COMMERCE, JUSTICE, SCIENCE, AND RELATED AGENCIES

APPROPRIATIONS FOR 2018

Wednesday, June 7, 2017

NATIONAL SCIENCE FOUNDATION

# Committee Hearings

of the

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WITNESS

DR. FRANCE CORDOVA, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. CULBERSON. The Commerce, Justice, and Science Appropriations Subcommittee will come to order. We are delighted to have with us this morning the Director of the National Science Foundation, Dr. France Cordova. We sincerely appreciate your service to the nation, Dr. Cordova. You have had a distinguished career both in government and academia. We share a common passion for astronomy and astrophysics. I know that is your area of specialty. I am looking forward to hearing you talk to us a little bit today about this extraordinary most recent detection of a third gravitational wave. That is right up your alley.

We have on this subcommittee always enjoyed bipartisan arm in arm support when it comes to investments in fundamental research at the National Science Foundation and NASA. Everyone on this subcommittee is here because we share a common passion for ensuring that the United States maintains its, has the world's best space program and the world's best fundamental scientific research. When it comes to peer reviewed scientific research, the National Science Foundation does a superb job. And your budget is extraordinarily important as the National Science Foundation represents about 60 percent of the federal government's annual investment in basic research that is conducted at U.S. colleges and universities, not including the research that is done by the National Institutes of Health in the

extraordinarily important work that they do in fighting cancer and other dread diseases.

In many fields the National Science Foundation is the primary source of federal academic support. May 2017, just this past month, marked the National Science Foundation's 67th anniversary, an extraordinarily important milestone. We are looking forward to more successful discoveries in the future when it comes to understanding the fundamental building blocks of the universe and the universe all around us.

In fiscal year 2018, the National Science Foundation is requesting $6.7 billion, which is a decrease of $819 million, is what the President's budget proposes, about 11 percent below the current fiscal year. Now we do not know yet what our subcommittee's allocation is going to be for 2018. The budget process has unavoidably gotten off to a slower start than normal. But the committee is going to work arm in arm to ensure that NSF is appropriately funded and we preserve American leadership in scientific research.

I would like to add that while we wholeheartedly support NSF's basic research in sciences, all of us are mindful of the fact that our constituents' tax dollars very scarce, very precious, and hard-earned. So we are counting on you to be good stewards of that precious resource.

Before we proceed I would like to recognize the

gentleman from New York, Mr. Serrano, for any remarks he would like to make.

[The information follows:]

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Mr. SERRANO. Thank you, Mr. Chairman, and thank you, Ms. Cordova, for being with us today. It is good to have you with us today and as the chairman said, you have a distinguished career and much more to come.

The National Science Foundation is vital in promoting basic research and education in science and engineering. In doing so, it is a major source of federal support for U.S. university research in the STEM fields. NSF's investments in STEM education also help train the next generation of scientists and engineers. As you know, Dr. Cordova, I am a strong supporter of NSF and believe that its programs help our nation be the world leader in major discoveries, innovations, and scientific breakthroughs.

The President's budget blueprint for fiscal year 2018 requests $6.65 billion for NSF, which is an $822 million or 11 percent decrease from 2017. It is the first time in the 67-year history of this agency that a President has proposed a budget below the previous fiscal year. The result is deeply troubling.

Within the total the President's budget also proposes $5.63 billion for the Research and Related Activities Account, which is a cut of $672 million, or 10.6 percent. This level of funding endangers the core missions at NSF. For example, if the requested amount is enacted into law the number of competitive awards for fiscal year 2018 would go

down from 11,900 awards per year to 10,800, a reduction of more than 1,000 awards. In a given year NSF grants awards to over 1,800 colleges, universities, and other public and private institutions in 50 states, the District of Columbia, and Puerto Rico. Cutting funding for NSF will leave many schools without much needed education and research funding. I strongly oppose this proposed budget cut.

Another area cut by the President's request is the Educational and Human Resources Account, which is requested at $760.6 million. This represents a cut of $123.5 million or 14 percent. The President's budget proposal accomplishes this by cutting initiatives that increase STEM participation, including programs that help underrepresented minorities. The request also cuts reducing the number of graduate research fellowships by 50 percent. No funding is requested at all for a program that I worked to authorize, the new Hispanic Serving Institutions Program.

Mr. Chairman, I have been a strong support of Hispanic serving institutions and minority serving institutions since I arrived in Congress more than two decades ago. Last year Congress mandated the NSF establish a new HSI program and we appropriated $15 million in the fiscal year 2017 bill for this effort. Notwithstanding the clear evidence that HIS's need this funding, the budget proposal does not fund this program in fiscal year 2018. This negatively affects

constituents, by the way, in both Republican and Democratic districts alike.

Another issue of importance to me is the Arecibo Observatory in Puerto Rico. The President's budget for NSF in fiscal year 2018 proposes a total of $7.72 million for the observatory, which is a reduction of $480,000 from 2017. Due to the quality of work taking place at the Arecibo Observatory and the need for maintenance and repairs, I strongly oppose this proposed cut. I know the NSF is currently debating the future of the observatory. But I believe the federal government must maintain an adequate level of involvement and support for Arecibo.

Overall the NSF's budget request for this year is an extreme example of the problems with the President's proposal to increase defense spending by $54 billion at the expense of domestic priorities. There is little justification for cutting vital agencies, like NSF, simply to fund a Defense Department already receiving more than half a trillion dollars each year.

The discoveries attained by investing in NSF help our economy grow, sustain our economic competitiveness, and enable us to remain the world leader in innovation. I would note that countries like China are not cutting back on their involvement and investment in the sciences. And unless we shore up the NSF's ability to invest in research, our global

leadership in a large number of scientific fields will be threatened. That is a serious national security threat. Unless we have the funding to promote our nation's values beyond defense, our leadership in the sciences is not the only thing that will be threatened.

That you once again, Dr. Cordova, for being with us. And let me just tell you something. You are before a committee that is unique in one way. When it comes to this agency, the chairman and the ranking member agree totally. It is a great agency and it is one that should be funded properly. He has got his limitations with the budget. I have my bully pulpit. I am not chairman right now. I was, and then I had the problems with the budget. But rest assured that we have an interest that is not seen on many other committees where we agree on one agency as much as we agree on this one. Thank you. Thank you, Mr. Chairman.

[The information follows:]

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Mr. CULBERSON. You bet. And Mr. Serrano is exactly right. We are arm in arm. This whole subcommittee is arm in arm when it comes to our support for fundamental research, the spectacular work done by the National Science Foundation and NASA. We are all of us committed to preserving American leadership in fundamental research and in space exploration.

And I also want to express my agreement with Mr. Serrano when it comes to Arecibo. We have had previous budgets recommend cutting or reducing, even eliminating Arecibo and we have always stood behind it. Because it is a national strategic asset. It is a unique radio observatory that has unique capabilities that we simply cannot permit to fall by the wayside. I know you are looking at options about what to do about Arecibo in the future. But Arecibo and Green Bank in West Virginia, we strongly support the preservation of those vital facilities and frankly the expansion of the great work you are doing in astrophysics, whether it be in radio or visible light or in the area I am looking forward to hearing you talk about, the dawn of the era of gravitational wave astronomy. We are looking forward to hearing you talk about that this morning.

