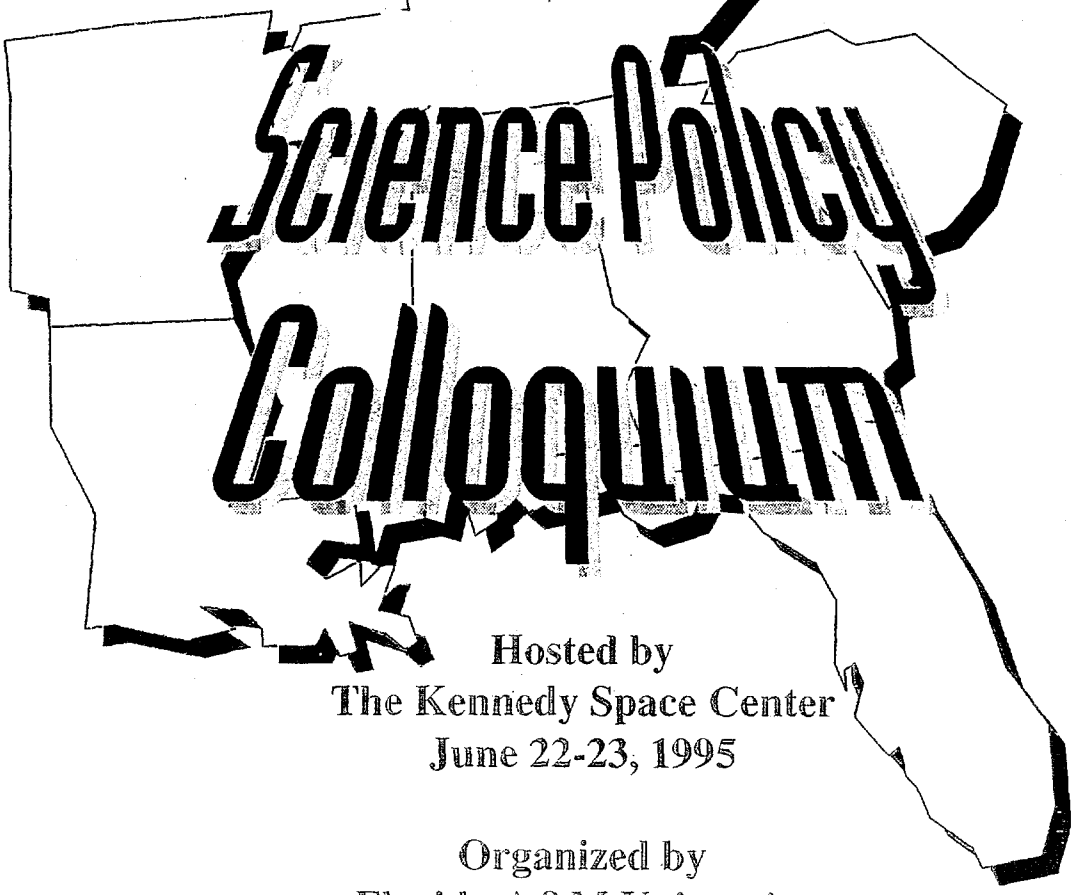
Science in the National Interest

A Southeastern Science Policy Colloquium



Hosted by
The Kennedy Space Center
June 22-23, 1995

Organized by
Florida A&M University
Tallahassee, Florida

Science in the National Interest

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Colloquium Proceedings

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DISCLAIMER

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Statement from the President and Vice President

"Technology - the engine of economic growth - creates jobs, builds new industries, and improves our standard of living. Science fuels technology's engine. It is essential to our children's future that we continue to invest in fundamental research. Equally important, science and mathematics education must provide our children with the knowledge and skills they need to prepare for the high-technology jobs of the future, to become leaders in scientific research, and to exercise the responsibilities of citizenship in the twenty-first century."

President William J. Clinton

Vice President Albert Gore, Jr.

Science in the National Interest
August 1994

Planning Committee
Science in the National Interest

Dr. Frederick Humphries
President
Florida A & M University

Dr. Raymond Bye
Interim Associate Vice President
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Florida State University

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Kennedy Space Center/NASA

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Florida A & M University

Dr. Herbert Jones
Florida A & M University

Dr. Don Meadows
Director Lean Enterprise
Strategic Planning
Lockheed Aeronautical Systems

Dr. Lynette Padmore
Florida A & M University

Dr. Decatur Rogers
Dean
College of Engineering and Technology
Tennessee State University

Acknowledgments

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National Science Foundation
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Kennedy Space Center of the
National Aeronautical and Space Administration

Florida A & M University and the Planning Committee acknowledge the contributions of the Office of Science & Technology Policy (OSTP) in stimulating the interest for this regional conference and for its valuable assistance in bringing these issues to the attention of the nation.

Kennedy Space Center

The John F. Kennedy Space Center (KSC) under the direction of Jay Honeycutt, Center Director, is NASA's principal launch base. The Center was originally established in the early 1960's as the launch site for the Apollo lunar landing mission. After the Apollo program was concluded in the 70s, the Center's facilities were modified to house the Space Shuttle program. Since the initial Space Shuttle launch in 1981, there have been 60 shuttle missions and current forecast calls for the launch of approximately 7 missions per year.

KSC is NASA's prime center for the test, checkout and launch of payloads and space vehicles and oversees NASA missions launched from Cape Canaveral Air Station, FL and Vandenberg Air Force Base (VAFB) in California. The Center is responsible for Space Shuttle vehicles and turnaround of Shuttle Orbiters between missions as well as operation of the KSC Vandenberg Launch Site Resident Office located at VAFB.

Situated on Florida's central Atlantic coast, KSC occupies 140,000 acres of land and water on Merritt Island and the adjacent areas surrounding the facility. A small portion of KSC is actually used for space operations; the balance is managed by the U.S. Department of Interior as a wildlife refuge and natural seashore.

Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1076 (Public Law 94-282.) The OSTP has the following key role:

⇒ to advise the President in policy formulation and budget development on all questions in which science and technology (S&T) are important elements.

⇒ to lead an interagency effort to develop and implement S&T policies and budget that are coordinated across Federal agencies.

⇒ to articulate the President's S&T policies and programs to the Congress, and address and defend the need for appropriate resources.

⇒ to foster strong partnerships among Federal, State, and local government, and scientific communities in industry and academe.

⇒ to further international cooperation in science and technology activities.

The OSTPs Director, John H. Gibbons, also serves as the Assistant to the President for Science and Technology. In this capacity, he manages the National Science and Technology Council (NSTC) and the President's Committee of Advisors on Science and Technology (PCAST).

Florida Agricultural & Mechanical University

Florida A&M University (FAMU), founded in 1887 as the Colored Normal School, is one of the three oldest universities in the ten institution Florida State University System. Following the enactment of the Morrell Act of 1890, the role of the institution was changed to the status of an 1890 Land Grant College. In 1909, the State Legislature changed the name to Florida Agricultural and Mechanical College, and, it was also during this year that the college conferred its first baccalaureate degree. In 1953, the State legislature changed the name to Florida Agricultural and Mechanical University (FAMU) and the institution was organized into what is now twelve schools and colleges.

As a land grant institution, FAMU offers a wide selection of programs. Baccalaureate degrees are offered in sixty-three fields and Master's degrees in twenty-one fields. These degrees are offered in such areas as pharmacy, engineering, agricultural sciences and engineering technology, biology, chemistry, physics, mathematics, and computer science. The doctoral degree is offered in ten disciplines in the areas of pharmacy and pharmaceutical sciences, electrical, chemical and mechanical engineering.

In the Fall of 1996 Florida A&M University enrolled 10,700 students in undergraduate and graduate programs. Approximately 87% of the student population is Black and approximately 67% of the students are Florida residents. The University is fully accredited by the Southern Association of Colleges and Schools with the most recent accreditation visit taking place in Spring 1998.

A major component to the development of FAMU as a comprehensive university is the development and implementation of a competitive research effort and the development of the associated research facilities. Under the leadership of Dr. Frederick S. Humphries, the university has more than tripled its research base. The faculty in the colleges of engineering, pharmacy and pharmaceutical sciences, engineering technology, agriculture and arts and sciences have been successful in attracting almost $40 million in funding from state and federal agencies for research and training.

The past decade (1987-1997) at FAMU is a reflection of the progress and growth that has always been an integral part of its mission. FAMU was named "College of the Year" by Time Magazine - Princeton Review for the 1997-98 school year. The University was also honored as producing more African American baccalaureate graduates than any other institution. Today, 110 years after its beginning, Florida A&M University is respectfully referred as the "fastest growing school in the country". FAMU is an HBCU leader, a key educator in the state of Florida and formidable competitor in the national and international research arena. The university is confidently positioned to take a firm and decisive step into the 21st century.

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Colloquium Program

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Moderator: Frederick S. Humphries
President
Florida A&M University
Tallahassee, FL

Speaker: David Mulkey
Professor
Department of Food & Resource Economics
University of Florida
Gainesville, FL

Topic: The South in Transition: Are we really Half-way Home?

Panel I: Southeastern Labor Market and its Impact on Corporate/ Insustry Development

Moderator: Catherine LeBlanc
Executive Director
White House Initiative on HBCUs
Washington, D.C.

Speakers: Heinz Niethammer
Director of Engineering
Kimberly-Clark Corp.
Roswell, GA

Jack Crow
Director
National High Magnetic Laboratory
Tallahassee, FL

Ronald Rasmussen
Chief Engineer
Honeywell, Inc.
Clearwater, FL

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Panel II: New Issues for Science and Technology in the Year 2000 and Beyond

Moderator:
Suzanne Allen
Vice President for Research
Tulane University
New Orleans, LA

Speakers:
Martha Krebs
Director, Energy Research
Department of Energy
Washington, DC

Cathie Woeteski
Interim Associate Director, Science Division
Office of Science Technology Policy
Executive Office of the President
Washington, DC

Paul Waugaman
Southern Technology Council
Research Triangle Park, NC

Russell Wright
Acting Director
Environmental Services Division
Environmental Protection Agency
Atlanta, GA

Dinner

Speaker:
Charlie Backof
Vice President and Director of Research
Radio Products Group, Land Mobile Products Sector
Motorola, Inc.
Ft. Lauderdale, FL

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General Session

Moderator: Decatur Rogers
Dean
College of Engineering & Technology
Tennessee State University
Nashville, TN

Keynote Speaker: M.R.C. Greenwood
Dean
School of Graduate Studies
University of California
Davis, CA

Panel III: The Role of Academia in Developing the Labor Force of the Southeast

Moderator: John Wolfe, Jr.
President
Savannah State University
Savannah, GA

Speakers: Barbara Hatton
President
South Carolina State University
Orangeburg, SC

Donald Zacharias
President
Mississippi State University
State College, MS

Frederick S. Humphries
President
Florida A&M University
Tallahassee, FL

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Panel IV: K-12 Education: Challenges for the 21st Century

Moderator:
Melvin Gadson
Dean
College of Education
Florida A&M University
Tallahassee, FL

Speakers:
Helen Blanch
Supervisor for Instructional Technology
Dade County Public Schools
Miami, FL

Weyman Patterson
Coordinator, Math & Science
Atlanta Public Schools
Atlanta, GA

Donald Cotten
Executive Director
Public Education Forum
Washington, DC

Luncheon

Moderator:
Nat Frazer
Associate Director
Savannah River & Ecology Laboratory
Department of Education

Speaker:
John Gibbons
Science Advisor to the President &
Director of White House Office of
Science and Technology Policy
Washington, DC

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Moderator: Joseph Johnson
Distinguished Professor of Physics
Florida A&M University
Tallahassee, FL

B - Higher Education

Moderator: Richard Hogg
Provost
Florida A&M University
Tallahassee, FL

C - K-12 Education

Moderator: Melvin Webb
Professor of Biology
Clark-Atlanta University
Atlanta, GA

Session Reports

Conference Wrap-up

Moderator: Frederick S. Humphries
President
Florida A&M University
Tallahassee, FL

Adjourn

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Panel I: Southeastern Labor Market and its Impact on Corporate/Industry Development

Panel II: New Issues for Science and Technology in the Year 2000 and Beyond

Panel III: The Role of Academia in Developing the Labor Force of the Southeast

Panel IV: K-12 Education: Challenges for the 21st Century

Colloquium Breakout Sessions

A - Industry/Corporate/National Laboratories

B - Higher Education

C - K-12 Education

Colloquium Participants

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New Orleans, LA

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Paul Waugaman
Southern Technology Council
Research Triangle Park, NC

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Executive Office of the President
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John Wolfe, Jr.
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Russell Wright
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Environmental Services Division
Environmental Protection Agency
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Donald Zacharias
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State College, MS

Keynote Presentations

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Keynote Presentations

Charles Backof
Vice President and Director of Research
Motorola Radio Products Group
Plantation, FL

John H. Gibbons
Assistant to the President
for Science and Technology
The White House
Washington, DC

M. R. C. Greenwood
Dean
Graduate Studies
University of California - Davis
Davis, CA

Donald Mulkey
Professor
Department of Food and Resource Economics
University of Florida
Gainesville, FL

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Keynote Address: Challenges in Recruiting for a Technology Based Business

Charles Backof
Vice President and Director of Research
Motorola Radio Products Group
Plantation, FL

This evening I'm going to talk to you about a survival issue - the survival of the United States as the economic leader of the world. The solution begins with us - leaders of industry, leaders of technology, and leaders of education. The outcome depends on our ability to work together as partners and agents for change.

