roger N. Beachy
Arthur Bienenstock
Vinton G. Cerf*
Vicki L. Chandler****
Maureen Condic***
W. Kent Fuchs****
Inez Fung*
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
Stephen Willard***

France A. Córdova, *ex officio*

Members Absent:

Maria Zuber*

* Consultant
** Participated via telephone
*** New Appointee – sworn in before lunch on November 28
**** Missed Closing Plenary, November 29.

***** Consultant for Nov 28, New Appointee
sworn in on November 29.

There being a quorum, the National Science -Board (NSB, Board) convened in Open Plenary Session at 8:00 a.m. on Wednesday, November 28, 2018, with NSB Chair Dr. Souvaine presiding.

NSB Chair's Opening Remarks

Dr. Souvaine welcomed everyone to the NSB's 460th meeting.

Dr. Souvaine began the meeting by welcoming the newly appointed NSB members for the Class of 2024. The class includes five new members and two reappointed members from the class of 2018. The new members are Dr. Maureen Condic, Associate Professor of Neurobiology and Anatomy at the University of Utah, School of Medicine; Dr. Suresh Garimella, Executive Vice President for Research and Partnerships and Goodson Distinguished Professor of Mechanical Engineering at Purdue University; Dr. Steven Leath, President of Auburn University; Dr. Alan Stern, Planetary Scientist and Associate Vice President at the Southwest Research Institute; and Mr. Stephen Willard, Chief Executive Officer of Cellphire, Inc. The reappointed members are Dr. Geraldine Richmond, Presidential Chair in Science and Professor of Chemistry at the University of Oregon and Dr. Maria Zuber, E. A. Griswold Professor of Geophysics and Vice President for Research at MIT.

Dr. Souvaine then expressed her appreciation to Dr. Vicki Chandler for her work in leading the Board Retreat Organizing Committee, consisting of Drs. Beachy, Ochoa, and Panchanathan. Dr. Souvaine noted the great agenda and the opportunities for stimulating discussion, reflection and camaraderie.

Dr. Souvaine continued by previewing the upcoming meeting agenda. She then turned the meeting over to the Director for her opening remarks.

NSF Director's Remarks

Dr. Córdova began her remarks by joining the Board in welcoming the new Board members to the meeting. She then went onto highlight recently announced prize winners who have received NSF support at some point in their careers. Those winners included Nobel Prize winners Gérard Mourou (Physics), Frances Arnold and George Smith (Chemistry), and Riksbank Prize in Economic Sciences winners William Nordhaus and Paul Romer. MacArthur Fellows winners included Clifford Brangwynne, Deborah Estrin, Kristina Olson [2018 Waterman Prize recipient], Rebecca Sandefur, Allan Sly, and Doris Tsao. Dr. Córdova continued by acknowledging the Breakthrough Prize winners, Charles Kane and Eugene Mele in fundamental physics and Adrian Krainer, Xiaowei Zhuang, and Angelika Amon in life sciences. She also explained for those not familiar with the Breakthrough Prize that it is a prize for science and technology that is funded by entrepreneurs in the San Francisco Bay area. Dr. Córdova's final prize acknowledgement was to Larry Hedges for the 2018 Yidan Prize for Education Research, which is the largest education award in the world.

Dr. Córdova continued her remarks with a summary of her activities in the U.S. She reported that she attended the National Governor's Association summer meeting in New Mexico where she spoke about NSF's role in the innovation pipeline. She noted that the founders of two cutting edge startups, K.A. Wireless and UbiQD, were on her panel and these both had received support from NSF via the Small Business Innovation Research (SBIR) Program. Dr. Córdova continued by reporting that NSF had announced a new partnership with Boeing to enhance workforce development and diversity on the same day that NSF hosted a meeting on reskilling the American workforce. The partnership is worth $11 million and the NSF team leading the effort was led by the Directorate of Education and Human Resources. Dr. Córdova also presented the keynote address at the Intellectual Property Championship Gala of the U.S. Chamber of Commerce's Global Innovation Policy Center. At the 2018 National Health Research Forum hosted by Research! America, Dr. Córdova spoke as part of a panel on science related to the brain. Dr. Córdova also reported that she participated on a panel with Synapse Technology Corporation, Open AI, and Information Technology Industry Council at a POLITICO-hosted summit on artificial intelligence. The summit brought together policy makers, business leaders, and experts for solution drive conversations on the impact of AI on governments, industries, and societies.

