

**TESTIMONY  
OF  
NORMAN R. AUGUSTINE  
BEFORE THE  
SUBCOMMITTEE ON ENERGY  
(COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY)  
OF THE  
UNITED STATES HOUSE OF REPRESENTATIVES**

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Good morning, Mr. Chairman and Members of the sub-committee. Thank you for inviting me to speak with you today on a subject that I consider to be of great importance to the nation: scientific research. This of course includes research related to high performance computing, the subject that I understand to be the principal focus of this hearing.

In the spirit of disclosure, I am a member of the board of directors of the Bipartisan Policy Council and co-chair of the American Energy Innovation Council, the latter is a group created by seven of us who are, or were, CEO's of non-energy companies. Our objective is to seek greater support for energy research because of its important potential impact upon the nation. I am an engineer and businessperson, not a researcher, and the views I express will be my own.

In my remarks today I would like to indicate why I consider research to be of such importance; very briefly address high performance computing; speak to the role of the National Laboratories; and conclude with an assessment of where America stands in the global, increasingly competitive research enterprise.

But first let me offer a few words about the nature of research. It is through research that scientists discover knowledge that enables engineers to create new products and services that through the efforts of entrepreneurs are introduced into the market to better people's lives. It has been pointed out, for example, that while Apple deservedly receives a great deal of credit for the iPhone, iPad and iPod, it was not Apple that made those devices possible. Rather, that distinction goes to scientists who conducted research decades ago in such fields as solid state physics and quantum mechanics. It is highly likely that as they conducted their research they had no inkling of the impact their efforts would have on products that would change people's lives; they were simply seeking to unlock secrets of nature.

I find it convenient to conceptualize research into three related categories. The first of these is purely curiosity-driven basic research—for example, studies in astrophysics of black holes. The second category is directed basic research which, for example, includes fundamental studies of the human genome with the intent of learning something useful in the prevention of cancer. The third is applied research, an example of which would be studying various materials in order to create faster electronic components to be used in high-performance computers.

Inherent to *basic* research is that one cannot know *a priori* what may be its ultimate application or impact. There is an abundance of examples of this, including research on seals in Antarctica that unexpectedly led to saving the lives of many children undergoing lung surgery; research on the chemistry of butterfly wings that led to an ingredient used in chemotherapy; or research on bacteria that cause abscesses which led to the accidental discovery of penicillin.

As to the overall importance of research, I will cite just three categories of examples. The first of these concerns the creation of jobs. In the aggregate it can be shown that adding jobs generally requires growing the nation's Gross Domestic Product. Numerous studies, one of which formed the basis of a Nobel Prize, demonstrated that 50 to 85 percent of the increase in America's GDP is attributable to advancements in just two fields: science and technology.

Further, the very foundation of advancements in science and technology is knowledge—and knowledge is the product of research.

Turning next to the subject of the health of the nation's citizenry, during the past century life expectancy in America grew from 47 years to 79 years—with much of the gain attributable to advancements in the field of medicine that were made possible through research in such widespread areas as vaccines, artificial joints, antibiotics, stents and advanced surgical procedures. Recently, when the Ebola outbreak suddenly burst forth, it was to research laboratories that the world's citizens looked for a solution—as had been the case with smallpox, polio, yellow fever, malaria, cholera and many other diseases.

Thirdly, virtually every product that we now take for granted in enhancing our everyday lives had its origin in research, whether it be television, video games, DVD's, electric lights, microwave ovens, GPS, electric cars, e-books, and much more.

Turning to the topic of research in high-performance computing, although perhaps an abstract sounding endeavor, past work related to this subject has produced extremely constructive impacts on our economy and our personal lives. It was earlier generations of such work that helped enable the human genome to be deciphered, criminals to be apprehended through computer matching of fingerprints, and medical imaging devices that “see” in three-dimensions. In my own early career as an aeronautical engineer we used giant wind tunnels requiring enormous amounts of power to determine the aerodynamic characteristics of potential aircraft designs. Today, this is accomplished in microseconds using computational methods. Given the massive databases that exist today, it is only through high-performance computing that we will be able to fully realize the benefits they potentially offer. Clean energy research is another example of a field that is highly dependent upon high-performance computing technologies.

Within the United States the Department of Energy operates 17 laboratories located throughout the country, the efforts of which are principally focused on energy research and the provision of weapons that underpin the nation's nuclear deterrent. Because the laboratories enjoy *relatively* stable funding they are ideally suited to fill a role that would otherwise be largely neglected; namely long-term, high-risk/high-payoff, often-large projects with applicability that may not be evident at their outset. Support of research in commercial nuclear fusion and hydraulic fracturing to produce shale gas would be but two examples of such endeavors.