My company, Motorola, has a history of continuing to renew itself to survive and prosper in this world. We went from vacuum tubes to chips. We got out of the TV business to concentrate on commercial and industrial electronics. We embraced a culture of total quality. Today, we continue the process of creating new technologies in a global marketplace.

And now, we in the United States confront the issues of job creation, economic growth and competitiveness. As a nation, we must reinvent and renew our institutions. We must be prepared to transform the way schools and companies work together to provide the skills needed by our most essential resource - our people.

Before I tell you how Motorola has changed, I'll give you a sketch of the company. Our annual sales are about $22 billion, and growing at more than 15 percent a year. About one-third of our sales are in semiconductor chips and more than half are in wireless communications, such as pagers, cellular telephones and two-way radios. We have 132,000 employees, and 56 percent of them are in the United States. But more than half our sales are outside the United States.

I began this talk with the Iridium Vision video to illustrate our business today. Customers for our products are global. Competitors from around the world are eager to serve them. To succeed, our design and manufacturing teams must be the best in the world. Our business organization model is one of local teams of world class people, serving global customer needs.

Motorola has three major design centers in the Southeast region: in Huntsville, Alabama; near Atlanta; and in South Florida. The oldest and largest of these is in South Florida. From its beginning 25 years ago, this site grew to a total technical staff today of about 2000 people. For the last 11 years, I have been part of the technical staffing effort there.

As a customer of engineering colleges and universities, I can tell you what we look for in our new employees. We see them as members of high-performance work teams that serve customers in a rewarding, productive environment. They must have problem-solving and complex thinking skills.

Regardless of level or professional training, they must be creative, receptive to new ideas, cooperative and participative - people who enjoy the spirit of the team and thrive in a climate of lifelong learning. We need people with high expectations of quality and product leadership. We need people who communicate well, both orally and in writing, in many cases, in more than one language - people who respect the differences in other cultures and can harmonize their thinking with those of others.

Above all, we need people who realize that education is a life-long experience of continuous renewal. We need bright people who discovered, early in their education, that science and technology are exciting and worth pursuing as a career. The half-life of the knowledge of an engineer is four or five years, so skills and knowledge must be continuously updated. Today's engineering student may ultimately change technology focus five or six times in the course of a career. Individual skills are less important than the willingness to adapt and learn.

How do we recruit engineering graduates who fit this model? Of course, we expect high scholastic achievement to show good study skills and a strong grasp of engineering concepts. But the key success factor beyond grades is training in problem solving. We find that this training comes from hands-on experience in labs and with computers, where students learn the relevance of the abstract concepts. Engineering schools with strong graduate programs excel in this area.

Every year, U.S. News and World Report rates engineering graduate schools. We find that undergraduate and graduate students from the highest ranked schools perform the best in our work environment. Of the 50 top engineering schools in their survey, only two are in the Southeast Region: Georgia Tech, and University of Florida. So the major challenge for us in the Southeast is that there are simply not enough strong engineering schools.

Traditionally we sent campus recruiters to the top schools around the country. We interviewed many students, but actually hired very few. We looked into this problem and found several reasons. First, many other recruiters were there at the same time, and it was difficult to differentiate our company from the others. Once we made job offers, we had a low acceptance rate, due to low interest in working in the Southeast Region, and lack of advanced engineering degree programs here. But our most surprising finding was that the very best students were not interviewing on campus at all. They had already found jobs through a co-op or work-study program.

So we changed our recruiting strategy. To address the issue of access to high quality advanced degrees, we developed a visiting faculty program with the University of Florida. Each semester, a professor from Gainesville teaches a graduate class at our Plantation, Florida facility, near Ft. Lauderdale. These live courses are supplemented by video taped courses, so that Motorola students may complete Master's Degree requirements at their own pace. We also conduct sponsored research with the professors, and now have several Doctoral research programs underway.

Another change in recruiting strategy was to develop an engineering summer intern program, aimed at undergraduate and graduate students from the South East. They are enrolled in engineering schools throughout the country, and are in the early part of their studies. This program has been in place for six years, and we and the students are very happy with the results. It is now our preferred recruiting method.

Students are strategically recruited to meet our future needs in computer, mechanical and electrical Engineering. We specifically recruit to assure a diverse and vital work force. We get students who are familiar with the area, familiar with our work, and interested in returning here after graduation. The students get hands-on experience in labs and with engineering computers, to supplement what they learn in school. They learn the skills and behaviors needed to succeed at work, and they can decide before graduation if they've made the right career choice. They also learn the limits of their knowledge, and start to appreciate the value of advanced degrees.

This summer, 54 students are in our intern program. All have excellent high school records, and maintain at least a 3.0 grade point average in their college studies. Two-thirds are from the top fifty schools mentioned earlier, and 20 percent are in graduate programs. The strength of the program lies in the quality of the students, careful selection of job assignments to supplement academic studies, and Motorola's commitment to the program objectives.

Working with students already in engineering schools is not enough. We must also help students in grades K through 12 to develop an interest in science and technology. We started several programs with middle and high school students to do just this.

Our Youth Motivator program provides students at risk of dropping out with role models and tutoring support. Motorola volunteers help students in their schools to develop a sense of accomplishment and self esteem. Our Plantation Associates Student Tutoring program brings employees' children into the facility after hours for tutoring in any subject. Our volunteers show the students the workplace environment, and help them with instructional guidance.

The Earth Generation Curriculum is an environmental course developed jointly by Motorola, the National Audubon Society, and the federal Environmental Protection Agency. It teaches middle school students, through practical exercises, about our environment. It is intended to show students that science and technology can be used to solve real world problems.

The skills required for factory workers are changing dramatically. Ten years ago, we hired people to perform set tasks and didn't ask them to do much thinking. A few years ago, we gave a basic skills assessment to 180 employees as part of the staffing process for a new factory. Only 15 were able to do basic math problems involving percentages, decimals and a simple bar chart.

Today, in the United States, we test new operators for reading comprehension at the ninth-grade level and math skills at the seventh grade level. They must be able to solve basic problems, both as individuals and as members of a team. Those requirements will continue to rise. In Malaysia, we recruit factory workers with reading and math skills at the eleventh-grade level. And they pass. That's a sobering fact for anyone concerned with U.S. competitiveness. So you can see, the challenge isn't just from Japan, It's coming from developing countries where students perform very well. The electronics industry doesn't put up factories in low-wage regions any longer; the industry now builds new factories in high-skill regions.

More than sixty years ago, in the industrial age, Motorola started making car radios, and we grew and prospered in an age of mass production. Today, in the information age, we put a million transistors on a chip of silicon the size of your fingernail. We build products that are tailored to individual customers, and we design individual systems. The jobs have changed as much as the products. The people who perform those jobs are committed to life-long learning.

This is not only a story about Motorola but a message for you and this nation. Workforce 2000 is a reality; we can no longer skim the labor market. For America to remain competitive in the global economy, it must have a world class work force; one composed of individuals who are highly skilled in reading, writing, and computation; who can also think critically, analyze and solve problems and work together productively in teams.

Let us also work together to enhance the quality of our public education system to ensure work force readiness - again, for a more competitive America. Let's develop our young people for citizenship, employability, and life-long learning. Let's try different teaching methods which encourage creativity and innovation rather then rote learning. Let's link math and science to real world experiences to make it relevant and fun. Let's reward outstanding teachers. Let's provide schools with the labs and computers so students can apply their skills. Let's revise the job description of every principal and superintendent from that of administrator to that of a leader and change agent!

I began this talk with a vision of a satellite system. I'll end it with a challenge. In our lifetime, a revolution in the way we live and learn and work will happen. It has already begun. We in the Southeast Region can watch the revolution unfold, or we can lead it. The choice is ours.

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Videotaped Remarks

John H. Gibbons
Assistant to the President for Science and Technology
The White House
Washington, DC

Good afternoon to my colleagues in the Southeast. I am most sorry I am not able to join you today to discuss the importance of science, technology and education and their critical contributions to the welfare of our nation and to your region of the US. I send my deep appreciation to President Humphries and the University, industry and government members of the planning committee. You have organized a wonderful symposium to bring together representatives of each sector to share perspectives on the challenges of the future and the crucial role of research and educational partnerships in addressing our concerns.

We are experiencing truly historic times for science and technology. Even as we evaluate all the spectacular research advances and achievements of higher education in the past 50 years since the pathbreaking report, Science: The Endless Frontier, the Congress is talking about changes in science and technology greater than any seen in these past five decades.

Education, science and technology are at the center of the Clinton administration's vision for the nation. They represent, in the purest form, the kinds of investments that the President and Vice President believe will ensure our leadership into the 21st century. They convey a message of hope, of continuous self-renewal. As Ralph Waldo Emerson wrote, "[We] love to wonder and that is the seed of our science."

Benefits of Science and Technology

Let us remind ourselves, as educators and researchers of the many, benefits of science and technology. Economists tell us that as much as half of growth in our economy per capita comes from technological advances.

Improvements in health can also be quantified. Just a little over a hundred years ago, almost half of all people died before the age of 45. The leading cause of death in this country was tuberculosis. You can go to 19th century graveyards all over the country, and read in the tombstones the record of an age when every cough held the possibility of a life-threatening disease.

Today, 90 percent of everyone born lives beyond the age of 45. And the campaign of biomedical science against disease continues to pay great dividends. Life expectancy in America has gone up by five years since 1970, five more years that grandchildren get to know the oldest members of their families.

We need to show that advances in science and technology affect us everyday. We need to show the lives of stroke victims who avoid disability because of clot-busting drugs, in the millions of individuals who sit down at their computers every day to build communities with people thousands of miles away, in the more efficient, safe, and less polluting cars we drive, in the compact disks we have so quickly come to take for granted.

The many contributions by science and technology have created an immense social transformation. Vannevar Bush recognized this almost half a century ago. In his autobiography, he wrote, "The greatest event in the world today is not the awakening of Asia, not the rise of communism-vast and portentous as those events are. It is the advent of a new way of living, due to science, a change in the conditions of work and the structure of society."

Yet paradoxically, just as science and technology are enabling us to enter a period of unprecedented productivity, the bipartisan support for science and technology seems to be crumbling. Congress is considering a series of proposals that would sharply reverse this nation's record of investment in science and technology. In its quest to balance the budget, Congress is talking about cuts that would wipe out a third of our civilian science and technology investments in four years. It would slash and even abandon broad areas of research that are vital in understanding how the world works and how to build our economy. We would sink far below other industrialized nations in the percentage of our gross domestic product invested in research and development.

In an "illustrative list" of cuts for next year's budget, the chair of the House Budget Committee has proposed reducing federal research and development $2.5 billion. More than half a billion of the cuts for the next year come from the National Institutes of Health, with $2.5 billion in cuts over five years. Agricultural research declines by $1.3 billion over five years.

Early on, the Clinton Administration set specific goals for science and technology. These goals include maintaining leadership across the frontiers of scientific knowledge, enhancing connections between fundamental research and national goals, producing the finest scientists and engineers for the 21st century and raising the scientific and technological literacy of all Americans. At the same time, this Administration has been working through the government from top to bottom to streamline operations. No aspects of how we invest the public's funds can be exempt from close scrutiny. In science and technology, each and every activity is in the process of being closely examined.

Take NASA as an example. The Vice President's Reinventing Government initiative is in the process of paring billions of dollars from the agency while simultaneously returning it over a sequence of years to a premier R&D institution focused on cutting-edge research and development.

