

TESTIMONY

House Committee on Science and Technology Hearing “Science and Technology Leadership in the 21st Century Global Economy.” March 13, 2007

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Chairman Gordon, Ranking Member (and fellow Texan) Ralph Hall, members of the Committee.

Thank you for inviting me to testify today in this important hearing “Science and Technology Leadership in the 21st Century Global Economy,” which deals with a matter of considerable urgency.

This committee has long been a champion for U.S. science and technology and research and education. It has been a bi-partisan “voice of reason” in Washington. I particularly appreciated the guidance and support this committee gave me when I was NSF Director and during my time as Director of OSTP. It is always a pleasure to appear before you.

I also feel very honored to be part of today’s distinguished panel.

Norm Augustine, who chaired the committee that wrote the National Academies’ report, “Rising Above the Gathering Storm”, has been ringing alarm bells throughout this town and the nation about the enormous challenges our country faces in this century. The findings in that report are frightening and the recommendations are both bold and compelling. I join many others who believe that there is great urgency in putting those recommendations into action.

And I applaud you, Mr, Chairman, and your fellow co-sponsors of legislation (HR 362 and 363) to move much of that agenda along by authorizing significant growth in the research budgets of several agencies and funding for several innovative programs to improve the teaching of science, technology, engineering and mathematics (STEM) in this country.

I might also mention that the “Gathering Storm” report has gotten the attention of many in my state of Texas. The Academy of Medicine, Engineering, and Science of Texas (TAMEST) has, with the encouragement of Senator Kay Bailey Hutchinson, taken on the task of determining how the education recommendations of the report might be implemented at the state level. I suspect other states are doing the same.

Earlier, I used the word “urgency.” So, let me tell you why I believe the Congress should waste no time in moving this and other relevant legislation along. And, I ask your

indulgence to let me personalize my testimony. Since the Chairman has talked about his five year old daughter, expressing some concerns similar to my own, I hope you will indulge me as I talk about my four grandchildren, Jessica, Matthew, Allia, and Alex, ages 4 to 17.

Over the past 60 years, my generation – and the baby boomers who came behind us – have enjoyed the fruits of considerable public and private investment in research, much of it in universities, where millions of bright young men and women have learned how to think, how to discover and invent – how to turn knowledge into wealth, jobs, and a standard of living for Americans that is the envy of the world.

No less important, as a part of this success, were the thousands of men and women who came to America from other parts of the globe to obtain their education in our universities. And many of them stayed and became a critical component of the most highly skilled science, engineering and technical workforce in the world. Thank God we welcomed them to our communities.

Well, the baby-boomer scientists and engineers are beginning to retire; and the pipeline does not have sufficient numbers to replace them. Furthermore, fewer of the brightest young people from other parts of the world are choosing to study and make their careers in America. They are finding excellent opportunities elsewhere.

These past six decades have been a golden age for America, in part due to our leadership in science and technology. But, looking to the future, things do not look so golden. Much has changed in recent decades. And many, if not most, of the factors that enabled the United States to be so successful no longer apply.

The “Gathering Storm” report presents frightening statistics and logical implications that should be a “wake up” call to all Americans.

My grandchildren, and your grandchildren and children, are wondering how their lives will compare to the lives we have enjoyed. I think they are concluding that they may not have it so good.

Their generations are looking at a very different world than the one I saw as a naïve physics student in the 1960’s.

When I was a teenager, we didn’t worry about the energy supply. It seemed to be endless. Well, today, we realize that it is not.

When I was a teenager, we couldn’t imagine that humans could be changing the climate, and along with it, the weather for future generations. Well, today we realize that the energy we use and the fuel we burn are changing the climate. And our concerns grow more serious with each passing day.

When I was a teenager, it seemed that the United States would always be the unrivaled economic power on the globe. Well, today, we realize that we could well lose that position. In many ways, the handwriting is on the Great Wall.