Next, I would like, particularly given its importance, to address the health of America's research enterprise. In the past century the federal government financially supported two-thirds of the nation's research and development activity but that has gradually declined to one-third. Industry, on the other hand, has increased its share from one-third to about two-thirds. The problem is that, because of financial market pressure for rapid returns, industry focuses largely on “D,” not “R.” The result has been that in terms of arguably the most significant measure of national research investment, research funding as a fraction of GDP, the United States has recently dropped from first to seventh place in the world. Even funding of biomedical research, generally strongly supported by the public, has been cut by 22 percent in real dollars over the

past decade. The extent of America's disinvestment in research is such that America now ranks 29<sup>th</sup> among developed nations in the fraction of research that is governmentally funded. It is projected that within about five years China will surpass the U.S. in both research funding as a fraction of GDP and absolute funding. This does not portend well for national security, jobs, the economy or the physical health of the citizenry.

Finally, returning to the subject of the National Laboratories, I would call attention to the large body of research that is conducted therein that may have potential applications in industry in fields well beyond energy and national security. Unfortunately, in my view relatively little of this potential is being realized by American industry as it seeks to compete in the global marketplace. Among the many reasons for this, one is that industry, especially small firms, has little idea what research is being conducted at the national laboratories. A second reason is that well-intended conflict of interest rules make it difficult for the laboratories to work closely with industry and also discourage the best means of technology transfer, the movement of people between government and industry. Other nations seem to have found solutions to these problems, albeit not without accepting certain risks. It is my view that the national laboratories are generally well run and are a national treasure that could make an even greater contribution than is the case today.

I will conclude my remarks by addressing the question that often seems to be on people's minds when they observe my commitment to strengthening research in America. Why, they ask, would a fellow creeping up on 80-years of age, a non-researcher, view this as such a critical issue. The reason is that everything I have observed in my roles in industry, government and academia suggests that other than our freedom and Free Enterprise system, education and research are the nation's most fundamental assets.

Thank you.

**NORMAN R. AUGUSTINE** was raised in Colorado and attended Princeton University where he graduated with a BSE in Aeronautical Engineering, magna cum laude, and an MSE. He was elected to Phi Beta Kappa, Tau Beta Pi and Sigma Xi.

In 1958 he joined the Douglas Aircraft Company in California where he worked as a Research Engineer, Program Manager and Chief Engineer. Beginning in 1965, he served in the Office of the Secretary of Defense as Assistant Director of Defense Research and Engineering. He joined LTV Missiles and Space Company in 1970, serving as Vice President, Advanced Programs and Marketing. In 1973 he returned to the government as Assistant Secretary of the Army and in 1975 became Under Secretary of the Army, and later Acting Secretary of the Army. Joining Martin Marietta Corporation in 1977 as Vice President of Technical Operations, he was elected as CEO in 1987 and chairman in 1988, having previously been President and COO. He served as president of Lockheed Martin Corporation upon the formation of that company in 1995, and became CEO later that year. He retired as chairman and CEO of Lockheed Martin in 1997, at which time he became a Lecturer with the Rank of Professor on the faculty of Princeton University where he served until 1999.

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years, Chairman of the Council of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, and Chairman of the Defense Science Board. He is a former President of the American Institute of Aeronautics and Astronautics and the Boy Scouts of America. He serves on the Board of Trustees of the National World War II Museum and is a former member of the Board of Directors of ConocoPhillips, Black & Decker, Proctor & Gamble and Lockheed Martin, and was a member of the Board of Trustees of Colonial Williamsburg. He is a Regent of the University System of Maryland (12 institutions), Trustee Emeritus of Johns Hopkins and a former member of the Board of Trustees of Princeton and MIT. He has been a member of advisory boards to the Departments of Homeland Security, Energy, Defense, Commerce, Transportation, and Health and Human Services, as well as NASA, Congress and the White House. He was a member of the Hart/Rudman Commission on National Security, and served for 16 years on the President's Council of Advisors on Science and Technology under both Republican and Democratic presidents. He is a member of the American Philosophical Society, the National Academy of Sciences and the Council on Foreign Relations, and is a Fellow of the National Academy of Arts and Sciences and the Explorers Club.

Mr. Augustine has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award. He has five times received the Department of Defense's highest civilian decoration, the Distinguished Service Medal. He is co-author of *The Defense Revolution* and *Shakespeare In Charge* and author of *Augustine's Laws* and *Augustine's Travels*. He holds 33 honorary degrees and was selected by Who's Who in America and the Library of Congress as one of "Fifty Great Americans" on the occasion of Who's Who's fiftieth anniversary. He has traveled in 112 countries and stood on both the North and South Poles of the earth.