Throughout the federal government, the number of federal civilian and military jobs is well below the peak of the Reagan years. The Reinventing Government initiatives already have pared more than 100,000 jobs from the federal bureaucracy.

And we should remember that this Administration has made very real progress in reducing the deficit. If not for the interest on the multi-trillion debt run up during the Reagan and Bush years, the federal government would be running a surplus right now.

A Focus on Technology

I want to say a word about our technology initiatives, because this Administration has made technology development a major focus. This decision reflects our belief that we are entering a world increasingly dominated by the advancement of knowledge. Individual firms in today's

fiercely competitive market cannot capture much of the return of new fundamental knowledge. Knowledge therefore becomes in part a public good, and the only way to ensure adequate investment in a public good is through public investment.

This is nothing new in our history. In 1842 Congress appropriated $30,000 for Samuel Morse to build a telegraph line from Washington to Baltimore to demonstrate the feasibility of the new technology Morse had developed. One recent investment recalls the experience with Morse's investments in electronic networks that would allow computers to communicate. Today private companies are investing hundreds of millions of dollars each year in a race to develop the powerful new medium spawned by federal investments.

The National Information Infrastructure is a prime example of a technology where the generic research and development critical to economic growth could not attract sufficient private investment. Economists have long made this argument for basic research, but more recently we have realized that is pertains as well to more applied work.

The proposals being made by Congress reflect an inadequate picture of the world. The Congress is assuming that basic research can be neatly separated from applied research and development. But in today's society where science and technology so thoroughly permeate our lives, these sharp distinctions can no longer be made. Science and technology are like a huge tapestry, with the threads intermingling in a single pattern. Pluck out the threads going one way and the threads going the other way will no longer cohere.

The same intermingling of interests marks considerations of where private benefits end and public benefits begin. Many of the outstanding opportunities of the 21st century will occur where public and private are most interconnected. Take environmental technologies as example. These technologies can produce major benefits for both the private companies that develop and sell them and for the public that enjoys a cleaner environment. It therefore makes sense for the public and private sectors to develop these technologies jointly.

The importance of technology development to our society is widely recognized outside Washington. Several weeks ago 16 CEOs of some of America's largest and most successful companies published an open letter of Congress in the *Washington Post* supporting university-based research. In it, they wrote, "Technological leadership, by its very nature, is ephemeral. At one point in their histories, all the great civilizations-Egypt, China, Greece, Rome-held the temporal 'state of the art' in their hands. Each allowed their advantage to wither away, and as the civilization slipped from technological leadership, it also surrendered international political leadership."

The Clinton Administration wants to work with Congress. An endless string of bills and vetoes will damage the country as well as the government. The leaders of Congress are hard-working advocates for change. I respect them for their convictions and their tenacity. But I want to make sure that every member of Congress understands the enormity of the cuts that are being proposed in key investments and the impact those changes would have on the American public.

With persistence and good faith, we can find areas of agreement and build on those areas. As John F. Kennedy said, "Let us not seek the Republic answer or the Democratic answer, but the right answer. Let us not seek to fix the blame for the past. Let us accept our own responsibility for the future."

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Keynote Address

M. R. C. Greenwood
Dean
Graduate Studies
University of California
Davis, CA

Good morning everyone and thank you very much for that kind introduction, Dr. Rogers.

In particular, I want to thank Dr. Humphries and the organizing committee for putting together this conference at the Kennedy Space Center. Although we do appreciate the warm welcome you have offered us this morning with this display of spectacular weather, we are, of course, expecting that you will extend the hospitality this afternoon and let us see the bright sunshine and brilliant liftoff of the Challenger space craft. In any case, it is really wonderful to be here. What I would like to do this morning is take a few minutes and give you some brief remarks. However, I hope we will have an opportunity to have some interaction and discussion towards the end of my comments. This is an important conference and we are here to continue the development of partnerships that are absolutely critical for the 21st century. Partnerships between academia, industry and government are necessary to share our ideas, to discuss our dreams and, if you will, to plan for the future of American science and technology.

The deliberations of this conference, concerning vital issues facing science and technology, will help guide the Clinton administration's efforts to secure the finest education for our children. This education will provide for their prosperity so that they may contribute to the country's leadership in science in order to remain competitive in the global economy. It should be evident, to all, that concerns about the future of our nation, the quality of education for our students, and the science literacy of our people are broadly bipartisan issues. Through these issues we can build a coalition that will be highly supportive of our agreed upon goals for the 21st century. I say that because I think there is probably no greater concern that we ought to have as a nation than the education of our students, very specifically their ability to compete in this developing and rapidly moving global competitive environment. Some of you may now that I recently returned to academia after almost two years as the associate director of Science for the Clinton administration. This opportunity to serve in the Administration has given me a rather unique perspective on science and the science technology enterprise as a university administrator and as a governmental official. In addition, I have the added perspective of having been in the Washington policy world in the midst of a rapidly changing policy environment and dramatic changes of the political winds.

These rapidly changing forces will influence future funding not only of science, but also of science education. I feel that meetings such as this one are of great value because we have an opportunity to send a message to Washington, whatever our political affiliations might be. Although it is very popular these days to accuse the federal government of being out of touch with people there are, are you learned yesterday, a number of people in the federal policy arena who care very, very deeply about science and they do want to hear from us, from you. I don't know if any of you read **Science and Government Report**, but I noticed last weekend in an article by Dan Greenberg that the response of the scientific community to some of the proposed cuts in the science and technology budget items was noticed by the Congressional leadership. The scientific community generated more than 12,000 pieces of communication to the Congress, in a fairly quick period of time, due, in part, to some enterprising academics who were on the internet and who were able to lead a very coherent and coordinated response to the proposed budget cuts. Thus, we find that there are things that can be done by people who care about building coalitions and who are able to agree on common grounds and are willing to put aside any specific differences between disciplines.

I am very pleased to see the broad interest and support in the administration's science policy document, **Science in the National Interest.** The amount of interest and support that the document has generated and continues to generate is a positive influence for bipartisan support for science and science education. You should also be reminded that this is the first formal statement on science policy by any President since 1979 when President Carter made a statement to the Congress about science and technology and its important link to the future of the nation.

Science in the National Interest, however, is somewhat different from the usual science documents that have come from the federal government. Previous science reports have stressed the relationship of scientific discovery and the application of scientific discovery to broad national goals. The difference, I think, between **Science in the National Interest** and previous reports is the fact that it ties very closely the education issues in this country -the K-12 issues, the changing needs of the undergraduate and graduate level education and the problems of scientific literacy. Furthermore, the document shows that the teaching of science is a two-fold problem. First, we have to train the scientific leaders, whose who will generate the ideas that will lead to future discovery, while at the same time, we must develop an appreciation for the value of science literacy among the general population. We must generate a general scientific literacy in our overall work force so that it is no longer a science for those who are capable of doing science, but science for everyone. **Science in the National Interest** is very much a people document as it presents the notion of investing in people. It links our scientific and technological efforts to broad national goals, while at the same time, broadens national goals to include health and prosperity, in the National national security, environmental responsibility, and an improved quality of life..

We are in a new age, the information age, and those who know how to gain the use of knowledge throughout their lives will be the most successful in the 21st century. This is not how we have trained people in the past. In the context of our changing global marketplace, development of new

information technology, the creation of cyberspace, and the immediacy of information transfer; there is a vibrant future for our citizens. The advent of home and office access to the information super highway will generate new alternatives for acquiring information and this may result in rendering existing institutions obsolete. People will not need the traditional information sources. Information transfer and exchange has already, and will continue to, transform the world dramatically. Many of you have students, or you are involved in job recruitment with industries that are interested in employing your well-trained students. Many of our students are much more facile with the technology than some of the faculty. They have been programming all their lives and they have been around digital technology for a considerable period of time. They are the "plugged-in generation," if you will. They are already making a tremendous difference to the future of the country and to the world. Our job, of course, is to help them plug into reality, as well as their machines, maximize their competitive advantage, and see those tools as job tools, not just play tools.

The environment in which we are developing a new vision of science and technology, a vision that emphasizes education, is increasingly constrained, not only by rapid technological and social change, but also by a society where social education and science literacy are going to be increasingly crucial. Perhaps more crucial is an understanding of science and technology and the importance of people understanding and appreciating the complexities of the world. At this meeting, our task is to analyze the challenges and the opportunities of this region, to consider the potential for contributions that may be gleaned from science and technology, to evaluate the strength and diversity of our human resources, and to use these components to develop a strategic plan for science and technology policy for this region.

As we approach these tasks this morning, we find that we must achieve these initiatives during a time of limited resources. Our challenge, therefore, is two-fold: to plan for future excellence and to achieve that excellence within increasingly tighter budget constraints. In Washington, there are those in Congress who would slash funding and undermine our investment in the sensitive ecosystem of science of technology education. In the current Washington culture of "anything you can cut, I can cut better," it is the legacy of our children that is increasingly threatened. President Clinton makes a very interesting point that we should all consider carefully. He talks about our "dual deficits." The first is the well-publicized fiscal definite. The fiscal deficit is a threat to our future, which must be addressed. On this joint there is broad bipartisan agreement, at least inside the beltway. The second deficit, of equally important magnitude, is the education deficit. The education deficit is an increasing problem in this country. President Clinton says that if we exert all of our efforts into solving the fiscal deficit and ignore the education deficit, we will embark on a downward spiral from which it will be difficult to extract ourselves. Such a course will threaten the future wellbeing and financial well-being of the nation.

It is obvious that we need to reduce the endless spiral of debt that is caused by our fiscal deficit. However, a very prudent course of action is to find a balance between fiscal deficit reduction and investing in the education of a generation of students who will generate future wealth well into the 21st century. When I worked in the White House, I was very pleased that the Clinton administration placed such a high priority on investing in education. The difficult budget decisions were carefully selected, not randomly chosen, as they were selected to address not only the fiscal deficit but to improve our investment in the future. Whether we are referring to classroom access to the information super highways or to opportunities to convert cost of higher education, it is vital that we continue to protect the quality and to ensure access and excellence of education. As we listen to the budget debates over the next few months, it is very important that our voices be raised individually and collectively to protect those efforts.

It is nice not being in the White House. I can tell you what I think.

There are many things that I miss about the White House. When I arrived at the White House, Jack Gibbons, the President's advisor for Science and Technology, spent considerable time orienting me to the job. One day when we were discussing this and it was prior to my actual arrival at the White House, he said to me, "well, do you understand the game of baseball." I said, "well, yes, I do. "I am not really a big baseball fan as some of my friends can give you states up and down, and my son knows each pitcher and his statistics. He then said that I clearly understand enough for this. He said you need to know that when you are in the policy environment in Washington and when you are working in the White House, you have to learn to pay the game with an understanding that there will be no hits and no runs, just saves. I think that the environment in Washington is very much one in which we have to be sure we get those saves or we are going to find ourselves not only with a lost game but a lost future as well.

While I am talking about policy makers, I want to say a few words to those of us who are scientists. There are many of you in the room today. We must come of the shell we have created for ourselves. We can no longer see ourselves as separate from society, a special class of individuals who create wealth and knowledge for the future. We can no longer see ourselves as persons who work in isolation with a certain purity of purpose. We have done a pretty poor job, as scientists, of educating the public, the Congress, and our local legislators about the value of science. For many of us it has been very appealing to pursue our research in isolation, sometimes without any attempt to explain our endeavor to the public at large. In fact, we find that in certain fields the better you are at talking to the press the lower the probability that you will receive positive reinforcement by the reward system in your institution. Such a person is subject to be viewed as one of those folks who popularizes science, which is seen as not a good thing for a scientist to do. We must begin to change this attitude about relationships with the press. One of the places where we must begin to make changes in graduate education. We must start training students to understand that not only is it necessary for them to master the fundamentals of their field, to create new ideas and new

knowledge, but they must also learn how to communicate their successes, however complex, to the press and to the public at large. These achievement must be expressed in terms that their peers, their grandmothers, their children and others may understand, especially the importance of the research to the future of our nation.

Now, if the revolution in science and technology is ever going to be successful, a heavy burden will fall on the K-12 teachers, university faculty, and our industry colleagues to work together. We heard some examples last night of how that can happen in terms of developing the best possible learning strategy, in the very best settings, to illustrate what we are talking about. In the past, if you received a high school education, and in some cases less than a high school education, you were capable of doing certain kinds of manufacturing tasks. You had a reasonably bright future. Indeed, you could look forward to providing a reasonable level of comfort for your family. This is no longer true. Technology has changed so rapidly that we must begin to educate people who are not afraid to learn. We must also change our institutions of high education so that they are supportive of ongoing lifelong learning styles. Such changes will provide challenges not only for the training of our future K12 teachers , but also for the graduate students and continuing education students in the future. It is incumbent upon each of us to continue to support and expand these successful efforts to identify and develop new, effective approaches.