We are delighted to have you with us today. We thank you for your service to the nation. Your written testimony will be entered into the record in its entirety, without objection. And at this time we would welcome your brief

summary of your testimony. Thank you very much.

Ms. CORDOVA. Thank you, Chairman Culberson, Ranking Member Serrano, and members of the subcommittee. I am very pleased to be here today to discuss the National Science Foundation's budget request for fiscal year 2018. And thank you both for your heartfelt remarks.

NSF is the only federal agency dedicated to the support of basic research and education across all fields of science and engineering. We support research that enhances our nation's security, drives the U.S. economy, and advances our knowledge to sustain America's technological leadership. And the results of that research enhance the lives of millions of Americans everyday.

The President's NSF budget request for fiscal year 2018 is approximately $6.6 billion, a reduction of over 11 percent from the fiscal year 2017 appropriation.

You already have my full written testimony so I would like to use this time to give some specific examples of how forward looking NSF investments are benefitting the American people.

NSF has long been a leader in information technology research, funding foundational research in computer science, helping to launch the internet, supporting advances in high performance super computers, and investing in cyber security research and education. On the first page of your handout

that is in front of you, it looks like this, you will see Dr. Rajkumar of Carnegie Mellon University loading software into an NSF funded self-driving automobile. This research builds on decades of NSF funded research in precision sensors, computer vision, real time data analytics, and artificial intelligence or AI. Researchers estimate that driverless cars could reduce traffic fatalities by up to 90 percent by mid-century.

NSF funded AI research also has broad impacts for health. For example, page two of your handout shows Dr. Suchi Saria, Assistant Professor at Johns Hopkins, who recently developed an AI program integrating data from patient health records to identify factors capable of predicting septic shock. Septic shock is a rapid immune response to infection that can cause organ failure, leading to more than 200,000 U.S. deaths annually. Early symptoms are notoriously difficult to spot, but with Dr. Saria's combining and analyzing of numerous health factors her program can accurately predict septic shock 85 percent of the time, often before organs are harmed. Imagine the impact this NSF funded tool will have on people's lives.

These two examples from transportation and health of the power of artificial intelligence and machine learning to transform lives are at the heart of the shaping of the future at the human technology frontier, which is one of our

ten big ideas.

Similarly NSF's investment has led to breakthrough manufacturing technologies, as illustrated on page three of your handout. NSF provided critical early support for the techniques behind additive manufacturing, sometimes called 3-D printing, that were discovered and patented during the 1980s and today 3-D printing has become a $5 billion a year industry.

In this image you see Harvard's Jennifer Lewis, who uses materials such as hydrogels, to create architectures that mimic those found in nature, such as bone and spider webs and vascular networks. Such advanced 3-D printing techniques suggest we may soon be able to grow organ replacements using a person's own tissue. Just imagine the lives that will be saved.

Finally, as an astrophysicist myself I cannot resist citing NSF's pivotal role in advancing the era of multi-messenger astrophysics. It is already enhancing our understanding of the universe and revealing its mysteries and is another of NSF's ten big ideas. With ground based telescopes and particle and gravitational wave observatories in the U.S. and abroad, we are hopeful that some of the biggest discoveries are in reach, unveiling for example the nature of dark energy and dark matter.

Because of the ingenuity of inventors and dreamers such

as MIT researcher Nergis Mavalvala, who is shown on page four of your handout, we increasingly have the capabilities to address these profound mysteries. The NSF funded LIGO facilities detected gravitational waves, which are ripples in the fabric of space time, for the first time in 2015. And just last week, as the chairman referenced, they made a third detection of gravitational waves, this time from a binary black hole source about three billion light years away. Without NSF's consistent funding over the past four decades, we would not have been able to make these kinds of discoveries. It is important to note that these types of projects are made possible because of our country's unique ability to perform complex systems engineering, integrating the talents of scientists and engineers who work together to achieve such results.

Mr. Chairman and members, these are only a few of the thousands of trail-blazing awards that NSF funds every year. On behalf of those talented scientists and engineers and the employees of the National Science Foundation, I would like to thank this subcommittee for its longstanding support of our agency and our continued goal to keep our nation at the very forefront of the global science and engineering enterprise.

And I would like to acknowledge the presence of the National Science Board Chair Maria Zuber and Vice Chair Diane Souvaine in the audience, and I am open to your questions.

Thank you.

[The information follows:]

**********INSERT**********

Mr. CULBERSON. Thank you, Dr. Cordova. We wanted to ask about the black hole merger and the gravitational waves. It is a great illustration I think, and if you could I would ask you to expand a little bit on the importance of the Congress providing sufficient funding to NSF over a sustained period of time for projects that might not immediately appear to have benefit or gain. The LIGO detection, if you could talk to us about that length of time that the investment was made and what the hope was. And of course, just this year was, in fact on Christmas Day of 2015, was the first detection of a gravitational wave and the discovery that was just announced last week is the third detection. That discovery took place, how long was the Congress' investment in the Laser Interferometer Gravitational Wave Observatory? And what sum of money was involved? And what significance does that hold for the future, this discovery?

Ms. CORDOVA. Well thank you, Mr. Chairman. The NSF has been investing in gravitational wave observing, its potential, for four decades. Since the early nineties we have been funding this particular experiment and more recently an advanced version of it. But integrated over those four decades we have put in $1.1 billion. And significantly our international partners, and there are 14 other countries that participate with us in the LIGO consortium, have put in $400 million. So about $1.5 billion

over a very long period of time.

Much of that money, of course, has gone to observers and students, post-docs, all through that time. And in developing the technology, which as you know this was a huge achievement that Einstein himself when he predicted it now over 100 years ago never thought would be realized because the sensitivity level that needed to be achieved was so very, very great. And he could not envision the kind of technology that would need to be developed to actually detect a gravitational wave. But the scientists and engineers working together did achieve that.

It was a slow progression over a couple of decades to finally get the LIGO facilities to be at the right sensitivity to detect just in time a huge event that happened a billion and a half years ago and then was detected during the first actually engineering run of the LIGO observatory in September of 2015. And then now to detect on January 4th the third detection that happened three billion years ago. So we are ready now to observe events that happened billions of years ago.

And the other thing, Mr. Chairman and members, that is so very important about this result, it is not only about achieving an amazing goal and over a long period of time which only the federal government can invest in. It is not only about building the kinds of technologies that will have

hug spin offs because these are very, if you could look inside the LIGO tubes, the four-kilometer-long tubes, and see the sophistication of the instrumentation and all that that has entailed over decades to build that and appreciate how impactful those can be in other regimes. But it is also about when we actually identified what those sources of gravitational waves were. They turned out to be something that was totally unexpected.

And that is the whole business of opening up a new window on the universe, is that you might just see something that you never realized was there before. And in this case with all three LIGO detections they are due to binary black holes, which are large in mass, on the order of 20 to 30 solar masses, each component of the black hole. Because they are orbiting each other they are losing angular momentum and eventually they infall into each other and form a single black hole. And when they do that they lose a lot of energy. In the most recent case two solar masses worth; in the first case three solar masses worth. And that is a tremendous amount of energy we cannot even envision. More than the whole universe is putting out is integrated in one instant of time, in just a fraction of a second. And so finding a whole new population of astrophysical phenomenon and then thinking about what that could mean for the evolution of the universe is also another tremendous aspect of these discoveries.

