

SPEECH

The Perfect Storm: A Weather Forecast

By

Shirley Ann Jackson, Ph.D.

President, Rensselaer Polytechnic Institute

American Association for the Advancement of Science Annual Meeting

Seattle, Washington

Saturday, February 14, 2004

7:00 a.m.

Good morning. [Good **early** morning!]

I am very pleased to be here with you. The long history of this particular AAAS gathering has established a venerable and valuable tradition—the bringing together of individuals from varying backgrounds, disciplines, generations, and geographies who have common interests and concerns about participation in the sciences, and the inclusiveness of that participation.

This morning I am going to address an issue I have been discussing for several years—the need to guarantee our national capacity in science, mathematics, engineering, and technology. It is something on which we all need to work together.

More than that, however, it requires a full-fledged national commitment.

This problem can only be solved if we have a dramatic increase in participation by underrepresented groups.

Young women and minority youth are now the demographic majority in our country, but they represent only a small fraction of the scientists and engineers. We must tap this group if we are going to guarantee our national capacity.

The details of this are outlined in a report issued today from BEST—Building Engineering and Science Talent, spawned by the Council on Competitiveness.

The report, ***A Bridge for All***, calls for the commitment of national will to assure that we have the national science and engineering capacity to carry us through this century. It, also, tells us what is required to make this happen. ***A Bridge for All*** lays out proven principles for programs which build the inclusive participation which brings us together, here, this morning.

But, I am getting ahead of myself.

Let me begin, instead, with a story which delineates the framework for understanding why ***A Bridge for All*** is so important. It is a story familiar to many,

because it was a popular book and, later, became a movie. It also was a real event, affecting real people.

It is the story of the “Perfect Storm.”

Just before Halloween in 1991, the convergence of unprecedented meteorological circumstances gave rise to an epic storm, in the northeast Atlantic Ocean. Meteorologists later dubbed it the “Perfect Storm,” because it was, in their parlance, “a monster” —a storm which, because of its power and its rarity, could not possibly have been worse.

On October 27, strong disturbances associated with a cold front moved along the U.S.-Canadian border. Satellite images revealed that the front’s leading edge, situated over Indiana, contained a “bend”—a pocket of low barometric pressure called a “short-wave trough”— embedded at about 20,000 feet. A short-wave trough is the embryo of a storm.¹

The front, carrying the trough, moved northeast at 40 mph, cutting due east at Montreal to cross northern Maine, the Bay of Fundy, Nova Scotia, and on out to sea. As the upper-level trough strengthened, it gave way to a surface low pressure system, with warm air rising rapidly. Barometric pressure fell rapidly, at more than a millibar per hour, which led to rapid intensification.

At the same time, a huge high pressure system was building over southeast Canada. As the low pressure system moved into the Maritimes and encountered the cold, dry air introduced from the north, it grew rapidly.

This alone would have created a huge storm. But, the remnants of hurricane *Grace*, moving into the region from the south and carrying warm tropical air, fed its considerable energy into the two Canadian systems.

The result was like throwing gasoline on a fire. The explosive convergence of systems created a storm unlike any seen in 50 to 100 years. Over six days, the storm tracked, first northeast and then retrograded in a figure eight, from Newfoundland’s Grand Banks south and west, to the U.S. coastline, and then north and east again to re-cross Nova Scotia.

It packed winds of 150 miles per hour and seas bearing 70 foot waves. It caused billions of dollars in coastal damage from Florida to New England. It wrecked havoc with the U.S. fishing fleet, prompting daring rescues by the Air National Guard. One vessel, the *Andrea Gail*, headed home to Gloucester, Massachusetts, with a hold full of swordfish, was lost, including its entire crew of six men.

¹ Junger, Sebastian. *The Perfect Storm*. W.W.Norton & Co.: New York, 1997.