The leadership of educational institutions and educators in this region have made significant gains in expanding the opportunities for science and technology education for the future. I understand that your discussion of yesterday indicated that the Southeast region is a significant force for technological change and it has a tremendous need for a highly qualified, well training work force. The results of this workshop will be part of an important effort within the Southeastern region to produce citizens who are better equipped to face the global challenge of the next century. No matter what our political beliefs are, we should all unite our efforts to plan for a better future. One of the most important things we can give our children is new knowledge, and the education necessary to put that knowledge to use. It is a path of demonstrated success, one that has transformed our nation, and one that will continue to transform our nation in the future.

I hope we can now have a dynamic discussion of the specific ways we might be able to push this program forward. A growing coalition has formed not only of university educators and K-12 teachers, but also of industry leaders, with a clear understanding of where we are going and how to get there. I look forward to hearing your views, your questions, and your comments. Thanks very much for having me here this morning.

Science in the National Interest
A Southeastern Science Policy Colloquium

Opening Session

David Mulkey
Professor
Department of Food & Resource Economics
University of Florida
Gainesville, FL

Slightly less than ten years ago the 1986 Commission on the Future of the South established by the Southern Growth Policies Board (SGPB), chaired by then Govemor Bill Clinton from Arkansas, issued its final report, *Halfway Home & a Long Way to Go*. The Commission, when established, was given the charge:

> to produce a short readable report to the people of the South which can be used by governors, legislators, and other leaders to mobilize support for those public policies and public-private partnerships which will increase the per capita income, reduce poverty, and reduce unemployment for Southerners by 1992 (SGPB 1988).

That Commission, though concerned with the broader question of economic development in the South, considered five "cross-cutting" themes (equity, internationalization, rural-urban disparities, capital and infrastructure, and quality of life) and developed regional objectives related to economic development in the South. Those objectives seem appropriate as a starting point for a discussion of development trends and needs in the south. These development needs are:

1. Provide a nationally competitive education for all Southern students.
2. Mobilize resources to eliminate adult functional illiteracy.
3. Prepare a flexible, globally competitive work force.
4. Strengthen society as a whole by strengthening at-risk families.
5. Increase the economic development role of higher education.
6. Increase the South's capacity to generate and use technology.
7. Implement new economic development strategies aimed at home-grown business and industry.
8. Enhance the South's natural and cultural resources.

9. Develop pragmatic leaders with a global vision.

10. Improve the structure and performance of state and local governments.

My title here today (*The South in Transition: Are We Really Halfway Home.*?) is intended to raise similar questions for your consideration. I want to suggest that the same issues (education, capital and infrastructure, work force development and global competition) are still important today and are inseparable from issues related to science and technology policy as it impacts the ability of the South to remain competitive in world markets. Further, by using a title similar to that of the earlier report but phrased in the form of a question, I want to suggest that the transition is still in progress; that the world is changing ever more rapidly and that success must be measured relative to the progress of our competitors rather than in terms of absolute movement from past benchmarks.

In other words, the concept of a globally competitive, technology based economy is a moving target; technology does not stand still (Malecki 1995). "Real development is an unending, ongoing process, constantly adjusting and adapting to changes in the external and internal environments" (Hyman, et al. 1994). Success requires not only that we improve, but that we do so at a rate faster than our competitors in other parts of the world. Flexibility, adaptability, and the ability to adjust to a changing economic environment are the measures of success.

Where are we today in terms of our ability to make the adjustments necessary and identify the policy choices for the future? I will attempt to offer some historical perspective as you begin the process of debating the question of science and technology policy as it relates to the continued development of the South.

The South emerged from its agrarian past later than the rest of the nation primarily due to early development patterns focused around a plantation based agriculture and the predominance of slavery across much of the region. Billings (1988) notes that,

> Slavery set the South on a distinctive path of development that conditioned all aspects of its economic, political, and social life and set the region apart from the rest of the nation, even until the present...Intra-regional trade, town-building, and entrepreneurship suffered as a direct consequence.

Similar conclusions arise from the work of Wright (1986) in looking at the history of the South.

> Because of slavery, however, the North and the South developed as separate economies, each with its own dynamic logic. The

> economic structure generated under slavery took many years to overcome. The most basic and lasting legacy of this era, however, was the simple fact of separateness itself.
>
> Property rights in human beings shaped the investment strategies, the economic geography, and the political economy of the South. As compared to the American North, the incentives of slave property tended to disperse population across the land, reduce investments in transportation and in cities, and limit the exploration of southern natural resources. Above all, slave owners had no incentives to open up labor market links with outside areas, and the resulting inelasticity of the labor supply squeezed out labor-intensive manufacturing activity....

The post civil war South was thus both geographically and economically isolated from the rest of the nation, what Wright described as being in 1870, "...a low-wage region in a high-wage country." Economic fortunes were tied to the price of cotton, and low-wage, abundant labor supported a "share-cropper" system of agriculture. Interest was, however, kindled in expanding transportation systems and in the improvement of cities and towns, and the late 1800's saw the beginning of the textile industry drawn by the low wages of the South. During the period lasting until World War II, both Billings and Wright note the continuing isolation from national labor markets, the absence of an indigenous technology in the South, and the reluctance to invest in human capital. However, the stage was set for dramatic change in the South - the mechanization of agriculture, the massive out-migration of unskilled labor in the years following World War II, and the beginnings of the economy we know today.

The South as defined by the U. S. Census of Population in 1940 was home to slightly more than 41 million people or 31.5 percent of the nation's population, and per capita incomes across the region were substantially below national average. Delaware, Maryland and the District of Columbia had per capital incomes exceeding national averages in 1940, but among remaining Southern states, only three (Virginia, Florida, and Texas) exceeded 70 percent of national average income. The poorest two Southern states (Arkansas and Mississippi) were less than 50 percent of national income levels.

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[1] The region includes the sixteen states and the District of Columbia stretching from Delaware to Texas. All data cited are from the Statistical Abstract of the United States, Selected Years, Bureau of the Census, U. S. Department of Commerce.

From 1940 onward, the South made rapid gains relative to the nation in terms of per capital income. There are some exceptions, but examining the income growth by decade from 1940-1980 reveals few Southern states that failed to outpace the nation in terms of income growth. Exceptions include the District of Columbia and Florida in the 1940s, and five states (Delaware, Maryland, District of Columbia, Louisiana, and Texas) in the 1950s. The strongest decade of Southern growth occurred in the 1960's when only Delaware grew slower than the nation in per capital income. The decade of the 1980s saw slower growth in income across all states. Six Southern states failed to grow faster than the nation, four (West Virginia, Kentucky, Mississippi, and Oklahoma) for the first time since 1940.

Where does this rapid growth in income leave the South today relative to the nation? Delaware, Maryland, and the District of Columbia, all above national averages in 1940, remained so in 1990. Among the remaining 14 states, only Florida and Virginia exceed national averages, having per capita incomes in 1990 of 100.6 percent and 104.7 percent of national averages, respectively. Only one state (Mississippi) had a per capita income of less than 70 percent of the national average in 1990, and nine states had per capita incomes which exceeded 80 percent of national averages. In short, following 50 years of rapid growth in per capita income, only two of the sixteen states in the census South slightly exceed national income levels, but there has been significant improvement since 1940.

Employment gains in the South have been equally impressive relative to the nation as a whole. Over the 1970-80 period for example, the Southern region exceeded national growth rates in every major category of employment, and similar results occurred in 1980-89 although both the nation and the region generally grew slower.

In short, economic growth in the South over the past fifty years has been impressive. Yet, a closer look at the data raise several cautions in interpreting the results. First, it is likely that income figures alone overstate the progress made in the South. Per capita incomes are a function of both absolute levels of income and levels of population, and in terms of population growth, changes in the South have been less dramatic relative to the nation as a whole. In 1990, the Southern region contained 34.7 percent of the nation's population compared to 31.5 percent in 1940, but there were significant differences among states. Over the 1940-1990 period, only six of the Southern states (Delaware, Maryland, Virginia, Georgia, Florida, and Texas) increased in population relative to the nation. Further, marked changes in relative population numbers were observed only in Florida, and to a lesser extent, in Texas. Two states (North Carolina and South Carolina) remained about the same, and all other Southern states had a lower share of national population in 1990 than was the case in 1940. Thus, at least a part of the gains in per capita incomes relative to the nation may be explained by the migration of unskilled-skilled labor out of the South.

A second caution has to do with the concentration of manufacturing employment in the group of contiguous states located in the central South, primarily the states of interest here today (North

Carolina, South Carolina, Georgia, Kentucky, Tennessee, Alabama, Mississippi, and Arkansas). In a paper developed for a presentation similar to this one in 1984 I noted the concentration of manufacturing industry in these states and argued for a new development strategy (Mulkey 1984). The region could not continue to grow faster than the nation by attracting an increasing share of an economic sector in which employment was either slow- growing or declining at the national level.

Hansen (1979) explained the growth of manufacturing in the South using the concepts of "spatial industrial filtering" and the related "product life cycle." As products reach the mature stage of their life cycle, production is associated with an increasing use of capital, the use of less expensive labor, and the shift of production facilities to low-wage regions. In support of his argument Hansen cited the growth of manufacturing employment in nonmetropolitan areas of the South, lower-wage, lower-skill areas, and the fact that much of Southern manufacturing growth came by attracting branch plants of national or multinational firms. He also argued that the process could not continue and at some point, the same industry would likely move out of the South seeking lower wages in other countries.

Yet, with the previous cautions aside, the South as a whole continued to outpace the nation in employment growth in the 1980s. Notable exceptions were the construction industry and manufacturing employment declines in those states dependent on energy production (West Virginia, Louisiana, Oklahoma, and Texas).

Where does the South stand now? In 1993 the South contains roughly the same percentage of the nation's employment as it does of population, and the region as a whole tends to mirror the nation in terms of the distribution of employment across the major sectors of the economy. The eight states mentioned earlier are still relatively dependent on manufacturing, but that dependence is much less marked than in 1970, and per capita income growth in the region continued to outpace the nation in recent years. Further, the emergence of high-technology areas such as Florida's space coast, the Research Triangle, and Huntsville, Alabama along with the performance of the South's metropolitan areas bode well for the future.

A dark spot is that many rural areas have not fully participated in Southern prosperity. The much touted "rural turn-around" of the 1960s and 1970s did not include the rural South, an area disproportionately impacted by the agricultural crisis, by changes in natural resource based industries, and by the loss of jobs in low-wage manufacturing industries. The story is perhaps best captured in the title of publications from that time period: After the Factories: Changing Employment Patterns in the Rural South (Rosenfeld, Bergman and Rubin 1985), The Tale of Two Souths (Rosenfeld 1988), Stagnation, Decline, and Development: A Trip Through the Southern Countryside (Schaffer 1992), and Global Cities and Back Roads: Perspectives on the Southern Economy (Malecki 1995).

But, aside from the concern over rural areas, where does this leave us with respect to the future and the ability of the South to compete in a technology driven, information-based global economy. Clearly, the era of Southern industrialization has ended. The new era will certainly involve the generation and use of technology, the skills and abilities of people will be more important, and the game is likely to be more competitive than in the past.

In his recent book entitled *Head to Head: The Coming Economic Battle Among Japan, Europe, and America,* Thurow (1992) makes this point with a series of questions: Who can make the best products? Who expands their standard of living most rapidly? Who has the best- educated and best-skilled work force in the world? Who is the world's leader in investment (plant and equipment, research and development, and infrastructure)? And, I would add investment in human capital to his list.

Thurow reinforces his point about the nature of the coming competition by noting that if you were to ask leaders in Japan, Germany, and the United States to name those industries necessary to support a world-class standard of living in the next century, you would get similar lists. The lists would include microelectronics, biotechnology, materials sciences, telecommunications, civilian aviation, robotics and machine tools, and computers and software. His point is that all represent "brain power" industries in which natural resource and locational advantages are less important and the competition will be "head-to-head." Not all countries can win.

If we asked the same question to leaders in the South, would we get the same list of six or seven industries? How will the South fare in this competition? In answering this question several aspects or issues are important. Some answers may be gleaned from Thurow's list of questions.

