

'Copilot in chief' Augustine takes on space, energy, and education

Prior to his retirement in 1997, the aerospace industry executive advised five US presidents on science and technology policy. He's still at it 13 years later.

Since NASA's inception, through the cold war and up to the current refocusing of NASA, former Lockheed Martin CEO Norman Augustine has been there, influencing US science and technology (S&T) policy. Six years after he graduated from Princeton University in 1959 with a master's degree in aeronautical engineering, he took on his first major role in government as assistant director of research and engineering in the Department of Defense. He later rose through the civilian ranks to become Under Secretary of the US Army under Presidents Nixon and Ford.

Augustine continued to influence national S&T policy even after he returned to the private sector in 1977. In 1990 he chaired the Advisory Committee on the Future of the US Space Program, which, among other things, recommended that NASA's space shuttle be reserved for human spaceflight. And in 2005 he chaired the National Academies committee that wrote the *Rising Above the Gathering Storm* report, which led to the America COMPETES Act—the 2007 law that aims to double science research funding (see PHYSICS TODAY, September 2007, page 34); it is on track to be reauthorized this year.

Last year, Augustine chaired the 2009 Committee for the Review of US Human Space Flight Plans. Its report influenced President Obama's controversial proposal to ground NASA's Constellation Program, which had been scheduled to develop a replacement for the space shuttles by 2015 and send humans to the Moon by 2020; Constellation's cancellation may push the resumption of US human missions beyond 2030. The so-called Augustine report says that human space exploration is "not viable" at current funding levels; to become so, it would need an additional \$3 billion per year (not accounting for inflation) above NASA's \$18.6 billion FY 2010 budget request.

This year Augustine, Microsoft founder Bill Gates, and other top business executives launched the American Energy Innovation Council (AEIC), which is calling on the federal government to invest up to \$16 billion per year in clean-energy R&D. And just last



Norman Augustine talks about space exploration with students in his grandson's first-grade class in Bethesda, Maryland.

month Augustine was named to the Secretary of Energy Advisory Board, which will advise the Energy Department on basic and applied research and other policy, educational, and operational issues.

PHYSICS TODAY spoke with Augustine in August, a week after he celebrated his 75th birthday.

PT: You completed your graduate studies in aeronautical engineering around the same time NASA was established in 1958. What got you interested in science and engineering?

AUGUSTINE: My answer is going to be disappointing. Growing up in Colorado and spending a good deal of my time hiking in the mountains, I thought I wanted to be a forest ranger. But a teacher took me aside and told me that I should apply for a scholarship to either Princeton [University] or Williams [College in Massachusetts]. I wound up at Princeton, but then I found out that they didn't teach forestry, much to my chagrin. When I asked them what they had that was close to forestry, they told me geological engineering, so I took that. I did have the good fortune to have [theoretical physicist] John Wheeler as my freshman physics teacher. But at the end of my freshman year, I ran into a

guy at the train station who was studying aeronautical engineering. He made it sound so terrific, I switched my major the following week. It all shows a great lack of strategic planning, but I guess it paid off.

PT: Sticking to the science-education theme, how effective can America COMPETES be in improving the quality of math and science education in the US?

AUGUSTINE: We on the committee unanimously concluded that the single most important thing we could do to increase America's competitiveness was to improve K-12 education in math and science. I was recently looking at data from the last third of a century, and I came up with a law: For every percent you increase the spending, you actually drive down the reading score 0.04%, and no matter how much you spend, you can't change the math or science score, which is very depressing.

I say that somewhat tongue-in-cheek, of course, but the point is that while we've vastly increased the spending, we've actually driven down some scores and not affected the rest. I think the two keys to improving are to have teachers who are qualified, which is quite the exception for math and science, and to have parents who are

deeply involved in their child's education. On the former, you introduce a major factor that has made America great—the free enterprise system. You pay a good physics teacher more than you do a poor physics teacher and you pay a physics teacher more than a physical education teacher. In terms of how to increase parental involvement, that one transcends my capabilities.

PT: What role should the federal government play in ensuring that public schools have qualified science teachers?