Mr. CULBERSON. The first astronomers were using visible light, obviously their eyes, and then telescopes--

Ms. CORDOVA. Right.

Mr. CULBERSON. --unaware of any electromagnetic radiation outside the visible spectrum. Then we moved into the era of course of radio, infrared astronomy--

Ms. CORDOVA. Mm-hmm.

Mr. CULBERSON. --ultraviolet astronomy--

Ms. CORDOVA. Mm-hmm.

Mr. CULBERSON. --x-ray astronomy. Talk about the meaning of this new era that we are entering into, the era of gravitational wave astronomy and what it is that when you say that the holes merged, very quickly, it is a very rapid event.

Ms. CORDOVA. Yes.

Mr. CULBERSON. The merger of these holes. This--

VOICE. This is the long one. And this is the shorter one. And now for the increased pitch.

Mr. CULBERSON. That is the first one.

Ms. CORDOVA. That is the sound of the universe, yes. That is great. So you have your chirps on your cell phone.

Mr. CULBERSON. Extraordinary. Talk to us about--

Ms. CORDOVA. Are you going to make this your ring tones?

Mr. CULBERSON. Yeah.

Ms. CORDOVA. Yeah--

Mr. CULBERSON. Talk to us about the significance of what we are hearing. We are seeing a very narrow band of--

Ms. CORDOVA. Listening to the universe now, which is just great. As you pointed out, chairman, we first were investigating the universe through electromagnetic means, all the way from the radio to the x-ray and gamma ray parts of the electromagnetic spectrum. And then we built particle detectors, like the great detector that NSF is involved in at CERN, and the neutrino detectors. We have one called Ice Cube at the South Pole so we can also look at the universe and the high energy particles that come from exotic sources. And now we have opened up a third window, the gravitational window. And as I said, we are observing new phenomenon. And yes, you are absolutely correct. That just as the electromagnetic spectrum has a very large, embraces a lot of frequencies or wavelengths, so does the gravitational spectrum. And with the particular configuration of the observatories that we have on Earth and their size, we can only observe a narrow portion of that spectrum. So who knows what could be observed? What kinds of phenomenon if we could build larger detectors? And those are certainly under conception in space to observe other parts of the frequency spectrum. And on the ground in explorations at the South Pole we are reupping and improving the cosmic microwave

background detectors so that they can go after identifying what is called the B polarization or polarization from the gravity waves embedded in the microwave background. So that is looking back to the big bang.

So yes, there is a huge amount of spectrum in gravitational waves alone to examine through various means.

Mr. CULBERSON. Well I thank the members for allowing me a little extra time. But the significance of this discovery I do not think can be overstated. And how vital it is for the Congress, for the country, to stand behind NSF and make sure that you have got the support, the financial backing over a sustained period of time to continue to unlock the mysteries of the universe. Because the universe is always more extraordinary than we can even imagine. Thank you very much. Mr. Serrano?

Mr. SERRANO. Thank you, Mr. Chairman. Fascinating. Now when you get a call it will be the universe calling you. The budget request, Ms. Cordova, we have before us is the deepest cut in NSF history. According to Science Magazine, prior to this year no President, as I said, had ever proposed cutting NSF below its previous year level. Beyond the numbers in terms of dollars, how far does this cut in funding set us back? Can you give us an idea of how many fewer grants will be funded and graduate students trained? Do we endanger our global leadership in the sciences at this level?

Ms. CORDOVA. The reduced funding, Congressman Serrano, will of course have an effect because fewer researchers, including students, will receive grants. We estimate that we with this budget would have the wherewithal to fund approximately 8,000 grants whereas in our current 2017 budget we can fund 11 or 12 percent more than that. And the public also will have less benefit from the federal investment in science.

That said, the current budget still has considerable resources and we will do our best to select excellent science to fund using input from the National Academy of Sciences, among others, and relying on the efficacy of our merit review process.

We are used to making difficult choices. Even in the current year we are leaving up to $4 billion worth of excellently funded proposals on the cutting room floor that we simply do not have the funding to make and the fiscal year 2018 budget makes our choices harder. We would see a lower funding rater, with perhaps $5 billion of excellent proposals unfunded.

Mr. SERRANO. Mm-hmm. Let me ask you a question that is on the mind of some people as we look at the 2017 budget. The budget you have proposed for NSF is frankly quite bleak. I along with several of my colleagues here on the subcommittee, I imagine, are interested in making sure that we do not see a

cut like this to your budget. After all, it is the Congress who has the final say in funding matters. With that in mind, I am concerned that the NSF may be taking steps to begin reductions now that have been proposed in fiscal year 2018 but not enacted. Can you assure me that fiscal year 2017 funding, which we just completed recently, will not be held back in anticipation of a cut that may or may not come in the future?

Ms. CORDOVA. I can assure you that we are not holding back. Our fiscal year 2017 budget was a robust budget for fundamental science and we are not anticipating what the 2018 budget looks like. We very much understanding that Congress is in the driver's seat on the fiscal year 2018 budget.

Mr. SERRANO. So we should have no fears that 2017 will be used to cover for 2018 at this point?

Ms. CORDOVA. We, I can assure you that we are not using 2017 to cover for 2018 and we are letting Congress make the decisions about the 2018 budget of course.

Mr. SERRANO. All right. Let me ask you something about the grants. You spoke about the reduction that this budget would reduce or would bring about. Are we seeing an increase in requests for grants? Or has it leveled off?

Ms. CORDOVA. We get around 50,000 proposals a year and that number, we are anticipating it could go a little higher, just depending on the situation with all agencies. There are

some principal investigators that apply to multiple agencies for their funding. But it is hard to anticipate until we actually see a budget to estimate how many people will apply for grants.

I do know that from going around to universities, I was just at a university yesterday talking with a lot of their faculty, that the funding climate can actually discourage people from applying for grants. So we do not really understand the full consequences of whether we will get more grants or fewer grants right now. But 50,000 is a lot of grants to manage and we do that well, I think.

Mr. SERRANO. All right. Mr. Chairman, I am at three. So thank you.

Mr. CULBERSON. Thank you, Mr. Serrano. Mr. Jenkins?

Mr. JENKINS. Thank you, Mr. Chairman. Director Cordova, wonderful to see you. Thank you for our good working relationship over these last couple of years and I enjoyed our phone conversation yesterday. So I am glad you made it back safely.

Mr. Chairman, thank you so much for this opportunity. And Director, obviously you and I have had multiple discussions about an asset in my district, Green Bank Observatory, a world class radio observatory. You have mentioned, and the chairman has mentioned, radio astronomy several times. So thank you for your commitment to that. And

over these number of years it has received steadfast support from NSF, literally for decades and I appreciate that very much. Because I do believe it is a key resource for radio astronomy and does contribute significant groundbreaking exploration. And in your testimony you mentioned the important aspects of NSF, such as maintaining global leadership in science and in investing in STEM fields. And I firmly believe, and I think we all would agree, that Green Bank does both.