1. Certainly, investments in plant, equipment and infrastructure are important. Particularly important are the policy issues surrounding telecommunications infrastructure outside of the major metropolitan areas where it is less likely to be provided by private market forces.

2. Investment in research and development, the scientific enterprise itself, is important. Issues revolve around the necessary level of investment, the funding for basic as opposed to applied research, and the use of public or private funds or some combination of the two. Perhaps, there are lessons to be learned from Germany and Japan in this regard.

3. Process development is likely to be more important than is the development of new products. Thurow makes this point with reference to the CD player, the video recorder/camera, and the fax machine. In terms of sales, profits, and employment all are Japanese products. Yet, Europeans invented the CD player and Americans invented the other two. Thurow notes that the United States typically has spent three-fourths of its R&D funds on product development and one-fourth on process development while the Japanese have done exactly the opposite.

4. We must consider the implication of the global economy itself, especially the implications for unskilled labor. Both Thurow and Daly make the point that opening the economy to global competition vastly expands the supply of unskilled labor. As a consequence, the wages of unskilled workers in the industrial countries must fall. For us in the South, this could mean lower wages, or given minimum wage laws, increased unemployment and expenditures on welfare programs. I suspect the process has already started.

5. Changes in the service industry will be important. Recent articles in the business press suggest that we are on the verge of a service industry restructuring similar to that which has taken place in manufacturing in recent years. We are likely to see dramatic increases in productivity spurred by the use of technology in new and different ways (Ehrbar 1993; Rothschild 1993).

When all these points are considered, what is the bottom line - the overriding consideration as we think about the future of the South? It appears to me that the answer is simple. The future of the South is dependent on the quality of our human resources. However, this area represents another dark spot when we compare the South to other areas. Without regard to the type of indicator we choose to measure human capital, the South compares unfavorably to other parts of the country. The South lags the nation, and the rural South is even further behind (Goetz and Debertin 1994; Beaulieu 1989; Mulkey 1993).

We simply cannot move forward without a quality, well-trained and well-educated workforce. With respect to education, we must focus on the overall quality and performance of the school system for all students. Thurow makes the point that if process innovation, teamwork, and flexibility are important, it is not enough to educate the best and the brightest. Further, we must reconsider what we teach with an emphasis on cognitive skills and reasoning abilities. We must also shift our educational focus to one of "life-long" learning. We live in an era in which knowledge becomes obsolete very quickly. Finally, it appears to me that to do a better job in schools, we must address those factors outside the schools which impede student/school performance. The educational research literature consistently suggests that one-half or more of variation in student performance is explained by factors over which schools have no control - factors involving families and communities. In short, children from poor or dysfunctional families and from poor or weak communities make poor students in school.

The bottom line, again. We simply must do a better job with public education for all students and at all levels of education if the South is to be a competitive region in the future. In the words of Ashby (1986),

> Economic development cannot be bought, borrowed, stolen, or even given away. It must be accomplished beginning with the particular set of circumstances at hand.

In closing, the South is certainly not out of the economic development game in the next century, but if we are to succeed in that game, we must begin and we must begin quickly.

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Panel Presentations

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Panel Presentations

Helen S. Blanch
Supervisor, Instructional Technology
Dade County Public Schools
Miami, FL

Donald R. Cotten
Executive Director
Mississippi Public Education Forum
Washington, DC

Joyce Bennett Justus
Assistant Director
Social and Behavior Science
Office of Science and Technology Policy
The White House
Washington, DC

Martha Krebs
Director
Energy Research
Department of Energy
Washington, DC

Heinz Niethammer
Director of Engineering
Kimberly Clark Corp.
Roswell, GA

Weyman F. Patterson
Coordinator of Mathematics and Science
Atlanta Public Schools
Atlanta, GA

Ronald Rasmussen
Chief Engineer
Honeywell, Inc.
Clearwater, FL

Israel Tribble
President
Florida Education Fund
Tampa, FL

Paul Waugaman
Southern Technology Council
Research Triangle Park, NC

Melvin R. Webb
Professor of Biology
Clark-Atlanta University
Atlanta, GA

John T. Wolfe, Jr.
President
Savannah State College
Savannah, GA

Russell Wright
Acting Director
Environmental Services Division
Environmental Protection Agency
Atlanta, GA

Donald W. Zacharias
President Emeritus
Mississippi State University
State College, MS

Science in the National Interest
A Southeastern Science Policy colloquium

Panel IV: K-12 Education: Challenges for the 21st Century

A Dade County Public Schools Perspective

Helen S. Blanch
Supervisor
Instructional Technology
Dade County Public Schools
Miami, FL

The challenges facing educators in the k-12 learning environment today are unprecedented. Changes are occurring daily that are altering the future of our society and of our planet. As educators, we are faced with the need to prepare all of our students for a society that will be unlike anything we have ever seen. We can no longer assign each student to a predictable category of achievement and employment. We need to prepare all of our students to apply their knowledge flexibly in new situations.

Mathematics, science and technology influence every aspect of our environmental, social, economic, ethical, and political systems. We need to ensure that all of our students have access to the information and experiences that will allow them to understand and Influence the changes brought about by mathematics, science, and technology, and to solve the problems that often accompany those changes.

Even though we do not know exactly what the future will look like, we have an idea about what our students will need to know and be able to do, and we have a vision of what all of our students can be in the future:

- Citizens who are able to make decisions in a participatory democracy and to function effectively in a technological world.

- Urban young people who are prepared to excel and take leadership roles in careers where they have been traditionally underrepresented; and

- Community leaders who are empowered to apply what they have learned in mathematics and science to solving local problems and improving the quality of their lives.

New teachers are often surprised, and sometimes overcome, by the challenges inherent in meeting these goals. Some of the barriers they encounter:

- Insufficient mathematics and science course requirements for state certification for elementary teachers.

- Insufficient training in using technology as an instructional tool.

- Insufficient preparation for teaching in culturally diverse or economically disadvantaged urban schools.

- Lack of effective staff development opportunities for educators which are ongoing and tied to their curriculum needs.

- Finding enough time for teaching mathematics and laboratory-oriented science at the elementary, middle, and senior high school levels during the school day.

- Dealing with the extremely overcrowded conditions which are inherent in large urban school districts.

These new teachers enter the profession at a time when schools districts, in an attempt to restructure existing curriculum to meet the national education goals and emerging content area standards, are grappling with other inhibiting barriers:

- Ensuring that restructuring initiatives reach every school and every classroom.

- Involving parents in restructuring efforts.

- Maintaining community support while systemic reform initiatives are implemented and until results become evident.

- Continuing reliance on norm-referenced standardized test scores as the most important indicator of student achievement.

- Increasing minority participation in challenging academic courses. Reducing the minority gap in achievement scores.

- Providing equitable access to technology resources.

- Upgrading the antiquated infrastructure of schools to support new technologies.

- Reducing the obsolescence rate of equipment.

Reinventing Urban Education In Dade County, Florida

What should new teachers be prepared to expect when they get their first job? The following highlights illustrate the types of initiatives occurring in many urban schools districts around the nation.

Dade County Public Schools, located in Miami, Florida, is the fourth largest school district in the United States, with an enrollment of over 321,955 students in kindergarten through grade 12, in 315 schools. The student population is 49.4% Hispanic, 34.2% African American, 15.1% White non-Hispanic, and 1.3% Asian American and Native American. There are 46,842 students classified as students with limited English proficiency (LEP). Dade County Public Schools (DCPS), encompasses the city of Miami, 27 different municipalities, as well as a vast unincorporated area. More than 70% of the residents of these regions are members of minority groups.

Over the past three years, DCPS has systematically set a course to reshape urban education as we know it today. World class standards and student achievement for all of our students are the benchmarks against which each decision in the district is measured. The reinvention of urban education in Dade County has been cast in terms of the following elements:

- The development and implementation of a Competency-Based Curriculum (CBC) which is standards driven and which details what each student should know and be able to do across all subjects and grade levels. The CBC integrates various standards set forth by academically recognized groups such as the National Council of Teachers of Mathematics (NCTM), the emerging national science standards, and the Secretary's Commission on Achieving Necessary Skills (SCANS). Preservice education which stresses traditional pedagogy puts their graduates at a disadvantage when faced with a curriculum that is much more interactive and hands-on.

- The selection and implementation of nationally recognized research based programs which have demonstrated positive impact on student achievement. These include the Audrey Cohen College School of Purpose program, the E.D. Hirsch CORE Knowledge program, Henry Levin's Accelerated Schools, the Coalition of Essential Schools, Robert Slavin's Success for All, BBN's Co-NECT project, and James Comer's School Development Model. Pre-service educators would benefit from reviewing these and other current models.

- The implementation of a five year plan for systemic reform in mathematics, science and technology education designed to impact all students, teachers, administrators, and parents to increase student achievement in the areas of mathematics and science. This initiative focuses on: strengthening content and instruction; extending the current school improvement process to include goal setting for mathematics and science instruction; removing barriers to promote equity; aligning policies to promote excellence in mathematics and science; and strengthening community partnerships to link mathematics and science learning in the classroom with the real

world. Preservice education should emphasize thorough mathematics and science content, especially for elementary education majors.

- A shifting role in the use of technology in schools. The current focus is to move computers out of lab settings where the primary use was in drill and practice programs, into the classrooms. Technology learning centers are usually comprised of three to five workstations and a printer. Infusing the technology effectively and seamlessly into the curriculum is not an easy task. The district is also piloting an instructional wide area frame relay network which provides desktop access to the Internet for those schools currently participating in the pilot. The goal is to eventually connect all 315 sites. The traditional one shot computer literacy course does not prepare teachers to step into this evolving classroom setting.

- Aggressive pursuit of grant funding designed to increase academic standards. Some of the recently funded grants in our district were: The Instructional Technology Incentive Award which has provided over $27 million in three years for the purchase of hardware, software and training; The Retrofit for Technology Award, which provided funds to upgrade the electrical and networking infrastructure of 23 schools; and the National Science Foundation's Urban Systemic Initiative which provided $15 million for improving mathematics and science education. Many other grants ranging from $300 to over $100,000 are written by and awarded to classroom teachers each year. Exposure to grant writing techniques is recommended.

- The development of a unified, systemic approach to professional development which begins with an intensive beginning teacher orientation program and includes ongoing training for teachers and administrators at all levels. New educators are often surprised to find themselves immediately submersed in more training.

DCPS realizes that doing business as usual will not work, and that future success rests on the district's capacity to take an entrepreneurial role in forming new, innovative and bold alliances. Some of our most successful alliances have been with the local universities, such as Florida International University from which we hire a high percentage of our new teachers. This close partnership has in recent years, been very effective in providing for our district a workforce that is ready to take on the challenges of teaching in an urban setting.

In closing, the goals for maximizing the potential of every student enrolled in public education rest in preparing a teaching force which itself is prepared to meet the challenges of education in the 21st century. As Schools of Education around the country continue to revise curriculum to improve the preparation of new teachers, school districts are also focusing on local initiatives which build on the strengths of people at every level of the system. If we truly believe that every child can learn, then we must stop viewing the challenges facing educators today as insurmountable obstacles. We must approach them as insurmountable opportunities.

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Panel IV: K-12 Education: Challenges for the 21st Century

Donald R. Cotten
Executive Director
Mississippi Public Education Forum

As we approach the topic of strengthening and sustaining K-12 education system in our country, it is imperative that we remind ourselves that K-12 education is inextricably intertwined with all education agencies pre-school, community colleges, colleges/universities. This total education system is enhanced through life long learning experiences. We have often isolated K-12 educators by classifying them as if they represent some entity other than the "real" academic community. These professionals have roles and responsibilities which provide the foundation that ensures that our citizenry is prepared to meet the challenges of the next century.

In order for our educational system to be an effective instrument which responds to the demands and expectations of our society, there are several major points that require serious consideration. The K-12 component of our system has been assigned, delegated, and has accepted many social responsibilities in our society. In addition, many have looked at the system and challenged whether it is performing up to the public's expectations. The pressures are immense, but the conversation is healthy. If we all stop and reflect for a moment, can we remember another time in our lives that the national, state, and local discussions regarding education have been so spirited and passionate. Whether we choose to agree or disagree with our critics, the fact that education is the primary topic of discussion and/or concern is significant to a viable system.