Turning to her activities abroad, Dr. Córdova reported that she represented the U.S. at the G-7 Science Minister's Meeting in Canada in September. Discussions focused on the importance of encouraging the general public to get involved in science, artificial intelligence and its impact, and on evidence-based policy making. In October, Dr. Córdova led the U.S. delegation to the Second Arctic Science Ministerial in Berlin. She reported that the Ministerial brought together science ministers and leaders from over 30 nations, as well as six indigenous peoples of the Arctic and associations to further international Arctic science collaboration. Also in October, Dr. Córdova attended the Science and Technology in Society forum in Kyoto giving a talk on lights and shadow, the good and challenging aspects of the newest technology.

Addressing her White House engagements, Dr. Córdova reported that she attended the White House Summit on Quantum Information Science and gave remarks with leaders from NIST, DOD, DOE, and OSTP. Additionally, she said that she had co-chaired two meetings of the National Science and Technology Council's Committee on STEM. With the leaders of NASA, NOAA, and the Department of Education, she also stood up the STEM Education Advisory Panel. She reported that the Panel has 18 members and has already participated in its first task of reviewing a new 5-year federal strategic plan for STEM education. Dr. Córdova also stated that she chaired the Interagency Arctic Research Policy Committee. She stated that the discussion focusing on improving scientific research cooperation among the eight Arctic States is closely aligned with NSF's "Navigating the New Arctic" Big Idea.

On the specific topic of artificial intelligence, Dr. Córdova reported that NSF spent nearly $450 million in AI research in FY 2018 and, over the previous two months, NSF had issued two calls to the field for proposals. The first was a joint solicitation between CISE and SBE together with the Partnership on AI to support Early Concept Grants for Exploratory Research (EAGER) to understand the social challenges arriving from AI technology and enable scientific contributions to meet those challenges. The second is a solicitation to support a Cloud access program with the goal to enable, enrich and democratize the use of public Cloud computing resources by the CISE research and education community. Dr. Córdova also highlighted NSF's leadership role in the AI activities of the National Science and Technology Council. She said that she co-chairs the White

House Select Committee on AI with the head of DARPA and Drs. James Kurose and Edwin Gianchandani from CISE alternately co-chair the Councils' Subcommittee on Networking and Information Technology Research and Development. The Subcommittee has been tasked with creating an initial National Artificial Intelligence Research and Development Strategic Plan.

At the university level, Dr. Córdova reported on a number of activities in which she participated since the July meeting. In September, she was joined at Rice University by Congressman John Culberson, former NSF Director Neil Lane, Rice University President David Leebron, and Professor Yael Hochberg for a panel on The Future of Scientific Research. Earlier that same week Dr. Córdova and Dr. Dawn Tilbury, Assistant Director for the Directorate for Engineering, visited Dr. Greg Fenves, President of the University of Texas, Austin. Dr. Córdova was there to give a TED-style talk on Convergence Accelerators. In November, Dr. Córdova was in California to visit UC, Berkeley and UC, Riverside. At Berkeley, she stated she gave a presentation on Broader Impacts and at Riverside she delivered the Chancellor's Distinguished Lecture and visited with students engaged in NSF-funded research. On her return from California, she added, she stopped in Chicago to speak on NSF's role in Quantum Research at the Chicago Quantum Summit.

Dr. Córdova also reported that NSF continues its efforts to help Congress better understand the value of investments in major research facilities. She stated that in August and October, administrators and staff from the Office of Legislative and Public Affairs and the Directorate for Mathematical and Physical Sciences hosted Committee staff visits to Gemini North and DKIST in Hawaii (August, House Committee on Science, Space, and Technology) and Gemini South in Chile (October, Senate and House Appropriations Committees).

Dr. Córdova concluded her remarks by highlighting the Federal Employee Viewpoint Survey results for NSF. She said that NSF remains among the top-five medium-sized agencies on employee engagement, inclusion, and satisfaction.

The Chair thanked Dr. Córdova for her report.