It gives students hands on experience in STEM at literally every level. And two of the most compelling stories that I have heard over the last couple of years serving in Congress representing this wonderful asset is some of the work that Green Bank's education programs have been doing from students literally from around the world who do pursue STEM careers.

What I would like to ask is while I see the budget, as we have talked about, does maintain and support the GBO, the Green Bank Observatory, at level funding for next year, it has been suggested that potentially in the future years NSF plans may be to divest. Can you share with me kind of what the steps of NSF is at this point vis a vis this next year and the potential for divestment moving forward, which concerns me greatly?

Ms. CORDOVA. So Green Bank is one of the observatories

539 that the National Academy of Sciences at the beginning of
540 this decade in its decadal report suggested that in order to
541 do new things, and what was at the time looking at a flat
542 budget scenario, that we would have to consider divesting
543 ourselves of some assets. And so a couple of years later,
544 namely in 2012, a portfolio review committee gathered of
545 astronomers nationwide and recommended that NSF divest itself
546 of the Green Bank telescope, among others.
547 And so since that time, and that has been reaffirmed in
548 a mid-decadal review as well, that is not saying that it is
549 not doing wonderful science. It is only in order to do new
550 things in a constrained budget that we have to let go of some
551 of the things that we have been doing for a longer time.
552 So right now we have undergoing environmental impact
553 study and that on all of the potential divestments, and the
554 results from the Green Bank environmental impact study that
555 will present the National Science Foundation with options for
556 divestment. Those results should be in by the beginning of
557 the next calendar year, early 2018. We do expect a draft
558 report of the environmental impact study in late August or
559 early September and there will be a 45-day comment period for
560 that.
561 As you also pointed out in fiscal year 2018 our budget
562 is approximately the same, even a little bit more, than our
563 fiscal year 2017 estimated budget and that assumes that the

ongoing partnerships continue like the partnership with the Breakthrough Prize Foundation.

Mr. JENKINS. In my 30 seconds I have left let me summarize and make sure I did understand. So based on the fiscal year 2017 that we are in, based on the fiscal year 2018 that is before us, we should be safe and sound for the fiscal year 2018 period. We have got this EIS study scheduled out early next year but a draft with public comment may be in the coming months of this year. But we have got some hurdles but at least at this point in time with the budget that is before us we should be good for the next year and we will address the issues moving forward after that.

Ms. CORDOVA. That is right, Congressman. And I think you also know that NSF is working with others to see what other possibilities there are.

Mr. JENKINS. Yes. Thank you, Mr. Chairman.

Mr. CULBERSON. Thank you, Mr. Jenkins. I recognize Mr. Kilmer.

Mr. KILMER. Thank you, Mr. Chairman, and thanks for being with us. You know, you touched on it in your opening remarks on the work NSF does around cybersecurity. And your organization has helped advance our cybersecurity efforts and has provided awards to outstanding schools like Tacoma Community College in my district that train the next generation of cybersecurity workforce and actually conduct

research in this space.

I am concerned about the level of budget cut and what that would mean in terms of NSF's role in this regard and our cybersecurity as a nation writ large. To what degree has the administration reviewed the additional risk to local and state and our federal government, not to mention private industry, if we invest substantially less in cybersecurity?

Ms. CORDOVA. All I can talk about is what NSF is trying to do, realizing how important cybersecurity is. I think you know we have a big investment in CyberCorps Scholarships for Service, which aims to develop just what you are talking about, a well-educated cybersecurity workforce. And we also have a number of other programs like our advanced technical education program for community colleges to develop the technical workforce.

I think absolutely we understand at the agency that cybersecurity is one of our biggest challenges going forward. There is enormous interest on the part of universities to provide curricula. I was, as I said, at a university yesterday which has developed and many others a curricula for involving their students in learning more about computer science so they can produce the cybersecurity workforce for the future. Our Social and Behavioral Sciences Directorate is very, very involved with our Computer and Information Science Directorate in encouraging interdisciplinary

collaborations of researchers to understand the behavioral practices that are also involved in conjunction with computer practices to provide for a cyber secure world.

Mr. KILMER. Do you think that that progress is going to be eroded based on the cuts that the NSF faces?

Ms. CORDOVA. Well as I said, the reduced funding does present challenges and we have had to make a number of tough choices in our budget. And there will be impacts from reduced funding, yes.

Mr. KILMER. Let me switch gears and ask about geoscience. Some folks may have read the article about the really big one that could hit on the Cascadia subduction zone and the impacts that that would have on the West Coast of the United States. We know a lot about the Cascadia subduction zone but there is a bunch that we do not know, and that is why the NSF funding grants, like the M9 grant awarded to the University of Washington four years ago, is so vital.

We have heard arguments made that geoscience and earth science research could be funded by other agencies, like NOAA. Unfortunately within NOAA the office that is responsible for the bulk of that extramural research is also slated for a cut of more than 30 percent. NASA Earth science is slated for a cut as well. So my question to you is this. If NSF is cutting back in geosciences, and NOAA and NASA are cutting back on research in related fields, who is going to

do this?

Ms. CORDOVA. We are, as you said, one of the major agencies that is involved in the geosciences and our work that we do, often in conjunction with those other agencies, is extremely important. And I think your question is probably a rhetorical question?

Mr. KILMER. Actually it is not. I actually am curious who is going to do the work. I mean, if the funding is being cut by everyone who is doing this work, who, where is it going to happen?

Ms. CORDOVA. Well there will be less wherewithal in order to do that important work. We will continue to do the best we can with the budget that we have and subject it to the best merit review processes. And we think that that work is very, very important.

Mr. KILMER. I do, too. I yield back. Thank you.

Mr. CULBERSON. Mr. Kilmer served in the State Senate, I believe, in Washington State. They are very familiar, very familiar with the coastline there, the geology of the area. Is it my memory there was a tremendous tsunami in the 1600s, they found evidence? What was the size of that tsunami? And what effect would that, what kind of an earthquake caused that tsunami, and what would be the effect today, Mr. Kilmer, if you have a similar earthquake and a tsunami of a similar size?

Mr. KILMER. I wish I had a science degree like Dr. Cordova. But the potential, you know, in the article that came out last year I think was definitely not night reading because it suggests that there would be massive devastation. The potential for an earthquake at the Cascadia subduction zone could trigger a very significant tsunami. And that is why I think this research is so important.

Mr. CULBERSON. Yes, I would certainly agree. Thank you. Thank you very much.

Mr. KILMER. Thanks.

Mr. CULBERSON. Mr. Palazzo?

Mr. PALAZZO. Well, thank you, Mr. Chairman, and thank you, Director Cordova, for being here today. I echo the comments from my colleagues on the important work the National Science Foundation is doing across the board. Earlier this year I cosponsored the Inspire Women Act, which was a bill that directs NASA to encourage women to study science, technology, engineering, and mathematics and to pursue STEM careers, especially aerospace. That bill passed the House alongside the Promoting Women in Entrepreneurship Act, which authorizes NSF to support STEM entrepreneurial programs aimed at women. As you know, these two bills were among the very first signed into law by President Trump.