This past year, William Raspberry, the Washington Post columnist and Pulitzer prize winner, addressed an audience of business, government, and education leaders during an education forum in Mississippi and made the following observation. "The public pressure for accountability and change in our schools has outstripped our school systems' ability to keep up. As a result, states are implementing accountability systems before identifying the goals, in effect putting the cart in front of the horse. New and different results are being sought while continuing to use old and traditional practices." Whether we accept Mr. Raspberry's thesis is not important, what is important is that we in education take the lead with our supporters and critics to demonstrate the positive aspects of our system. Furthermore, we must address the needs of our competitive and compassionate public.

The dilemma faced by educators is one of maintaining the support and confidence of the overwhelming majority who depend upon an accessible education infrastructure. While there is a constant call from the public to maintain programs and practices that ensure students acquire basic academic skills (reading, writing, and mathematics), there is also the underlying belief that our schools can also serve to reestablish the basic principles on which our country was built.

The challenge for all of us is to determine what we can accomplish within the framework of the system. Any structure for the next century must be based on the financial and human resources that are available to meet the goals and a commitment by all of us to work toward these common goals. If we fail to reach consensus on the goals for K-12, community colleges, and colleges/universities we will surely fail. An important lesson to learn from the business world is that we must develop and implement strategic plans with realistic expectations. I know that we all have and will continue to plan, but somewhere along the way we have not communicated to the public-at-large our plans. It is important that we are consistent with our message to the public to assure that there is no confusion in their minds.

After joining with the of the business leadership in Mississippi to identify and influence the major challenges facing education in our state, I want to present to you my perception as to what their expectations are for a strong education system.

Academic Integrity

We will all agree that most business leaders, small to major corporations, believe that what's good for education is also good for business. An educated, not a trained workforce, is essential for sustaining a strong economy. The business community and the public continue to identify high academic standards as essential elements for our schools. Businesses are faced with the need to integrate employers into the workforce as rapidly as possible. This need coupled with the demand to have an efficient, skilled workforce means that our business partners expect our students to come to them prepared to be productive upon arrival.

To the business community, this means an educational system that instills in our citizenry basic skills in reading, writing, and mathematics. It is essential that these individuals be prepared to meet the challenges of a rapidly changing work environment. A trained workforce is prepared only for the present. An educated workforce is prepared for the present, but also possesses the knowledge to adapt.

Alliances

For the educational enterprise to reach its potential, real collaborations must exist among all of our partners, both private and public. As I indicated earlier, a solution must be found that bridges all of the education entities together, kindergarten through universities. Systematic delivery systems must be established that provide viable exchanges across the education spectrum. These delivery systems must be interactive in that teachers and professors learn from each other in an environment where each respects the expertise of the other.

The private sector must be willing to commit to long term partnerships with the education community. The business community has accused educators of speaking in education ease and

educators have stated they do not understand the jargon of the private sector. When we discuss the others needs and concerns, it becomes evident that our interest in students are similar, but our vocabulary may differ. If this indeed is our primary difference, the challenge to educators and business leaders should be to establish operational definitions that all understand.

Technology

In 1996, we will celebrate the fiftieth anniversary of the computer which marked the beqinninq of the technology explosion. The age of technology has brought about instant accessibility of information and people. The private sectors ability to compete nationally and internationally will depend upon its efficient and effective use of technology. It is sad to point out that we have many students in our schools who do not have access and/or opportunities to become technologically literate.

Technology is not the answer to all of our questions, but it does represent a significant component of learning and working in contemporary society. Technological literacy now becomes a basic skill for problem solving.

Human Resources

The future of the education system is dependent on our ability to attract and retain individuals who are competent and motivated. The lure of financial gain and professional status must be addressed by those of us in the profession, as well as those who support education. With the maturing of the education population, there is a large segment of the present teacher population that will be exiting the system. In addition to this drain of human resources, the pipeline is lacking not only in numbers in specific and critical disciplines, but diversity.

We must continue to explore creative ways to attract qualified and talented individuals into education. They must possess not only strong academic credentials, but also knowledge of instructional techniques that engage students in innovative minds-on learning experiences.

The need to continue to promote strong preservice education programs is essential. In addition, as educators enter the profession, we must empower these individuals with the opportunity to strategically improve themselves professionally.

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Panel II: New Issues for Science and Technology in the Year 2000 and Beyond

Joyce Bennett Justus
Assistant Director
Social and Behavior Science
Office of Science and Technology Policy
The White House
Washington, DC

I don't know what am I doing here? That's an almost impossible act to follow. I was thinking about what I would say to you today as I took your message literally about issues for science and technology for the year 2000 and beyond. As one of the few people who will be up here today who is not what people traditionally think of as a scientist, I thought I would take a slightly different tactic from what my true, real scientist colleagues would take.

As you heard, I'm an anthropologist and we anthropologists have a different take on most things in the world. That's why we are anthropologist. I also listened to the first panel and I was heartened. I started to think I was really in the wrong meeting but after one of the presenters suggested that there are two things that industry needed which seem to speak to the things that I do and I know something about. Reading the list there were interpersonal skills and the other thing he talked about was leadership skills.

The last presenter in the first panel talked about the things we're going to have to select if we wish to reduce the number of units that our students take in order to complete their engineering programs. I would like to suggest that as you select among the things that you will omit, remember the first presenter's request that we also maintain a focus, and exposure to interpersonal skills, leadership skills and communication skills. As a person who spent much of my professional life in an institution that was dominate by the physical sciences, I can remember arguing very often, as my colleague said, the perhaps if the students learned how to use the library, learned how to write, learned how to speak, that they'd also get good jobs as scientist and engineers. So much for my sermon. What can we expect in the marketplace in the year 2000?

The first thing that comes to mind, in my mind any way, is that the increasing technological sophistication that we see today will continue four and half years into the year 2000 at an increased rate as the world becomes smaller. We're talking of a global economy and no longer a domestic economy. The key element in this marketplace, then, will be a loss of the kind of jobs that, if I understand the presenter at lunch, people sought in the Southeast. Low skilled, low waged jobs are a thing of the past.

They won't be around and we will not have them! Industry told us they needed more than low-skilled labor.

The second issue that I think is an issue for us for the year 2000 which is very near and dear to my heart, is that we're going to have a more racially and ethnically diverse population. That includes the groups that we have not been very successful in educating in science and engineering with very few exceptions. This is one (Florida A & M University) that has done a great job at trying to bring different populations into science.

In my state of California, my state of adoption, we have a situation which is similar to the data for the Southeast, an increasingly large population of high school graduates, kindergarten classes filled with kids from homes where the first language is not English, which creates a complexity of the demands on our teachers. In Los Angeles schools, a first grade teacher may have kids who are speaking 35 different languages or are from families speaking 35 different languages in a classroom. Social science research tells us that language also help kids learn. If you are dealing with kids who speak different languages, you also have to figure how to teach them. Because the whole way of learning and reference points are different.

We need to do something new with how we train our teachers. We have to develop this new talent pool because this is where the work force of the future depends. This is where we are going to get our employees from and we're going to have to figure out how to teach them better so that they can be more successful. A subset of this increased diversity among our population is what we see in the affirmative action debate nationally with increasing hostility among racial, ethnic and gender groups.

Competition for jobs and downsizing of the economy are leading to scapegoating. This is not going to do us or the United States any good in the future. I was reading Gale Sheeney's notebook, which I thought gave me the best explanations for what we now call hostility and the angry white male. Gale Sheeney points out that White men are opposed to women who identify with their careers, as some of us are just coming into having long continuous careers. That is what's happening in the United States with corporations downsizing, right sizing and now the federal government, in addition, are putting people out of work in the prime of their careers.

When you retired at 67, it probably looked pretty good to spend the rest of your life fishing and playing golf. When you are changing jobs at 52 or 47, that's not an option. We must find new ways of right sizing and moving from one place to another without this kind of hostility that the country is now seeing. We must figure out how to teach our students how to continue learning, how to prepare for second, third and fourth careers, and to help each other to move away from blaming the next person for What's not happening to us? How are we going to do that? I would argue that we would have to move from science education for the few to science education for the many. We need to educate all Americans aspiring scientists, those who will not pursue scientific careers, those who will not pursue technological careers - the general public.

Our science education for scientist is excellent as is witnessed by the number of foreigners who come to the U. S. to pursue advanced degrees in science. What we don't do well is provide adequate science education for the masses.. We must work to improve science, math, and technology education for the non-scientist. Frankly, that's where the bulk of the workforce is. It is not among the science majors, never has and never will be. Somebody mentioned the community colleges, that's where the non-college bound student is - the people who are going to go from school to work and we need to do a better job at every level in science education. We have to work in partnership with industry.

One thing I thought was interesting is one of the previous presentations was the suggestion that we need real time learning. People learn when they need information. Maybe one of the ways we will learn to improve the education in K-12 is to work with industry to apply some of the techniques that industry is using to have K-12 teachers improve their own ability to impart and excite students for science. New job skills are required for changing conditions. My bias tells me that with all the best will in the world, President Humphries and his faculty will not really be able to train the students that they have now for the job in the year 2000. We're moving too fast and too quickly. So we have to create the kinds of students who will be able to learn a new skill pretty easily and be comfortable in doing that.

I think the major thing that we must do in education is to change the way we prepare students at all levels. More time in teaching learning, more time in teaching how to think than what to think. My own discipline is probably much more slower about + changing than the sciences, but in graduate school no self-respecting faculty member in anthropology would have his student learn today. While in graduate school, we were told that as social scientist you don't need to learn mathematics. My daughter, who is a graduate student, is dealing desperately with the fact that when she was a sixth grader she thought that women didn't do mathematics and how, preparing for advanced degree, she is learning that mathematics is no respecter of gender. Its a broadly trained individual who is technologically sophisticated who will be able to move from one career to another.

Finally, I think we need to depend much more on each other and depend much more on institutions within a region. One of the real advantages of states like Florida and California is that there is a large number of institutions within the region. As resources become less, and as institutions change to meet the requirements of the time, its probably not economical for all us to try to be all things to all people. The kinds of partnerships that were built between institutions and K-12 now must be built across institutions of higher education. It makes no sense, and its probably not going to be possible, for all of us to continue to do and improve and grow as we need to. So my charge to you is as those of us in OSTP continue to think about how we produce the finest scientists and engineers for the 21st century, that we need to do three things. One, we need to work with K12 in every way we know how so that the kids who come out of K12 will be ready for everything we have to offer them in the institutions. But we also have to work with K12 teachers. They must change and learn new ways of teaching students. They are going to teach us how to be ready for those students when they come into our institutions because the students in K12 are changing faster than the students that are currently in our institutions. We need to be ready for them. We need to learn from the teachers who have learned to deal with them.

The second thing I would suggest that we need to learn to do is to continue to figure out how to do better what we do, especially with those populations that we have turned off of to science and mathematics, probably somewhere in the sixth grade. Finally, we have to create lifelong learners because the 21st century marketplace is not going to have the kind of situation I grew up with where one became an anthropologist and retired an anthropologist. Although I didn't learn that message very well, however, we are now in a situation where we are going to change our careers 3 or 4 times.

If we are going to survive, as the Department of Energy needs to survive, and as a country needs to survive, and as we need to learn the languages of 35 kids to be able to move from country A to country B, with Honeywell and Kimberly Clark, then we must figure out how to make language diversity an asset rather than a liability, to make racial and ethnic and gender differences an asset and not a liability, to be parts of things that institutions of higher education pride themselves about and share and learn and teach people how to live and work and grow together. If we do that, then the 21st century will be a better place than the 20th century. My real fear is that we're not doing that very well now. If we don't figure out a way of doing it better, we won't have anybody for Kimbery Clark or Honeywell to employ.

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Panel II: New Issues for Science and Technology in the Year 2000 and Beyond

Martha A. Krebs
Director
Office of Energy Research
U.S. Department of Energy
Washington, DC

Good afternoon, it is a pleasure to be here today to speak to you about the new issues for science and technology in the Year 2000 and beyond. I am particularly happy to be here with my colleagues from Washington whom I don't often have an opportunity to see. I am also very pleased to participate in an event that's been put together by Fred Humpries and Florida A&M University. Over the years, I have had many opportunities to interact with Fred and products of this institution although this is actually my first visit to FAMU. I am well aware of the contributions of the students and the quality and effort that he and the faculty have put into the next generation of scientists and engineers.