Summary of DC Meetings

Dr. Souvaine continued the meeting by summarizing her activities since the last Board meeting. She began by announcing the delivery of the Board's report to Congress on midscale research infrastructure. She thanked former Board member and Board consultant Dr. Peter Lepage for his leadership in sheparding the report through the research and drafting process. She also thanked the other working group members, Drs. Carl Lineberger and Anneila Sargent, and the members of the NSBO and NSF staffs, for their work on the report. Dr. Souvaine reported that meetings with House and Senate staffs from the respective Authorization and Appropriations Committees went very well. There was great interest from the staffs and from OMB on the details of any future centralized NSF midscale programs, as well as the oversight mechanism that would be put in place. She noted that Drs. Lepage and Lineberger joined her for those meetings.

Dr. Souvaine then reported on the publication of the Board Statement on Security and Science and Security. She noted that the statement was instigated by reports of credible security concerns surrounding research and the Board's desire to go on the record with a general statement of principle espousing the importance of fundamental research to the U.S. economy and national security.

Dr. Souvaine continued by highlighting the two listening sessions held by the Board as part of its continued effort to gather information on the state of the skilled technical workforce. One listening session was held in Florence, South Carolina and the other was held in Washington, DC, in conjunction with NSF's Advanced Technical Education Principal Investigators' Conference.

Turning to her presentations, Dr. Souvaine reported on two speaking engagements. The first was her role in leading a panel discussion on *Science and Engineering Indicators 2018* at the Association of Public and Land-grant Universities, Council on Research summer meeting in Bozeman, Montana. She reported that there was a lively Q&A session and a great deal of interest from the audience, particularly on the issues of trends in international R&D. The second speaking event was at the National Academies' Committee on Science, Engineering, and Medicine Public Policy. Dr. Souvaine stated that she spoke on the Board's recent activities including *Indicators 2018*, two reports on NSF research infrastructure, and the skilled technical workforce initiative. She said that one of the key points that emerged in the conversation was the need for policymakers to connect the education/workforce pipeline conversation with the conversation about China and an increasingly multipolar S&E world.

Vision Discussion

Dr. Souvaine next turned to the last agenda item for this session, NSB's Vision Project. Before handing the floor to Dr. Beachy, Chair of the Committee on Strategy (CS), Dr. Souvaine framed the conversation by stating she hoped decisions could be made on three key items: 1) Board consensus that developing a new vision was a Board priority, 2) the time horizon for the vision, and 3) a deadline for publishing the vision. She argued that without agreement on these three fundamental issues, the broader questions would be moot. She then turned the floor over to Dr. Beachy.

Dr. Beachy began by providing the background to the Vision Project. He noted that the current NSB vision document (*Vision 2020*) was published in 2005 at the request of Congress. Acknowledging that a lot has changed since 2005 and that the "expiration" of the 2020 vision is rapidly approaching, Dr. Beachy stated that it may be a good time to take another prospective look at the world of science and NSF's role in that world. He also recounted discussions that had taken place on open CS conference calls and at the recently concluded Board Retreat during which potential audiences for such a document were considered. These included future NSF leadership and NSB, Congress, the science community, and the general public. He also proposed a time horizon of 10-12 years, noting that looking too far into the future may risk the document becoming irrelevant as time passed. Dr. Beachy concluded his introduction by suggesting a deadline for drafting on December 2019 to permit publication in early 2020, NSF's 70th anniversary.

Dr. Cerf began the discussion by advocating for a document that focuses on maintaining NSF's support for uncovering the unknown unknowns of science. He added that the vision must resist the potential for conventional wisdom to curtail innovation.

A number of Board members emphasized the need to have a well-developed engagement strategy for the document's publication and rollout to the target audiences. Dr. Anderson noted that many current Board members did not know that there was a *Vision 2020* document until

discussions began for the development of the current effort. Dr. Bienenstock asked if there was any evidence regarding the impact of the current vision document. Dr. Souvaine responded that she was not sure about the *Vision 2020* document, but that she has been told by stakeholders that a revised version would be welcome. Dr. Ochoa added that since the new Vision Project is a Board initiated effort, in contrast to the 2005 document that was requested by Congress, this represents an opportunity for the Board to challenge itself to think about the big issues and provide guidance for future years.

Dr. Córdova added her support for the project and stated that its release in conjunction with the 70th anniversary of NSF would be very appropriate.