I have long been a supporter of STEM programs, especially those geared towards women, not only because I had

the privilege of serving as the Chairman for the Space Subcommittee for five years but also because I have a teenaged daughter at home that I hope pursues a STEM field as well as career one day.

Your budget proposes calls for providing opportunities and support for those pursuing STEM programs and it aims to produce measurable, sustainable progress geared towards diversity and inclusion. What is your plan on providing these opportunities, especially as it relates to the Inspire Act and Promoting Women in Entrepreneurship Act? And how do you plan on measuring diversity in STEM programs?

Ms. CORDOVA. The National Science Foundation is very committed to broadening the participation of women and minorities in STEM. And we have had a lot of programs over time in order to further those goals. One particular one is the ADVANCE Program, of advancing women faculty at universities. I in fact was a PI on that when I was at Purdue University. We have more recently an INCLUDES Program and we are currently funding 40 pilot programs around the United States in order to encourage women and minorities, everyone really, to have more access to STEM careers. And some of these programs are for K through 12, others are for other age groups, and many different disciplines involved. There is much diversity in the kinds of programs that are being piloted around the country.

All of them have the goal of broadening participation, broadening access to STEM. It is hard to be a STEM entrepreneur without first being STEM literate and then being involved in research and then being inspired to go on and start to be an entrepreneur perhaps in a startup company. And so those pilot programs are going on. INCLUDES is one of our ten big ideas. And they are showing tremendous promise. We will be funding more of those proposals in the fiscal year 2018 budget. We will be forming alliances of groups, because what we really want to do is to scale up this effort so that it connects the whole United States in an effort to make progress in this area. And then more particularly in our SBIR programs, our Small Business Innovative Research programs, where women can actually, can be encouraged and funded to start their own business, we are upping our efforts to reach out to potential prospects and to encourage a larger number of women to want to be, to start their own companies.

Mr. PALAZZO. Well thank you, Director Cordova. And I think promoting women in STEM careers and fields and education is a sound federal investment. I think you make an outstanding role model for inspiring young women to pursue STEM careers as well. So thank you. I yield back.

Ms. CORDOVA. Thank you.

Mr. CULBERSON. Thank you, Mr. Palazzo. Mr. Cartwright?

Mr. CARTWRIGHT. Thank you, Mr. Chairman. Dr. Cordova,

thank you for joining us this morning. And I congratulate you on a stunning career and I wish you all the best in the future.

I am not the first one to say it. The chairman has said it. My ranking member has said it. This is the first time in the history of the NSF that we are talking about reducing budget, 11 percent lower than the previous year. I will cut to the chase, that was not your idea, was it?

Ms. CORDOVA. The NSF is an executive branch agency of the administration. This is the President's budget.

Mr. CARTWRIGHT. Okay. Well NSF of course is wholeheartedly and full throatedly supported by both sides of the aisle here in Congress. It is credited with unimaginable discoveries that have increased social welfare and long term economic benefits. American Sign Language, facial recognition software, fiber optics, and the MRI all have roots from NSF funding to promising researchers at institutions like Penn State, where my district is in Pennsylvania. You know this all too well having worked there yourself. Institutions will be gravely damaged by this budget.

I want to focus on climate change for a moment. Last week the President announced the U.S. withdrawal from the Paris Accord. Although unfortunate it was not unexpected from an administration that denies climate change and denies

that human activity has an effect on as the primary cause of climate change. As the head of the Nation's premiere scientific agency, you must have a scientifically informed view on this issue.

I am equally concerned that we might lose our best and brightest, our most talented researchers, to other nations because of these cuts. Just recently French President Emmanuel Macron actually invited American climate change scientists to move to France. You saw that, did you not?

Ms. CORDOVA. I heard about it, yes.

Mr. CARTWRIGHT. Yes. How does NSF, in this climate how does NSF plan to retain our best and our brightest? Our talented researchers, not just on climate science, but in all scientific fields within the U.S. in an environment where we are cutting the budget for the first time ever, this time by 11 percent? How do you keep your best people in this kind of environment?

Ms. CORDOVA. I think the budget does, as I said, present impacts and challenges. The budget is not final until Congress weighs in on the budget and I am sure many prospective scientists and engineers are anxiously waiting for how it all unfolds.

Meanwhile, as I also said, we have a lot of money to do good science. We have $6.6 billion proposed and presently we have $7.5 billion. And our goal is to do the very best

science that we can and continue to fund researchers that are talented and that are presenting great proposals, continue to invest in them.

We will do everything we can to be more efficient and effective as an agency in order to make those dollars go farther. We will continue to increase our partnerships, and I mentioned partnerships in the context of Green Bank and the context of Arecibo, to leverage the federal investment. And I will continue to go around the country. And just last night I spoke in D.C. to a lot of very young people about the importance of, and their mentors, about the importance of STEM careers. And I do think that emphasizing broadening participation and welcoming more women and minorities into the fields of science because it is just a terrific thing to do for one's self and for the country, for the world, the future.

Mr. CARTWRIGHT. Not to interrupt, but I want to follow up with another question. There is a movement afoot on Capitol Hill to selectively fund programs at the NSF. You are aware of that, I believe? A movement to pick and choose here in Congress of what programs to fund at NSF.

Ms. CORDOVA. Sure.

Mr. CARTWRIGHT. Which I believe would unnecessarily and detrimentally inject politics into questions of what science projects should be funded. How do you feel about that?

Ms. CORDOVA. I feel the same way, that the science community is best equipped to set the priorities for science and engineering. We rely on the advice of the National Academy of Sciences and its reports and our advisory groups. And we work with Congress and the administration, of course, to integrate all of those priorities to come up with the very best strategic plan for investment. But I have often said that as the world is changing and evolving the grand challenges require more disciplines, not fewer, to aggregate around those challenges and to give their best input in solving them. And we found the most effective solutions come from interdisciplinary groups that converge on an important question. We never know where the next discovery is going to come from or who is going to make it. And so it just behooves us to continue to fund, as has been our mandate for these 67 years, all of science and engineering.

Mr. CARTWRIGHT. Thank you, Director Cordova, and I yield back, Mr. Chairman.

Mr. CULBERSON. Thank you, Mr. Cartwright. I am pleased to recognize the gentlewoman from New York, Ms. Meng.

Ms. MENG. Thank you, Mr. Chairman, and thank you, Director Cordova, for all your wonderful work. America's economy cannot deliver on its full potential and cannot continue to be great if we do not have STEM workers to fill open STEM jobs. Neglecting to invest in new generations of

scientists will only further this problem. Our research shows that STEM fields face persistent and dramatic worker shortages in this country. And for example on the STEM unemployment rate category a study shows from the years 2010 to 2016 unemployment rate within the STEM fields went down from 5.9 percent to 2.7 percent.

So I believe, as I think many of my colleagues do, that at a time when we should be developing STEM expertise and encouraging the pursuit of these advanced degrees we are cutting funding. And by doing this we will be limiting, cutting back on entire generations of scientists. Because those in these fields will be more prone to leave and less students may want to enter into these fields and will have less support if these cuts go through. So how does the NSF intend to deal with consequences of these cuts and the decreasing numbers of people going into these fields in the first place?