And I think it would never have occurred to us that our performance in school would rank well down the list of nations, by almost any measure you could name.

So, my grandchildren face enormous challenges. But, the news is not all bad. There are things we can do right now to help – and it would be irresponsible not to do them.

The reality, of course, is that there is no simple solution, no magic bullet, as the “Gathering Storm” report points out. Progress will require a number of difficult strategic decisions and investments of taxpayers’ money. It will take vision, political leadership, perhaps even courage. My hunch, however, is that the American people know that we’re in big trouble, and they are willing to do their part, provided their government tells them the truth and puts forward sensible plans.

Fortunately – and it is a big plus – we have the strong institutions needed to implement the recommendations in that report and contained in your proposed legislation.

We have outstanding state and private colleges and universities all across the country that collectively make up what is by far the strongest system of higher education in the world. And one of the principal reasons for this success is decades of federal investment in research and higher education. I do not believe that these institutions can remain strong if that investment is allowed to continue to slide downward.

And we have many outstanding federal agencies, which, given the resources, flexibility and effective leadership can do their part.

So, Mr. Chairman, that brings me to the specific legislation you have put forward to address some of these matters. In HR 363, you authorize increases of 10% per year (for five years) for basic research in the physical and mathematical sciences and engineering for NSF, DOE’s Office of Science, NIST, NASA and DOD with special emphasis given to: early career development, integration of research and education, interdisciplinary research, and infrastructure enhancement. In the case of NSF, you also authorize increased funding to promote research on the process of innovation and teaching inventiveness, which would involve NSF’s social sciences and educational research programs.

I want to state unequivocally that if this bill passes and funds are appropriated for these important efforts, and provided the agencies are given flexibility in implementing them, America’s future competitive position in the world will look much brighter than it does today. Our grandkids should be pleased.

Let me comment, specifically, on NSF, DOE/OS and NIST. What do these three agencies have in common? In a word “excellence”:

- Excellence, in the research they support (all have garnered Nobel prizes);
- Excellence in the quality of their programs and staff; and
- Excellence in their contributions to advancing the nation's position of leadership in science and technology over the past half century.

In the case of DOE, the agency has the mission and wherewithal to connect the research results of the researchers it supports with the future carbon-free energy and fuel needs, as well as the security, of our country.

In the case of NIST, the agency has the mission and wherewithal to provide U.S. industry: (a) with appropriate support to bring high-risk emerging technologies closer to market and (b) well researched and tested industrial standards that reflect the results of excellent research and the latest technological innovations.

In the case of the NSF, the agency has the relationship with our institutions of higher education to effectively integrate research and education to deliver new knowledge at the frontiers of science and engineering and tomorrow's technically trained workforce so vital for the future of the Nation.

Your bill also addresses DOD and NASA. I believe it should also include NOAA.

DOD has, in the past, been a prime investor in basic research. Indeed defense agencies invented the process of competitive peer review that is the hallmark of excellence in research. In recent times, however, defense priorities have shifted to short-term mission-specific goals. Your legislation sends a strong signal that this situation should be reversed.

NASA has made extraordinary contributions to science in such fields as astronomy, astrophysics, space, planetary, and earth science, including satellite observations of the earth's atmosphere, land and sea. The recent shift in NASA priorities has placed science well down the list in order to make room for an aggressive drive to go back to the moon, and perhaps beyond. Whether returning to the moon is a good idea or not, sacrificing critically important science to do it clearly is unwise.

That brings me to one more issue I would like the Committee to consider - how one understands and frames innovation and competitiveness. It is in this context that I mention NOAA.

One of the major costs of doing business is weather and weather-related events – storms (hurricanes and tornados), blizzards, floods, droughts, and other disruptive acts of nature. We already suffer billions of dollars a year in losses due to weather events. Hurricane Katrina cost well over \$ 120 billion and immeasurable human loss. These financial and human costs could be considerably reduced with more accurate and timely forecasts. The management of Jet Blue could probably attest to that need based on the problems they and their customers suffered during the ice storms of Valentine's Day last month.