This epic storm was caused by an unprecedented set of meteorological circumstances—a high-pressure system, a cold front, a storm embryo, and a dying hurricane, crossing and re-crossing the warm Gulf Stream—converging at the same time and place. And, its force and destructiveness was unparalleled.

I retell the story of the “Perfect Storm” because another unique, though different, set of circumstances is building in the United States with potentially also devastating results. Unless we do something about it.

This other “Perfect Storm,” comes not from meteorological patterns, but by the convergence of societal forces—demographic, educational, cultural, economic, and global. They, too, are unprecedented, and, they, too, are potentially, explosive.

Let me explain.

The engine of our national economy, upon which our safety and security, our wellbeing, our quality of life, and our global competitiveness, indeed, our national preeminence depends, is powered by the technological and scientific discoveries and innovations made by scientists and engineers.

These important people form a very small segment of our national workforce—only about 5 percent. When the nation has sufficient numbers of them to keep our national capacity at peak performance, we might describe the outlook, in meteorological terms, as optimal—“sunny and clear.”

To maintain optimal “weather” conditions, we must assure that the current cohort of scientists and engineers are not only being replaced in sufficient numbers, but are increasing, since we increasingly must rely upon our own talent.

This is not happening. And, it this is a storm embryo forming on the horizon. Let us take a quick look.

As it happens, the U.S. scientific and engineering workforce is aging. The number reaching retirement age is likely to triple in the next decade.² This is compounded by another fact. For years, government and corporate requirements for specialized science and engineering skills have been filled, when **needed**, by foreign nationals. But, since September 11th, 2001, visa applications have declined dramatically, while at the same time, forces at work in the global economy are creating opportunities which encourage foreign scientists to find employment in their home countries.

² National Science Board, *Science and Engineering Indicators 2002*.

Fewer American students are studying science. Undergraduate student enrollments in engineering and the physical sciences are static or declining, and have been for a number of years. Computer science degrees decreased steadily between 1985 to 1995. The only fields showing an increase have been psychology and the biological sciences.³ This trend is compounded further by a decline in foreign students attending American universities, again, because of new national security restrictions, and increased opportunities for higher education and employment at home or elsewhere. Nationwide, university and college enrollment management officials report a drop in foreign graduate student applications of as much as 40 percent.⁴

We begin to see a cold front moving in to feed the low-pressure system.

Where should we turn for the science and engineering workforce of the future? What about our own talent supply?

We have plenty.

But national demographics are shifting. In the last decade, as the U.S. population grew from 249 million to 281.4 million, the minority population increased 35 percent overall. While the non-Hispanic white population grew only 3.4 percent, the Hispanic population grew by 58 percent, Asian Americans by 50 percent, and African-Americans by 16 percent. Since our traditional science, mathematics, engineering, and technology (SMET) workforce is nearly 82 percent white and more than 75 percent male, it appears unlikely that we can replace it with a similar population.

And so, when we look to the available talent pool, it looks very different from the cohort that they will replace. Minority youth and young women, groups traditionally underrepresented in the sciences and engineering professions, now form the majority—what I call “the new majority” – the underrepresented majority. They have the talent, it needs only to be engaged, encouraged, nurtured, and prepared.

Will that happen?

International comparisons show that our eighth graders are at, or below, international averages, and that our high school seniors are near the bottom⁵, despite the fact that we spend more than all, except Denmark and Switzerland, on education. And, since as a rule, minority youth and young women often are even farther behind the national average, we begin to see that the “new majority” generation is under-prepared to fill the void left by the retiring scientists, engineers, and technologists.

³ Statistics taken from Convergence speech to GE Corporate Executive Council December 2, 2003.

⁴ From Therea Duffy.

⁵ Third International Mathematics and Science Study, 1999.

You can see powerful forces converging, feeding energy into the storm mix, and their collision, could be unforeseen consequences.