With a consensus established about time horizon and deadline, a motion was made, seconded and approved that the Board would undertake the Vision Project with a time horizon of 10 years (to 2030) and with a deadline for completion of December 2019.

With no further business for this session, Dr. Souvaine adjourned the Open Plenary until 4:00 p.m., when Mr. Michael Kratsios from OSTP was scheduled to join the meeting for a briefing on OSTP and Administration initiatives.

Session 2

Dr. Souvaine reconvened the Open Plenary session of the 460th Board meeting at 4:20 p.m. on November 28, 2018, to introduce Mr. Michael Kratsios, Deputy Chief Technology Officer and Deputy Assistant to the President at the White House Office of Science and Technology Policy (OSTP). Mr. Kratsios thanked the Board for the opportunity to speak and to present the Administration's agenda in the technology space. He explained that the agenda is based on three pillars: 1) ensure American leadership in emerging technologies, 2) empowering Americans to innovate, and 3) protecting and defending American technologies abroad. He added that encompassed within these three pillars are such elements as pursuing 5G connectivity, developing a strategic plan for advanced manufacturing, and issuing a national strategy for STEM education.

The session was then opened to questions. Dr. Cerf asked if Mr. Kratsios had seen anything that would increase the aggregate ability to expand innovation across the federal government. Mr. Kratsios responded that innovation is a collaborative effort across several agencies and in partnership with private entities. He added that the real value in technology innovation is the return on investment created by bringing federal research out of the lab into the market place.

Dr. McCrary asked how the Administration will promote the development of STEM across the primary and secondary education levels. Mr. Kratsios stated that this is a critical need across the country. He noted that advanced manufacturing requires STEM skills. He also called attention to the National Strategy for STEM Education that was due to be released by the White House in the coming days. [The strategy was released on Dec 4, 2018.]

Returning to the topic of partnerships, Dr. Panchanathan asked about the extent to which the U.S. government was looking at developing partnerships with state and local entities to expand their programs. Mr. Kratsios stated that the involvement of state. local, and tribal jurisdictions was important for program success. Very little that is on the technology agenda can be achieved by the U.S. government alone. He cited as an example the coordination with state, local, and tribal

communities on the issue of rules governing use the use of unmanned aerial systems. Much of the airspace in the U.S. is not controlled by the Federal Aviation Administration at the lower altitudes where such systems typically operate.

With no further questions, Dr. Souvaine adjourned the second session at 5:00 p.m. She announced that the Plenary would reconvene at 1:15 p.m. on Thursday, November 29.

Session 3

Chair's Remarks

Dr. Souvaine welcomed the NSF staff, guests, and members of the public listening via webcast. She began by requesting the Board approve a change to the agenda in order to proceed with the ceremonial swearing in of the new Board members, Class of 2024. With the change approved, Dr. Souvaine invited those new members present to the front of the room. Drs. Maureen Condic, Suresh Garimella, and Geraldine Richmond participated. Mr. Stephen Willard elected to not participate.

Following the swearing in, Dr. Souvaine introduced two videos that were produced to support the work of the Skilled Technical Workforce task force. They highlighted the value of STEM education and the opportunities offered by Community College and Technical College programs. Dr. Souvaine announced that the videos would be posted on the Skilled Technical Workforce website and used in future external engagement activities.

Dr. Souvaine then gave an official welcome to Dr. Arthur "Skip" Lupia as the new Assistant Director for the Directorate for Social, Behavioral, and Economic Sciences and Dr. Karen Marrongelle as the new Assistant Director for the Directorate for Education and Human Resources. She also congratulated Dr. John Anderson for his nomination to be the next President of the National Academy of Engineering. Finally, she thanked Ms. Turquoise Bowen for her service to the Board Office while on detail from the Directorate for Engineering.

Director's Remarks

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.

Referring back to Dr. Anderson's question during the Committee on Oversight session concerning the total number of individuals that NSF impacts, Dr. Córdova provided some numbers to offer context to NSF's reach. During the Oversight session, Ms. Grancorvitz, Chief Financial Officer, noted that there are 386,000 individuals in the science and engineering talent pool being supported by NSF investments. Dr. Córdova described how this number is significantly greater than Dr. Anne McKinney's figure of 29,684 scientists supported by MPS. Dr. Córdova explained that the MPS figure only included scientists and students progressing from undergraduate to graduate to post-doctoral status, whereas the CFO figure includes the full range from K-12 teachers to principal investigator researchers. Dr. Córdova also highlighted that NSF has 435,525 Facebook likes and 1,088,643 followers on Twitter.