Ms. CORDOVA. I hope that there is not decreasing numbers of people going into these amazing fields. Because the country really needs them to remain a global leader. And we will do everything we can to promulgate the importance of science and engineering and to fund programs all the way K through 12, K through my age, for people to get more involved in science and engineering. And we will try to leverage those programs with partnerships from foundations and

scientific societies in the private world and industry, which is becoming ever more involved in working with us.

Ms. MENG. Colleges and students in my district, which is one of the most diverse districts in our country, they are now receiving many NSF grant funds supporting STEM faculty training, teacher recruitment, development. These are schools such as Queens College and Queensborough Community College in Queens, New York, York College, and the CUNY system in general. And they have been doing a lot of work in this area. Are you concerned that the NSF budget cuts effectiveness may decrease in terms of NSF's ability to support these important efforts moving forward?

Ms. CORDOVA. They are important efforts and by the way, just your mentioning Queens, that is where my mother was born and raised. So it was nice to hear that. But absolutely, the reduced funding will have an effect and fewer researchers will be able to be funded. Yesterday I was in St. Louis at Washington University and one of the things I did was to have a round table with some two dozen young faculty who were Career Awardees, which is a very special competitive award that we give. And every time I go to a university I meet with the Career Awardees because they represent the bright, up and coming, the people who are going to make the LIGO and other discoveries of the future. And they represented all of the disciplines in science and engineering. And they were so

alive with the transformative nature of their research and part of the Career Award is that they must also do educational outreach in addition to the research. And they said that doing that education, and it is usually in a school system in K through 12, has transformed even they way they think about their future. So it was very heartening to hear them. And but as for impacts, a reduced budget does have impact.

Ms. MENG. I too have been having conversations with both private stakeholders and nonprofit organizations who are very concerned about STEM education and want to ensure that they are doing their part to bolster these efforts. So if we could ever have a larger or a further discussion on how to collaborate in light of these potential cuts, I would love to continue this conversation. Thank you. I yield back.

Ms. CORDOVA. Thank you.

Mr. CULBERSON. Thank you very much. All the members of the subcommittee have expressed our strong support for the National Science Foundation and your mission on the importance of continuing the nation's investment in fundamental research. But I wanted to be sure to add because we have an opportunity through our hearing today, Dr. Cordova, to talk to the scientific community at large.

I know that the general sciences here, I see Jeff Mervis, I assume some of the major publications from around

the country are here. And the scientific community I hope will join, and my colleagues will join with me and certainly on our side of the aisle to focus the attention of the country on the urgency of bringing down the national deficit, of bringing down the national debt. Because that is the fundamental problem that is devouring all of these precious resources that our constituents work so hard to earn that the 70 cents out of every federal dollar goes out the door immediately, as soon as it comes in, for Social Security, Medicare, Medicaid, veterans benefits, under the Obamacare program, the Affordable Care Act, principal on the debt, and interest on the debt. Seventy cents goes right out the door. And the Appropriations Committee is responsible for that remaining 30 cents. And 15 of the 30 cents goes right out the door to help our men and women in the military ensure that they can fight and win, ideally two battlefronts on two sides of the world. But because of underfunding in previous years for the military, 70 percent of the Marine Corps aircraft cannot fly because of lack of spare parts. Half of our Navy's airplanes cannot fly because of a lack of spare parts. It is an unacceptable situation.

Our military urgently needs a shot in the arm to bring them back up to the level of readiness and preparedness that we expect the United States military to have to ensure that those young men and women come home safely. So we, all of

us, I think, have an obligation in educating our constituents, working with our colleagues, to ensure there is enough money for the National Science Foundation, for NASA, for the other critical work in law enforcement, all the important work that the federal government does. We have got to address the bigger problem of money flying out the door to the programs that are an automatic pilot and devouring our annual federal spending to such an extent that this subcommittee, the Appropriations Committee is going to be reduced to a smaller and smaller percentage of each one of those federal dollars. And we just simply cannot pass this massive debt onto our kids.

So, you know, Donald Trump was elected because the country wanted to see these problems dealt with. They wanted to see the debt resolved, the deficit resolved, spending brought under control, the military restored. They wanted problems solved. And we have got a CEO in the White House who is dealing with these urgent problems who has laid out a budget proposal that we may not agree with all parts of it but fundamentally we have to recognize that our military needs help, we have got to get spending under control in order to make sure that the National Science Foundation has got the help they need.

And I encourage the scientific community to do all they can to speak to their members of Congress, their members of

the Senate, to focus on the bigger problem. Let us balance the federal budget, save the looming bankruptcy of Medicare and Social Security, and that will free up a vast amount of money and allow us to get the deficit under control and get back to balance and ultimately pay down that debt so we are not leaving that to our kids. So that we have got the money to invest in critical work that, expanding the STEM grants, for example, that are so important; making sure that the tsunami detection network is safe and sound; that you have got the money that you need to invest in really important work like the Daniel K. Inouye Solar Telescope, which has a $20 million line in the budget to continue building this, the world's most powerful solar telescope.

And the total cost I understand for the Daniel Inouye Solar Telescope is about $345 million. Could you talk to us about the current status of the program? Is everything proceeding as planned? And when it comes online in 2020, how will NOAA be able to access the data to fulfill its space weather prediction responsibilities?

Ms. CORDOVA. Sure. May I make just a comment related to your remark about the military?

Of course a lot of what the military can use today traces its root back to science and technology investments, and whether it is GPS or prosthetics and new materials that are used on the battlefield or above have their roots in

science. So we look at science beyond funding a telescope or instruments as really creating a pathway to the future and that has tremendous impacts for all aspects of life, including national security and health, transportation.

So on DKIST, and so that is the Daniel K. Inouye Solar Telescope, which will be the world's largest telescope, we expect it to see first light in the middle of 2020, and we welcome any members who would like to see how the telescope is progressing. It is really, besides its promise of being a scientific marvel, it is an engineering marvel.

And I took members of the National Science Board, two of whom are in this audience today there several months ago and they were just in awe. It is like building really a satellite on the ground, but one that has enormous capabilities.

So it is on track to fulfill its promise of having first light very soon. Everything is going very smoothly.

Mr. CULBERSON. Well, the Space Weather community, have they begun discussions on how this solar telescope can be exploited by both NOAA and NASA to inform their operational or research roles?

Ms. CORDOVA. Yes. I don't know the details of that, but could provide them to you. But clearly we advertise that this telescope, because of its incredible sensitivity in observing the sun and magnetic flares, will be very, very

useful for Space Weather and Space Weather predictions of substorms and the like from the sun, and those can of course affect the electric power grid.

And so I am quite sure that those discussions with other agencies have already taken place, because the world is really looking to us to have this extraordinary capability to do this.

Mr. CULBERSON. I am sure the telescope will also help us, for example, understand things like during the I think it was the Maunder Minimum, it was a little ice age during the Middle Ages, it got very, very, very cold as a result of decreased solar activity, this will help us understand to what extent the cycles of the sun are and the effect they are having on Earth's climate.