I basically have a two-part talk. Before November, I would have presented and expanded on the first part, and the second part covers some of the policy issues that have developed over the last seven months. I believe they will have an impact on what the situation may be for science and technology beyond the year 2000. First, where are we? What's important? What does the Department of Energy, from the point of view of technology or the point of view of science, think is important as we look beyond the year 2000? Essentially, and Joyce Justus may expand upon this, there is a vision for science and technology and an agenda that the President and Vice President came into this Administration with. The Clinton-Gore agenda for Science and Technology is not a science plan, nor is it a technology plan -- it truly is an integrated Science and Technology agenda that goes beyond the linear model of the past to a new model recognizing the symbiosis among fields of science and technology at all stages of inquiry and practice.

This agenda was made visible by the need for technology in America's economic growth and environmental stewardship. We must have some common goals in this endeavor: that we invest in world class science, mathematics and engineering education; that we work for a cost effective environment, and a downsized government. In any event, that is essentially the framework within which we have worked throughout the Administration and within which we have worked together.

What I d like to discuss is where the Department of Energy really has a central role in this set of goals and the agenda that is associated with the sustainable future. In large measure what we are talking about within a context of a sustainable future is what is the mix of technologies that we

can apply now. What scientist, what knowledge, what people must we invest in the coming years, say the next 20-30 years, that will allow us to both grow our economics in the United States and in other parts of the world and, at the same time, protect our environment? In clear terms, it means cleaning up the contamination that previous generations have left to us. It means controlling the pollution that we do not yet know how to prevent. It means changing the materials we use, changing the processes that are involved in producing products in the economy. The reason the Department of Energy is in the middle of this is because energy has driven the economy since it is involved in the production of items for the marketplace and the interaction between resource use and energy use is intimate.

As a consequence, within the Department of Energy we are looking at the development of energy efficient technologies, of new energy conversion technologies whether we're talking about electrochemical storage, or new processing technology and science for pulp and paper industry or the chemical refining industry or the aluminum and other metals industries. These are areas in which we see ourselves investing in the near term and also in science chemical sciences programs. In the engineering programs, we are planning to make investments that feed into these concepts. I could, in fact, go on with this in much more detail if I were going to give you a programmatic review of what the Department of Energy plans to do. We have already begun. Let me give a couple of examples because I think it's important to speak in concrete terms. Since I'm in Florida I did a little research or, I should say, my staff did a little research, to indicate the kinds of investments and partnerships we already have within the State of Florida.

For example, the Tampa Electric Company is involved in a program with the Department of Energy, along with other utilities, to increase the use of energy efficient motors in industrial environments. This is a voluntary and cost shared program that we believe will save on the order of 10-15% of the current energy used in electric motors. We have a program titled Clean Cities. The Miami/Ft. Lauderdale area of Florida is committed, along with 200 other utilities across the country, to reduce pollution associated with energy production. Its important to note that the State of Florida is the third largest user of petroleum and natural gas for electrical power generation. As a consequence, if utility companies can reduce their pollution it will make a big impact, not only for Florida but for the United States for our own energy production and carbon emissions.

This is important to the state of Florida, in some respects, because the people of Florida spend 8 percent of their gross income on energy -- that's 2 times higher than the rest of the country. So that's a real motivation within Florida. There's a real need for Florida to understand and to develop new technologies to save energy and to change the way they do business. I know it gets more profound when you start to think about other natural resource issues. I am thinking particularly of water use and environmental preservation of some of the delicate ecologies within the state of Florida. This is an area where the Federal Government is making changes.

However, much money is actually being invested in research and development. It is something that as we look to our neighbors in other parts of the world, they are paying attention to this. They are talking about sustainable development.

When I visited Japan and China early this year with the Presidents Science Advisor, Jack Gibbons, we heard from senior members from the governments of Japan and China that this was an issue for which they were looking for partnerships with us to help develop their own policies, programs and priorities. I think Florida and the Southeast have something at stake here. That's the first part of my talk. However, as you all know, people may ask me more questions about this than they may ask me about sustainable futures.

I have another view graph that I use often which has the title November Revolution. It is important to note not so much that there was a change of majority party, although that is certainly significant. What's really significant to me is that we have so many new members of Congress, whether Republicans or Democrats, that do not have the sense of history of sense of what has been appropriate or successful in terms of federal investments. Clearly they are taking actions with respect to not only science, but also technology when they target organizations like the Department of Energy and the Department of Commerce and their advanced technology programs, that really will have an impact on how we generate new knowledge and on the people who will come into the business of knowledge generation as well as how we use that knowledge.

Who will be available to use technology at the forefront that will drive the markets and drive our economies 20 years from now? What this view graph represents is some of the Republican proposals and the focus on the Department of Energy. I really live with it everyday. I have a hard time getting beyond thinking about some of these other agencies. One of the topics that comes up often in this discussion, and I spoke with a number of radio talk show hosts this morning while I was trying to get here, is the issue of privatization. Can't we privatize the laboratories of the Department of Energy? Can't we privatize the facilities of NASA? Isn't this something? If it was really worth something to the United States, to the economy, then private industry would be doing it. A couple of weeks ago, the Wall Street Journal indicated big companies such as IBM, AT&T, Bell Labs. and Texaco have been reducing their investments in R&D, particularly over the last 5 years and in long-term research. Recall that long-term research is what agencies like the Department of Energy and NASA are involved in. We do things that won't payoff to an individual company's bottom line. We do things that will have an impact.

In the past, for example, AT&T and Bell Labs. invested in astrophysics and in radioastronomy. There were reasons for doing it but not the Nobel prizes that were won for discovering the cosmic microwave background radiation. They invented the transmitter but they don't produce transmitters, none-the-less, the country has benefited as a result of that discovery. That is the reason why we support research for the long-term. These institutions, whether we're talking

about national laboratories for the universities in which we invest in important and appropriate activities to the federal government. It's not as if we're alone. People have begun to recognize that we have a problem.

Perhaps, particularly the freshman members, the new members of Congress are rushing too fast to judgment or perhaps I am misinterpreting their mandate. One of the problems with this view graph is that it only deals with basic research. There's a lot of applied research in which we're engaged that supports the long-term benefits and development of what you might call enabling technology. No single company is likely to invest in this type of activity. But certainly, from my point of view as the Director of the Office of Energy Research, its this activity that is at stake and there's not one of these agencies that isn't prepared and hasn't been directed by the President or their agency head to run their programs. However, we must find ways to reduce our program costs and to cut the inefficiencies.

The Secretary of Energy has identified up to $14.1 Billion worth of savings over the next 5 years. This is what is at stake and for the most part, the Republicans are going after these programs more seriously than the Administration. The issue here, of course, is new knowledge for technology in 20 years. It takes people to generate and use that knowledge in 20 years. This gives you an example of basic research investments. This is a picture, as you can see, where the stars are user facilities, dots are partners, our users and the institutions at which they exist, about half of those dots are universities, about half are private sector.

Overall, we have 15,000 individual users, including faculty and students, supported not only by the Department of Energy but by other federal agencies. This is, if you will, a virtual organization investing in long-term knowledge. In a way the real challenge is to maintain the vision, find courage to make reductions, and yet to preserve our leadership in science. We must convey a message to our young people that science and engineering are worth going into. I believe that the Administration and certainly, the Secretary of Energy, understand that, I have concerns about where the Congress has been going.

Now, you can tell that I feel strongly about this. I went into this job not because President Clinton gave me this opportunity to do this job but because I think that these programs are very special investments. The 1994 Nobel Prize for neutron scattering went to Cliff Shull for the Kimochino program that we do jointly with the National Institutes of Health. This project is changing the way life science is going to be done. I do this because I love the program. It is hard not to get emotional about and even become political. But that part's of my job. At the same time, I think that what has happened in the last 50 years is that the science and technology community, whether in universities, national labs or private sector, have enjoyed strong bipartisan support from Administration to Administration, from Republicans and Democratic leaders of Congress until the last few months. We need, within the science and technology community to recognize the importance of the contributions of science and not to depend on

bipartisanship support but to rebuild total support. We need to work with our new members, to engage them, to develop them into new champions.

When we formed the partnership and the contract between the federal government and universities of 50 years ago, science was led by a few great individuals. There are many more of use now. I think that we must work together in a joint way that we have not been used to doing. I'm not sure I know how to tell us how to do that but we must really make the effort. It is a longer-term effort than just these few months. Some of the things that will happen in the next few months are not going to be good. We need to make sure that they are perhaps a set of singular incidents as opposed to a true long-term trend. I would say to you that it is really up to you. It's up to us to get the message out about the benefits of science in our life today. How technology is being used at Disney World, how technology is being exploited at Lockheed Martin, how technology that's going to life the shuttle tomorrow morning depends upon knowledge that people generated 20 years ago, 10 years ago, 5 years ago. If we don't make this investment we won't have technology that will drive benefits in our neighborhoods and other parts of the world in 20 years. This is an important element of our future.

Science in the National Interest
A Southeastern Science Policy Colloquium

Panel I: Southeastern Labor Markets and its Impact on corporate/Industry

Heinz Niethammer
Director of Engineering
Kimberly Clark Corp.
Roswell, GA

Thank you, Catherine and good afternoon. It's good to be here and talk about things that are dear to our heart - opportunities for the next generation, bringing out the very best in kids, challenging them and growing them to their potential. To be honest, I probably wouldn't be here if it weren't for Dr. Humphries' very persuasive talent. He visited our facility in Atlanta about a month ago and, as a result, here I am. Since that time, Kimberly Clark has made a commitment to FAMU on a corporate level as we become proactive in furthering the education of our youngsters. We will interface with Southeastern universities to turn their visions and dreams into reality. I've been around long enough to know just how long it takes to make a baby elephant. I've been around long enough to know that rushing that process isn't going to get you anywhere. But I have also been around long enough to know you ain't got nowhere to go if you never get started. So we at Kimberly Clark may be accused of getting started late, but anyway, we're getting started and we're about to help facilitate the change.

I'm here today to bring you a bit of the background of the Kimberly Clark Corporation- where we are and where we're going in the future. Kimberly Clark. When I say the name, most people typically say, "Kimberly who? Kimberly what? Who's that company? The organization started back in 1872 as a partnership. When four guys got together in a place called Nina, Wisconsin. For those of you who need a little help in geography, that's about 150 miles north of Chicago. The first product that they put on the market was what is now known as Kleenex facial tissue. It was put together as a makeup remover and nobody thought it would have the market position that it enjoys today. At one time Kimberly Clark had a 98% market share of feminine napkins. But they didn't quite know how to handle that so they set a totally separate sales organization in the 1930s to handle that product and expand its market. They also got into all sorts of paper products. They worked on that for a little while and the company started growing.

By 1975, shortly after I joined them, they were about a billion dollar organization. Huggies disposable diapers, many of you know by now, is a retail product in the market. We had a presence in what we call non-woven, polypropylenes fabric like structures that we use in many of our products and we have gone into a great variety of industrial papers. We also have started to expand a bit in the international market, but not on a very large scale. All of this was handled out of a strong midwest culture that essentially decided if it's not in the midwest, we don't want it. But then that midwest culture in 1980 did a seemingly strange thing and caused a lot of uproar in the organization. I remember they wrote a one line announcement which essentially said we will

build the administrative site in Roswell, GA. The Board of Directors approved dollars for the site.

Why did they choose Roswell, GA? A number of reasons. They foresaw the development of the consumer products area in the South. They said that it was a good transportation hub. Wisconsin is not a favorite place in the world to attract professional people. They thought Atlanta might be and it turned out to be just that. And they also knew the base of the industry was shifting to the South and so those were some of the reasons we went South. In 1980, we also had five production facilities. The largest one of which is at Cossapine, Alabama which is a pulp and newsprint mill. Kimberly Clark invested over a billion dollars in all sorts of machinery and equipment in that mammoth facility. The rest of them are manufacturing facilities for paper and paper-like products.

So what do we look like by 1995? A couple of things have changed. First of all, our chairman of the board moved from Wisconsin to Dallas, TX. Now that's pretty much the deep South - it's not Southeast, but it's at least South. We've also added another administrative site in Knoxville, TN where we do such things as payroll and benefits and general administration that is not specific to any one business. By that same time, 1995, we have grown from 4-5 facilities to 10 facilities in the South. We have now 5700 people in the South, 1500 of those are professional and 4200 are hourly employees that work in the various mills. If you look at that as compared to the rest of the United States there are some interesting numbers here. The Southeast facilities grew from 3500 people total to about 5700 people. That's a net gain of 2700 people. In all of the United States the employment at Kimberly Clark increased from 12500 to 16300 people - that's an increase of 3800 people. Put it on a percentage basis, the southeast grew 61%, the rest of the country only grew 31%, which just shows you where the shift of activities has been for our corporation. Our Wisconsin headquarters, today, still has 3850 professional people - scientists, engineers, business units and business support units - so it's still the largest units.