AUGUSTINE: First, you need some form of measurement. It doesn't always have to be numerical. But if, as some claim, standardized tests cause a teacher to teach to the test, I say that's wonderful—if the test is accurately measuring the desired level of achievement. The way that's being done now is through a carrot: the Department of Education's Race to the Top [in which states compete for \$4.35 billion from the American Recovery and Reinvestment Act]. The states need the money badly enough that they're willing to make reforms that they may not have made three years ago.

PT: The America COMPETES Act also created ARPA-E, the energy research equivalent to the Department of Defense's Advanced Research Projects Agency. How effective can the so-called ARPA model be in advancing clean-energy technologies?

AUGUSTINE: I'm a great supporter of the DARPA model. When I was assistant secretary of the army, we had our own labs, but [DARPA] provided an alternative avenue to somebody with an idea, and that made our labs better. I recently attended some medical lectures, and in one talk a surgeon attributed several of the major breakthroughs in robotic heart surgery to work done through DARPA and also NASA.

But the ARPA model has certain features that have to be preserved, or it just doesn't work. Such as rotation of personnel every 3 to 5 years, no careerists; such as throwing the long ball and looking for the big breakthrough; such as focusing on problems to be solved. Universities advance science, and the ARPA's role is to apply that science to solve problems.

PT: The AEIC wants ARPA-E—which you've said is badly underfunded—to receive \$1 billion per year. How can the government afford to do that in the midst of two wars and a weak global economy?

AUGUSTINE: I get asked that a lot. As an aeronautical engineer, I found that when I was working on an overweight airplane, we never solved the problem

by taking off one of the engines. I view science and engineering as one of the engines. It's something we just have to fund if we hope to be competitive in the long term.

PT: The AEIC's position is that industry cannot take on the risk of starting the new energy economy. Is that because of the decline of the so-called Bell Labs model, in which companies took on high-risk research internally?

AUGUSTINE: I think it's a great loss not to have the Bell Labs, and the Xeroxes, and the IBMs in the form that they once existed. But I also think that model can't be sustained in today's market, where a firm must show financial improvement every quarter. That puts more responsibility on the federal government and on the universities to do the risky, long-term research. It also calls for more cooperative work between industry, academia, and government.

PT: The president's NASA budget has controversially proposed cutting the Constellation Program. Do you think the administration has effectively adopted your committee's recommendations?

AUGUSTINE: Well, at the moment there are three different visions of the space program: one in the House, one in the Senate, and one in the White House. I should emphasize that when the president asked us to do the review [of NASA's human-spaceflight programs] last year, we were asked not to make recommendations, but rather offer options. The strongest thing we had to say is that we all are space enthusiasts and favor a strong human-spaceflight program, but we are totally opposed to undertaking programs where there's not sufficient funds to do them properly. Such is the case, in our unanimous view, of the Constellation Program.

PT: If you were a member of Congress, how would you prioritize between energy and space funding?

AUGUSTINE: I get asked that a lot, too. My answer is that the question should be, If you were to spend all the money our federal government intends to spend, would you continue to spend on both energy and space at the current levels? And the answer is, absolutely yes. Instead of comparing energy and space, one has to compare each of them with the least payoff item in the entire federal budget, and then consider replacing that least effective item with energy or space projects. If we do that, there's no doubt that we can support both of these pursuits far more strongly than we now are.

PT: What is your view on the emerging commercial space sector?

AUGUSTINE: It must first justify itself

Laboratory Cryogenic Systems



1.7 K

**Improved
Performance
and Stability**

**Ideal for
X-Ray Diffraction
and Transport
Measurements**

40mW @ 2K

**Micro PL
Ultra Low Vibration
3-5nm**



**Spectroscopy
3 K — 800 K
Cryogen Free**



Advanced Research Systems
www.arscryo.com

as a business. Now, if you won't write me off as a crazy person, I do believe that the day will come when humans will go to hotels in orbit for a day or two and listen to lectures, experience weightlessness, take photos of Earth and other planets, and so on, as tourists. That's the only thing I can think of that can really drop the cost of spaceflight—like in the airline industry, you have to get the volume up.

PT: Cost aside, do you hope to become a space tourist?