Ms. CORDOVA. Absolutely, and understand more precisely the physics of the sun and then how that translates into impact sun and Earth.

Mr. CULBERSON. Thank you.

Mr. Serrano?

Mr. SERRANO. Do I understand, Mr. Chairman, that this telescope eventually will be able to look at a state and determine how many people are going to vote Democrat and how many people will vote Republican?

[Laughter.]

Ms. CORDOVA. Our telescope is--

Mr. SERRANO. It is called the anti-pundit telescope. I couldn't help myself.

[Laughter.]

Mr. SERRANO. Speaking of telescopes, back to the Arecibo Conservatory and Observatory in Puerto Rico, which is very important to me and obviously to the chairman also.

We know about the reduction; how much have we spent throughout the years to operate, how much did it cost to construct, and what is the research benefits of the facility?

Ms. CORDOVA. Well, let me look up my notes here on the costs. It was built by-- actually, it was built by ARPA, the precursor of DARPA in the '60s and was completed at a cost of only $9 million. That was in the '60s. And then the transfer to NSF was made in 1969 with us assuming full responsibility a couple of years later.

So the operations have cost NSF about $255 million from 1990 through the present fiscal year and total operations costs before that time from 1970 to 1990 we estimate were about $100 million.

So as far as the importance of Arecibo, it has been extraordinarily important. Of course, that was where Joe Taylor and Dr. Hulse discovered the binary pulsar, which was the first real evidence of gravitational waves, and it has made many other seminal observations, especially on pulsars, which just happens to be one of my fields. I have been to

the telescope and extraordinary observatory.

Mr. SERRANO. I am also concerned about the condition of the observatory with respect to maintenance and modernization. Have any maintenance needs been deferred? Which ones? Could improvements be made to modernize Arecibo and what would that ehtail?

Because there is a concern, I am hearing, that it is not being taken care of or kept up, because some people believe it is going to go away.

Ms. CORDOVA. Well, two major upgrades have been funded, one as long ago as 1974 by NSF and NASA at a cost of $9 million. And there was a 1997 upgrade, funded by again NSF and NASA at a cost of $27 million, which added some powerful things like the Gregorian feed and a more powerful radar transmitter.

Modernization of Arecibo could include new optic elements to allow the telescope to access more of the visible sky, because observations are currently limited to an angle of just 20 degrees from straight overhead. New receivers, upgraded reflector panels and new radar transmitter subsystems. When I asked my group how much all that would cost, they don't have firm estimates yet, but they think it could approach $100 million to do those kinds of upgrades.

Mr. SERRANO. Do you see a desire to continue? I mean, I would like to get to the bottom of this information

floating around that in some cases some people say, well, give it away to some universities, which may not be the worst thing in the world, but then there are others who say it is time for it to cease, which should be a warning to other members of this committee, because it may affect how these kinds of things are seen in their districts.

What is your sense of what the scientific or the government community is saying about the observatory?

Ms. CORDOVA. NSF's preferred alternative is to collaborate with interested parties for a continued science-focused operation and that is why we put out a solicitation in January of this year to ask others if they were interested in partnering on this telescope. And proposals that are being received in response to the solicitation are currently under review and they will inform us as to next steps.

I go back to my earlier comments that we--and the chairman often asks us just how priorities are set for NSF, we really do rely on the science/engineering communities to inform our strategic planning and that is often done through the Decadal Reports, which actually the astronomy community piloted a number of decades ago. And in this decade's report they have said that we couldn't continue to do everything, if we wanted to do new things, DKIST was mentioned, the LSST, the spectroscopic survey telescope was mentioned, and we

couldn't do new things and all the investment that requires without letting some things go.

And then we asked the community to assess current assets and what they would divest of. And Arecibo and Green Bank telescope are on that list not because they are not excellent telescopes, they do do great research in particular areas, but there are other telescopes that could have improved resolution over a large what we call phase space in all areas of observing that can provide just simply more capability, and we are in a constrained budget.

So that is where we are with Arecibo.

Mr. SERRANO. Thank you so much.

Thank you, Mr. Chairman.

Mr. CULBERSON. Mr. Jenkins.

Mr. JENKINS. Thank you, Mr. Chairman.

Director, during our last round right at the end you made reference to collaborations and I would like to explore that just for a few more minutes relating to GBO, Green Bank Observatory, and the opportunities and the work that NSF has been undertaking to look for partners in collaborative relationships that may also provide additional funding for maintenance moving forward.

Can you share with me kind of what work your office and the NSF in general has been doing to look for collaborative relationship opportunities, partners with GBO?

Ms. CORDOVA. Yes. We have been since we started the environmental impact study, we have been on that course, and I have to say I myself have been one of the prime movers in pushing us to look for collaboration and partners. And one potential partnership has turned up recently for Green Bank with the national security community and so we are engaged. I don't want to say too much about it, because it is very new, within the last couple of weeks, few weeks, but those have been very, very long and now sustained discourses with that community over their potential interest in that.

And so we are always hopeful that that will produce something of significance here and we will keep you informed.

Mr. JENKINS. Well, thank you and I appreciate that. Our office and I am sure the entire delegation looks forward to working with you for that. We think there are touch points with not only those interests, but others, NASA, and there are just unique opportunities and capacities.

And what I think we are trying to do is obviously not only continue to work with the relevance and fulfilling those core NSF missions and functions that you have outlined at your direction, but also with other federal entities and agencies and programs.

So we look forward to working with you. Thank you for your personal interest, as you described engagement in this, very helpful.

One of the areas we are very supportive of is the EPSCoR funding. I actually back in the '90s served on the EPSCoR state board and capacity, so this activity is very important. One of the things I do notice from NSF funding is that about 88 percent of your funding goes to about 25 states. So I just really would encourage some careful consideration about the breadth and the scope and the talents and capabilities of the other 25 states that are now enjoying only about 12 percent of the NSF funding and making sure, candidly, like I do is fight for our fair share in the unique talents and capabilities.

So I just hope that I put a place marker out there of concern that I have about the disparity in the funding allocation. I understand this isn't going to be a pot that is divided in 50 equal ways, but I do believe 25 states getting 88 percent of the funding warrants a careful evaluation of those 25 states that receive 12 percent.

Ms. CORDOVA. I hear you, Congressman Jenkins, and clearly the agency feels similarly and that is why we really value the EPSCoR program and we do a great deal. It has had wonderful leadership under Denise Barnes and I think all of us were at, I spoke at that event and you introduced me a couple of years ago, it is just a great and transformative program. And I love going to the EPSCoR states, I went recently to Rhode Island with Senator Reed and just saw the

amazing work that they are doing.

So I am very appreciative of your remarks.

Mr. JENKINS. Well, thank you.

Thank you, Mr. Chairman. I yield back.

Mr. CULBERSON. Thank you, Mr. Jenkins.

Mr. Kilmer.

Mr. KILMER. Thank you, Chairman.

I know there has been a lot of talk by the current administration about a big infrastructure initiative. I know also that research dollars from NSF don't just go to individual investigators; they support facility investments, including in my neck of the woods at the University of Puget Sound, an NSF major research instrumentation award for a mass spectrometer has made a real difference for faculty and staff and student research.