Dr. Córdova then announced new senior staff moves and additions across the Foundation. She announced the arrival of Ms. Janis Coughlin-Piester, who serves as the Deputy Office Head for the Office of Budget, Finance and Award Management. Dr. Terrance Quinn is the new Director for the Division of Ocean Sciences in the Directorate for Geological Sciences. Dr. Córdova continued with the introduction of Dr. Marc Sebrechts as the new Director for the Division of Behavioral and Cognitive Sciences in the Directorate for Social, Behavioral, and Economic Sciences. Dr. Córdova concluded her introductions with Dr. Alan Tessier, the new Deputy Assistant Director for the Directorate for Biological Sciences.

Dr. Córdova ended her remarks with a farewell to Drs. Vinton Cerf and Inez Fung, who were concluding their service as consultants to the Board with the appointment of the Board Class of 2024.

Approval of Prior Minutes

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

Open Committee Reports

Dr. Souvaine then turned to the open committee reports, noting that the full record of committee activities would be detailed in the respective committee minutes.

Dr. Sargent reported for the Committee on Oversight (CO). She reported that she had provided an update on the Merit Review Report highlighting that NSF staff have developed a conceptual approach for digitizing some of the data and making the report more useful to stakeholders. She also stated that the Committee had reviewed the OIG's Semi-Annual Report prior to the meeting and approved the Report and NSF's Management Response for full Board consideration for submission to Congress. Dr. Sargent also reported that CO heard a report from the external audit firm, Kearney and Company, concerning NSF's unmodified audit finding for Fiscal Year 2018. She also stated that the Committee received briefings from NSF on Responsible Conduct of Research and Reducing Administrative Burdens. The Committee also heard the regular OIG and CFO updates.

Vote: OIG Semi-Annual Report and NSF Management Response

In order to ensure a quorum, Dr. Souvaine interrupted the Open Committee Reports to hold the vote on approval of submission to Congress of the OIG Semi-Annual Report and NSF's Management Response. With a motion and second, the vote was unanimously in favor of approving the submission.

Open Committee Reports (Part 2)

Dr. Richmond represented the Committee on External Engagement (EE) and reported that the Committee requested feedback on three pending activities: additional one-page resource topics, meetings with Congressional members in their home district offices, and the launch of a pilot of the alumni network. Dr. Richmond stated that the feedback was supportive of all three issues. She added that the new NSB logo was revealed to "great enthusiasm and excitement."

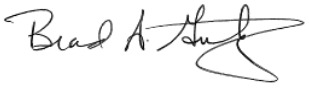
Dr. Phillips reported for the Committee on National Science and Engineering Policy (SEP). She stated that the Committee had received an update on the ongoing effort to modify the *Science and Engineering Indicators* Report beginning with the 2020 edition. She said that Dr. Khan from NCSES presented a summary of the eight initial thematic reports and the roadmap for advancing the *Indicators* project. The Committee also discussed the draft companion policy document on the state of U.S. fundamental research in a multi-polar world. She reported a robust discussion of the draft.

Dr. Beachy reported for the Committee on Strategy (CS). He stated that the CS heard a status on the FY 2019 budget appropriations process and an excellent briefing from Dr. Anne Kinney, the Assistant Director for MPS. The Committee also began the work of conceptualizing the Board's Vision 2030 Project.

Dr. Lineberger reported that the Committee on Awards and Facilities (A&F) received an update on the pending construction completion of the National Ecological Observatory Network. The Committee also approved a new action approval process that will replace the 2009 policy. Dr. Lineberger also stated that the Committee is planning for a February 2019 retreat.

Dr. Lineberger also reported for the Skilled Technical Workforce Task Force. He reported that the task force received an update on the efforts of NCSES to collect policy relevant data on the skilled technical workforce. He also reported that the Task Force discussed potential next steps for the group over the next six months.

There being no further business, Dr. Souvaine adjourned the meeting at 1:45 p.m.

X 

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