This confluence leads us to some critical questions: Who will do the science? Who will be the next generation of scientists and engineers? How will the nation maintain its capacity, its national competitiveness, its global economy, its international preeminence? **And**, how will the United States safeguard its homeland, without those who create the evolving technologies to detect and to protect against terrorists' threat?

How, for instance, can we even discuss preparing for human exploration of the Moon and of Mars without discussing who will do the science to get us there?

How will we solve the technical, economic, and infrastructure barriers standing in the way of hydrogen as a viable fuel source that could improve the U.S. energy economy, reduce air emissions, and expand domestic energy resources?⁶

What about the urgency to develop vaccines to combat HIV/AIDS? Or, Severe Acute Respiratory Syndrome (SARS)? Or, the virulent new strain of avian influenza virus, suddenly, making an unusual leap to humans?⁷ Or, bovine spongiform encephalopathy (mad-cow disease) and its human variant Creutzfeldt-Jakob disease? And the biodefense need for advances in the basic biology of little-studied pathogens for diseases including plague, anthrax, tularemia, botulism, and hemorrhagic fevers.⁸

. . .and, many other similar questions. . .

This "Perfect Storm" is not one which will build over a mere six days. Unchecked, this "perfect storm" will unfold over many years. It could be called the "Quiet Storm" or the "Quiet Crisis". It already **is** unfolding. It takes several decades to create or to build a scientist. So, the convergence of forces will create a lasting storm, with lasting impact our national security, national competitiveness, affect our health and wellbeing, our way of life, even our democracy.

Meantime, other nations have national plans in place to build their own capacity.

⁶ NSF report. 02-04-04.

⁷ Normile, Dennis, **INFECTIOUS DISEASES: Stopping Asia's Avian Flu: A Worrisome Third Outbreak**. *Science* 2004 303: 447a-.

⁸ *Science* 2003 December 19; 302: 2040

This “Perfect Storm”—is creating a risk which, as a nation, we cannot allow without taking action.

The **risk can be mitigated if we assure that the “new majority”**—young women and minority youth—**is well prepared** for careers in science, engineering, and technology. The BEST report, **A Bridge for All**, to which I referred at the outset, tells us, clearly, how to accomplish this at the higher education level. [Two other reports covering similar issues in Pre-K through 12 education, and the Workplace, are forthcoming.]

The **risk can be mitigated by** a full-fledged, **national commitment** to develop the talent inherent all our young people.

This **risk can be mitigated** at the **higher** education level by programs developed with the principles distilled from the BEST study.

Ultimately, it will require a national commitment to coordinate federal and state policy and resources and the active involvement of the corporate community and higher education.

History tells us that this can be done. A national commitment inspired by the Soviet launch of Sputnik swept me and many of my generation into breathtaking careers in science and engineering. The nation, of course, was ultimate beneficiary.

The story of the “Perfect Storm” tells us that we need a similar national commitment, immediately—this one, specifically, to include the diverse talent pool which makes up the new majority of our youth.

So, today, I am urging our nation’s educators, business leaders, and policy makers to make that commitment to assure that the United States does not lack for the world class science and engineering enterprise it must have to maintain its preeminence.

I anticipate that I will be calling upon all of us, here, and the entire science and engineering community to address this issue. We can create a national leadership coalition to address “The Perfect Storm,” and this is an issue I will focus on during my AAAS presidency.

A Bridge for All gives us a road map of what works.

The question before us now remains, will we do it?

Thank you.

~ END ~

[Question and Answer session. Dr. Jackson moderating:]

I will be happy to answer questions about the development of **A Bridge For All**. With me are:

- Dr. Wanda Ward, BEST's chief advisor for 18 months, on detail from the National Science Foundation.
- Dr. Daryl Chubin, senior vice president of NACME and a BEST project integrator. Dr. Ward and Dr. Chubin know the particulars of **A Bridge for All** inside out. . . .
- . . .as does Dr. Shirley Malcom, co-chair of the BEST research board, who will provide additional back-up.