I am just curious, is the NSF involved in the administration's infrastructure initiative and, if not, how could the NSF perhaps be a partner to increase accessibility to science?

Ms. CORDOVA. The NSF is very willing to work with the administration and Congress to pursue important investments like that. We know there are many findings from NSF-supported research that can improve infrastructure investments and we have a lot of research on that going on, especially in our engineering directorates. We hope that

investments in scientific infrastructure can be considered and also in cyber-infrastructure as part of the administration's interest in bolstering infrastructure. And so we are very open to collaborations.

We have had some talks with congressional members and their staff about how we are positioned to do increased investments in infrastructure and you mentioned specifically the major research instrumentation program that is so important to our colleges and universities. And of course then we have the large facilities program and we are trying to close the gap in funding with our mid-scale program, which the American AICA, a new Act for Competitiveness and Innovation asks us to do.

So there is just a lot. Infrastructure has been part of what NSF has built its scaffold of amazing discoveries in science and engineering, and we hope that the entire nation realizes what an important investment that infrastructure is.

Mr. KILMER. I also want to ask you, you mentioned the Competitiveness Act, it is rare to get to talk to someone who is NASA's chief scientist. I was thinking as you came in about October 4th, 1957, Sputnik, and that was a moment in which the United States woke up to an existential threat and as a consequence the United States, Democrats and Republicans, embraced the notion that to respond to that existential threat required a substantial investment in

science. And we talked about what could be an existential threat in my neck of the woods with the geoscience issues of potential earthquakes, but I want to talk about an economic threat.

A few years back the National Academies worked on Rising Above the Gathering Storm and then the Gathering Storm, Revisited partnership with, you know, a number of CEOs and folks in the scientific community. And as you look at their findings, they said first, ''The Federal Government funding of R&D as a fraction of GDP has declined by 60 percent since Sputnik,'' since the response to Sputnik. And then they wrote, ''Without a renewed effort to bolster the foundations of our competitiveness, we can expect to lose our privileged position as a nation.''

The former CEO of Intel Paul Otellini put it this way, he said, ''Without a change in U.S. policy, the next big thing will not be invented here, jobs will not be created here, and wealth will not accrue here.''

I am just curious, do you agree with the findings of the National Academies in the Rising Above the Gathering Storm report and their call for doubling investment in NSF?

Ms. CORDOVA. I agree with their findings. As the head of an executive branch agency, I won't comment on their call for doubling the budget of the National Science Foundation.

I gave a little talk yesterday about I think the

existential threat is even larger than a lot of people realize, because we have competition from other countries that is incredibly serious.

Mr. KILMER. Yes.

Ms. CORDOVA. And that is something that, you know, it can creep up on you slowly and then all of a sudden you have lost another market, you have lost your premier position, and it has gone somewhere else. And, frankly, I am concerned about that. I am concerned about the accelerating pace of investments in other countries, I am concerned that we will lose our global leadership if we don't also invest in science and engineering.

Mr. KILMER. I share that concern and I know it puts you in a tough position to have to speak to a budget that calls for a double-digit cut in the work you are doing. So I appreciate you being here.

I yield back.

Mr. CULBERSON. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

And thank you for your candor on that last question, Director Cordova.

Director Cordova, we are concerned on this side of the aisle about our ability to get our questions answered under the current administration. My question to you is, has the White House or the Office of Management and Budget approached

NSF about any kind of policy or guidance that would prohibit or delay responses to ranking members, that is the head Democrats on congressional committees or subcommittees of jurisdiction?

Ms. CORDOVA. There has been no direction that would in any way interfere with the flow of information between NSF and Congress.

We have ourselves at NSF internal processes for answering congressional inquiries that have been in place for years and that haven't changed. We track all incoming and outgoing congressional correspondence, I sign off on that myself, and we try to answer all inquiries as quickly as possible. There is no policy or guidance that would prohibit or delay the flow of information.

Mr. CARTWRIGHT. Thank you. I am glad to hear that.

Now, we have been talking about climate change and one of the things that I am concerned about are adaptation and resiliency. As NSF's fiscal year 2018 budget states, the Agency-wide Risk and Resilience Initiative, quote, ''aims to improve predictability and risk assessment, and to increase preparedness for extreme natural and manmade events to reduce their impact on quality of life, society, and the economy,'' unquote, but the proposed fiscal year 2018 budget includes a 27.4 percent reduction for the Risk and Resilience Initiative overall.

How would this kind of proposed reduction in funding for this initiative affect the anticipated outcome of improving resilience and readiness of interdependent critical infrastructures?

Ms. CORDOVA. You are right that some difficult choices had to be made and that the overall annual budget for Risk and Resilience will be reduced.

Research on hazards in extreme natural events, which is called our PREEVENTS program, will not be affected and will continue to enhance understanding of the fundamental processes underlying geohazards in extreme events on various spatial and temporal scales, as well as the variability inherent in such hazards and events, and improve models for extreme events and their impacts.

But research on resilient infrastructure we have called our CRISP program, an acronym, will be reduced by about 40 percent and impacting the number of new awards, and that has been an effort to promote research on interdependent critical infrastructure systems.

So we do plan to invest in both our PREEVENTS and our CRISP program to the tune of about $31 million in Risk and Resilience in the fiscal year 2018 budget. And I know that is a reduction and, again, we had some tough choices to make.

Mr. CARTWRIGHT. Further, the Risk and Resilience Initiative is an NSF-wide investment that has been supported

across six NSF directorates and offices. The fiscal year 2018 budget proposes to eliminate funding completely to the Computer and Information Science and Engineering Program, CISE, that is taking away $6 million.

What is the rationale for eliminating funding for this program and how might eliminating the CISE program's funding for this initiative affect efforts across the other directorates?

Ms. CORDOVA. Well, I think, again, we will supply you with a more detailed answer for the record, but I think you are talking about the contribution to the programs I just talked about by the CISE directorate, the Computer and Information Science and Engineering directorate. And when I asked all the directorates to look at roughly a ten-percent cut in the directorates, they all had tough choices to make and on these cross-agency initiatives there were puts and takes.

I think the numbers are what I mentioned for the total effort, which comes from a number of directorates. The size of the computer directorate cutback on that, it means that they made a choice to invest in other initiatives.

Mr. CARTWRIGHT. Thank you, Director.

I yield back, Mr. Chairman.

Mr. CULBERSON. Thank you very much.

Ms. Meng?

Director Cordova, we will submit the remainder of our questions for the record.

Mr. Serrano, is that--

Mr. SERRANO. Yes.

Mr. CULBERSON. Very good. We will each submit the remainder of our questions for the record.

I want to thank you again for your service to the nation.

Ms. CORDOVA. Thank you.

Mr. CULBERSON. And we will stay focused on doing our best to balance the budget as a whole, so that we can have more resources for the vital work that the National Science Foundation, NASA, our law enforcement community, and the military all do for the United States.

Thank you very much.

Ms. CORDOVA. Great, and thank you.

Mr. CULBERSON. And the hearing is adjourned.

Thank you.

[Whereupon, at 11:58 a.m., the subcommittee was adjourned.]

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SPEAKER LISTING

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