Furthermore, global warming and climate change will alter the patterns of the past and may lead to more frequent and more disastrous events. We need the research to improve our understanding of climate and weather, provide better forecasts, as well as invent the technologies to cope with the impacts.

In addition to the research supported by NSF and DOE's Office of Science, the work of NOAA and NASA are central to our understanding of climate and weather. NOAA, in particular, the National Weather Service, has the responsibility to produce official forecasts, and NOAA experts need the observational data and computer modeling capability to this well.

NASA is the agency with the capability to design and launch the satellites that provide much of that observational data. It is incomprehensible to me that NASA would remove "earth observations" from its mission statement at a time when we are facing staggering future weather-related costs and when our weather satellites are aging and the plans to replace them are not going well.

It is also disturbing that both NASA and NOAA are cutting back on their extramural research support, where the competitive process of peer review can be used to select the most meritorious and promising ideas. Moreover, the kind of research these agencies support (for example, the geosciences, or climate science) in universities involves students in complex problem solving that trains them to work in interdisciplinary teams. This is precisely the kind of technical workforce industry says they need. Cutting back on university support in these disciplines does not bode well for the future.

The recently released National Academies' report: *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* raised alarm bells about our deteriorating system of weather and climate observations and ability to protect our nation's citizens and businesses from natural disasters. The report has received an enormous amount of attention.

Both NOAA and NASA's science and earth observation programs will need your support for the additional funding required to meet these critical societal needs, as well as your continued protection of those agencies from earmarks that in the past have made it hard for them to do their jobs.

Before I leave the topic of federal support for research, I would be remiss if I did not mention that many federal agencies have important research programs that deserve attention and increased support. Even though NIH is not strictly under the jurisdiction of this committee, it is important to note that its budget has been essentially flat for four years running. That can't be good public policy.

Now, turning to your second bill (HR 362), I want to commend the Committee – and you, Mr. Chairman for your leadership – in moving forward to address the serious problem this country has in K-12 education.

Your bill HR 362 addresses the critical need to improve the quality of teaching of science, technology, engineering and mathematics (STEM) in our schools, colleges and universities. The programs you authorize with this legislation are important steps to take as the nation deals with this enormous educational challenge. The bill should be strongly supported by all members of Congress.

Mr, Chairman, in your letter you asked me to specifically address the appropriateness of the proposed role of the National Science Foundation in administering the science, technology, engineering and mathematics education programs contained in H.R. 362.

Let me give three reasons why I consider that to be the right decision:

- First, NSF has decades of experience working with school districts and teachers, for example, through much heralded summer institutes such as the ones you propose. (I cannot count the number of occasions when teachers came up to me and said the most important thing that happened to them during their early teaching years was the NSF summer science institutes.)
- Second, over the years, NSF has funded much of the pedagogical research that has been done in this country. Only by getting the researchers, themselves, into contact with the schools and teachers will it be possible to apply what has been learned to improve teaching and learning.
- Third, NFS (and DOE's science program) have a close relationship with most of the researchers in the physical sciences and engineering in colleges and universities where our science and math teachers get their education. Given the green light and the funding, these agencies, working with universities and colleges, can dramatically improve the education (and re-training) of future math and science teachers.
- And, I should add a fourth: namely, that the NSF and DOE's science program use a process of competitive peer review to select only the most meritorious proposals for funding. They keep the standards high. And I want to emphasize that I am not criticizing the Department of Education, which has an excellent staff and a hard job to do. But it is a different job. They have neither the experience nor the staff to take on the role of NSF and DOE's Office of Science.

In summary, I congratulate the committee for moving forward with this important legislation and want to express my appreciation for for holding this hearing and allowing me to share my views.

Thank you, Mr. Chairman.