AUGUSTINE: I'd love to! My father lived to be 96, my mother lived to 105, and as you know, I just celebrated a birthday. I'd be the oldest person in space by far! But I don't think a person my age has got a chance. Younger people will do it, because humans are adventurers. For example, one of my highlights this year has been a trip to Africa to track gorillas. People just love to do that sort of thing.

PT: You taught at your alma mater Princeton from 1997 to 1999. What did you teach and what did you take away from your academic experience?

AUGUSTINE: I was teaching an engineering course for both engineering and liberal arts majors. It was intended to

teach the liberal arts majors how to survive in a world that is shaped to a very large degree by engineers and scientists. And I tried to teach the scientists and engineers that just because you think you have a neat idea doesn't mean the world is going to embrace it. We dealt with project management, ethics, economics, systems engineering, and so on.

The first thing I took away was that I absolutely loved teaching. It was one of the most rewarding things I've ever done. And the second was that teaching is really hard work. I had no idea how hard it is to try to be a good teacher.

PT: How do you decide what post-retirement assignments to take on?

AUGUSTINE: One of the great things about being retired is that I can say what I think and I don't have to defend someone else's position. In whatever time I have left, I will continue to pursue activities that meet one or more of the following three criteria: First, they have to offer the possibility of contributing to something important; second, they have to be something that I would enjoy doing; and third, they are often something I am doing for a friend.

Jermev N. A. Matthews

ronmental Protection Agency (EPA), the US Geological Survey, and NASA, also have been deploying scientists and research assets to the Gulf. Six of NOAA's eight Atlantic fleet research vessels and numerous aircraft were deployed to collect data and images of the slick and provide input to models that tracked its spread. An interagency effort led by NOAA produced the government's controversial early August analysis estimating that of the 4.9 million barrels of oil that spewed from the damaged well during nearly three months, only 26% remained in the Gulf. NASA's Multi-angle Imaging Spectro-radiometer provided dramatic false-color views of the spill from the orbiting *Terra* spacecraft. An EPA review of dispersants found that the product used by BP was no more toxic than alternative chemicals.

But academic researchers say RAPID may be the sole program among federal agencies that can respond so quickly to their needs. "Typically, research proposals require months for turnaround. Weeks would be considered fast; days is astonishing," says Richard Camilli of the Woods Hole Oceanographic Institution. Camilli was the principal investigator for one of three RAPID-funded research teams that crowded aboard the NSF-owned *Endeavor* in the Gulf.

Ephemeral data

Dennis Wenger, NSF's disaster program manager, says the foundation has a history of accommodating researchers who must gather their data during or soon after a disaster. Until a few years ago, such "ephemeral data" grant proposals were lumped in with requests for funding high-risk, high-impact research in a program known as Small Grants for Exploratory Research (SGER). What the otherwise disparate types of proposals share is a need to be reviewed outside NSF's external peer-review process, which, NSF officials

NSF speeds funding for research on BP oil spill

Sopping up oil with new materials, mapping the subsurface plume, and accelerating biodegradation of the slick are among dozens of time-sensitive research projects receiving grants.

For David Schiraldi, a chemistry professor at Case Western Reserve University, getting an NSF award to study a novel material for soaking up oil was "phenomenal." The entire process, from filling out the brief five-page application "in one sitting" to receipt of his funding, took less than a month. It was, he says, "the best grant experience of my career."

Schiraldi's experience is being shared by dozens of other academic scientists who are studying various impacts from the millions of barrels of oil that spewed from BP's blown well in the Gulf of Mexico in April. The disaster has spotlighted a special grant mechanism, known as Rapid Response Research (RAPID) that NSF has used to support urgent research that can't wait for the agency's standard proposal-review process. The environmental calamity in the Gulf, when combined with the Haitian and Chilean earthquakes, has made 2010 a busy year for RAPID awards. As

PHYSICS TODAY went to press, NSF had awarded a total of \$8.9 million for 79 such grants in connection with the BP spill; the bulk of that supports researchers who are gathering data as the event continues to unfold.

To be sure, other federal agencies, including the National Oceanic and Atmospheric Administration, the Envi-



Three research teams sailed aboard the NSF-owned research vessel *Endeavor* in June and collected samples of and data on oil-contaminated waters in the Gulf of Mexico.