Let me get back to that. I have a reason why I referenced this. Our administrative office in Roswell houses about 950 professionals of which 500 are researchers, scientists and engineers. Our Knoxville facility is somewhere in the neighborhood of 350 people and they are in finance, statistics, and payroll kinds of functions. Let me summarize, there are currently close to 1300 professional jobs available in Knoxville and Atlanta that didn't exist in 1980. In addition, Kimberly Clark has increased employment by close to 3000 people in 6 manufacturing sites. These people work in newly constructed facilities and channel millions of dollars into the local economies. The families of these employees tend to use local educational institutions to educate their children. All three of my kids graduated from Georgia schools--the last one, last week. I have no way to assess the total impact of the local economy due to the expansion undertaken by Kimberly Clark.

In the last 15 years I do know, however, that the facilities were constructed using local design and construction firms as well as local companies to provide the services. Many businesses have sprung up in support of Kimberly Clark mills which again provide jobs for people. People who will send their kids to college on their way to becoming permanent, contributing members of the

work force. Most of these will stay in the Southeast and, therefore, continue to support the expansion in growth.

Now, let me talk a little about where we are going. Our chairman of the board who has been working in this position over the last 3 years has challenged us to grow the company to be recognized as one of a handful of best companies in the world: best in products, best in people and best in return to stockholders. We have had a lot of discussions in the last three years on how to make this happen and what we're really after here is continuing growth of a very sound financial company and we want to keep going and make it happen in the years to come.

Science in the National Interest
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Panel IV: K-12 Education: Challenges for the 21st Century

Success for all Children in a Technological Society

Weyman F. Patterson
Coordinator of Mathematics and Science
Atlanta Public Schools
Atlanta, GA

There was once a car factory that manufactured blue cars. Now these were good cars; large, sturdy cars designed to travel the back roads of America. But then-along came the superhighways, one of them was called the information superhighway, and those big blue cars became obsolete. No longer was there a need for cars to carry a heavy load, but there was a demand for smaller, brighter cars, designed to make quick starts, stops, and turns necessary to navigate this information superhighway. Smarter cars-if you will.

So it was decided-to change the blue car factory into one that manufactured red sports cars. It is clear that the blue car factory is a metaphor for the Public Educational System. There is a demand for a new product- a smarter- more critically thinking product, therefore, since the old system was designed to produce a different product the factory must be retro-fitted in order to meet this new demand.

If this were the Ford of Chevrolet factory, we know how this retro-fitting would be carried out. The plant would be closed for re-tooling and the workers would be laid off. But a school system does not have that luxury. We must redesign our infrastructure and upgrade our product at the same time. That means that we cannot produce a red sports car overnight but we can expect that over a period of time the cars will get smaller and redder until the ultimate product is realized. One thing we do know is that once we obtain this ultimate product the infrastructure must be changed so that no blue car will slip through ever again.

In his publication "Megatrends", John Naisbitt seemed to have the foresight of Nostra Damus, when he predicted the advent of the information age. Therefore, we have little basis for doubting his prediction in his latest publication, "Global Paradox," that less is more. He predicts more-smaller work groups communicating and collaborating in order to compete in the world marketplace. It is clear what the mission of K-12 education must be in order to produce players in this game of survival.

The goal of public education must be to produce a more critically thinking, more communicative, more computer literate student. It is only by achieving this goal that we will be able to produce citizens who will be employable in the 21st century. In order to reach this goal we must move with all dispatch to create a paradigm shift in the following: who we choose to teach, what we choose to teach them, and how we choose to teach them.

One might assume that in public education we choose to teach all students. But do we really? Traditionally we have chosen to train only the top 10% of our students for technical areas claiming that the others were "not ready," not ready for algebra, not ready for algebra, not ready for chemistry and so on. This might have been appropriate during the industrial age when as Henry Ford stated that "90% of our population live and work on the genius of the other 10%" It is clear that this is no longer acceptable. Even in a classroom setting it is very easy to choose to teach the well behaved, easy to choose to teach the well motivated, and even easier to choose to teach those with well rounded backgrounds.

We must develop a teacher work force with the willingness and the ability to teach students who represent the converse of all those mentioned above. We must educate a greater number of our students in the same manner in which we have previously educate only our "talented tenth". As we begin to compete in the world market we must do an even better job of preparing them. Given that we must teach all of our students in a meaningful way, how can this be done? Certainly not by reducing the natural rigor of course content, this world prove counterproductive. We can start by making learning more relevant and more participatory. We are dealing with a sound bite generation, we must make learning more interesting. We must also remember that there is no law that says learning cannot be fun.

In Atlanta we intend to facilitate this restructuring process through the Urban Systemic Initiative, a systemic reform effort sponsored by the National Science Foundation. The theme of Atlanta's Initiative is "Success for all Students in a Technological Society" which was derived from the system' s major theme, "Success for all Children. "Dr. Benjamin O. Canada, recently named superintendent, has forth eight student oriented goals in order to accomplish this. One of these goals relate to the fact if we are to prepare Atlanta' s children for tomorrow' s world, it must be through greater access to higher mathematics, science, and technology.

Specifically, we must increase the pool of students who pursue post secondary education, especially in the areas science, mathematics, and technology. This means we must give all students access to higher level science and mathematics training in their early years so that educational background will not be a deterrent to those who would otherwise choose technical careers.

There are usually two barriers to providing all students' access to higher mathematics and science, one is political and the other cognitive. School administrators must strike down the political barrier. Test scores must no longer be the single criterion by which students may be enrolled in certain courses. The cognitive factor must be addressed through appropriate curriculum, teaching methods, and student support programs.

There has been much talk lately that algebra is truly the gatekeeper to higher mathematics and science. There is much credence in this conjecture since concepts developed within this course formulate the language needed to understand higher mathematics, science, and computer programming. If our students are unable to speak the language they are as aliens in a foreign world-

helplessly lost. By that same token, the sooner students are able to speak the language-the sooner they are able to understand higher mathematics and science. Algebra must be accessible to all students during their middle school years, in order for them to participate in a five year program of mathematics and science or early entry into college.

In the past the goal was to get students ready for algebra. The new strategy must be to get algebra (and all other mathematics and science courses) ready for the student. This must be accomplished by making appropriate curriculum revisions and a shift in teaching pedagogy. Algebraic concepts must be introduced in the early elementary grades, and be addressed within a variety of contexts and problem solving situations. Manipulatives should be used to develop core concepts such as signed numbers, polynomials and equations. Functions should be taught across the mathematics curriculum utilizing the graphing calculator and computerized graphing tools.

One other important aspect in this preparation process must be the planning and delivery of instruction with the learning style of the student in mind. Noted researcher Rita Dunn, sets forth a plausible theory that most children can master the same content; how they master it is determined by their individual styles. This hypothesis is supported by a number of studies conducted during the last decade that have found that student's achievement increases when teaching methods match their learning styles-biological and developmental characteristics that affect how they learn.

If mathematics and science are taught and evaluated in only one cognitive mode, only those students who prefer that mode are being adequately served. To give all students the opportunity to succeed, the repertoires of teachers must be expanded to include a variety of cognitive modes. Another goal is to help students move from one preferred learning mode to a base of mixed preferences, so they may benefit from various instructional approaches.

In order to address the various learning styles of today's student a multi-faceted approach to instruction must be employed utilizing a wide variety of teaching techniques and resources including small group projects, interactive laser disc and video tapes, computer applications, exploration, experimentation, and other programs geared to a hands-on approach. There are three phases involved in teaching a concept introduction, development, and reinforcement. Different modalities should be employed at each level to ensure that at some stage the learning styles of all students will be addressed. For example manipulatives might be used to introduce a concept, interactive video used to develop it, and a group project might serve as a means for reinforcement.

The traditional mathematics classroom must be transformed into a non-threatening problem solving environment, where problem solving is the central focus of the curriculum. The learning environment for science must be structured so that students are able to apply the scientific method to interesting and exciting experimental situations. In short we must begin to teach for greater understanding. We must take advantage of the available technology that which will become available to us. Today's computer accessed technology provides the means, not only to do things faster, easier, and more efficiently but allows one to do things he or she would not have been able to

do previously. In order for students to become successful in a technological society they must have access to technology in a regular and systematic manner.

Science in the National Interest
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Panel I: Southeastern Labor Market and its Impact on Corporate/Industry

Ronald Rasmussen
Chief Engineer
Honeywell, Inc.
Clearwater, FL

Major Areas for Discussion:

- key industry and business issues
- skill needs (past, present and future)
- what has been successful in the industry/education system relationship
- implications of change for employer/employee/education system
- how we can partner to meet the challenges Key industry/business issues:

Key industry/business issues:

- cost reduction - companies becoming much more likely to consider buy vs. make; outsourcing becoming common
- systems solutions - will require different thinking approach to problem-solving
- commercialization of formerly government markets
- international markets and competition - lowest cost and customer satisfaction are paramount
- dramatic, acceleratlng, ongoing change - mergers and consolidation
- Cycle time reduction - always translates to lower cost and better schedule performance

- Major concern- reduction of total credits for engineers to graduate, SUS----128 Hrs

- Forcing companies to spend more on training
- Makes Co-ops much more attractive

Skill Needs:

- Technical Skills

- systems engineering (analysis, design, integration)
- software engineering
- program manager and technical director

- Business Skills

- Commercial and international marketing
- general business and financial skills

Behavioral Skills
- change management
- teaming (Integrated Product Development Processes/Cross-functional)
- Leadership skills

Bottom Line: We look for demonstrated classroom success (GPA is important!) and applicable experience as well as leadership activities

Past Relationship successes:
- Campus recruitment pool/process especially the Co-op programs
- Industry/education advisory boards
- Consulting/subcontracting through Engineering schools

Implications of change:
- Increased competition for internal business resources (training investment)
- Emphasis on just in time training and training effectiveness
- Increased responsibility of individual for self development and investment
- Increased outsourcing/partnering with education system
- Greater reliance on Co-op programs

Partnering:
- Review/update of educational system mission and purpose
- Benchmark international technology and education systems
- Reduction of government bureaucracy and legislative restrictions
- Course work consolidation and curriculum/degree standards
- Industry training outsourcing and resource brokering
- Advisory boards and councils

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Panel III: The Role of Academia in Developing the Labor Force

Israel Tribble
Florida Education Fund

I guess I'm the only one here who looks like he wasn't dressed for the occasion. However, please don't hold that against me. I came here to listen and not talk and, of course, some of you may have the problem of thinking that I'm Fred Humphries -- I'm not Fred Humphries. I'm Ike Tribble. Fred Humphries looks a little taller and is a little wider. In all seriousness, Dr. Humphries asked if I would substitute for him this morning and I was not planning to do that so I'm not making any excuses. I just want you to know that I didn't have the time that Dr. Wolfe had to put all of this together but I'm going to try to share something with you rather quickly that I think is important.

I think we're doing it better than anybody else in the country and that is the production of African American Ph.Ds. I want to tell you a little about what we've been able to do over the last 11 years and, hopefully, that will have some bearing on some of the things that you might be thinking about or interested in sharing. Ralph mentioned my latest book which is called, If You Can Walk, You Can Dance, And If You Can Talk, You Can Sing. This is a Zimbabwean proverb and I think the meaning is quite evident. If people, human beings, have the basic tools they can use those to get to the next level. We have implemented that to the maximum and our success at this moment is 78 Ph.D.s graduated and working since 1988. Fifty percent of them in the hard sciences or science related fields. Talk is cheap, if you really don't want it to happen. I guess what we can tell you is that it can happen.

Florida has been fortunate in some ways, but it has also been fortuitous. The McKnight Foundation came to Florida and talked to my former boss, Barbara Newell who was the first woman to head the State University System of Florida, and talked about wanting to do something special in the state of Florida on behalf of Mr. McKnight. Mr. McKnight was the founder of 3M Corporation in case some of you don't know this. In his latter years, he spent a lot of time in Florida. He owned Calder Race Track in Miami, Racing Dates in Tropical Park, and Tartan Farms in Ocala which is one of the finest horse breeding farms in the country. He provided philanthropy for neuroscience and plant biology, owned large holdings in Southeast Bank, which is no longer in existence, and the family thought something ought to go on in the State of Florida that would reflect this man's contribution to the state.

We expected the Foundation to drop 2 or 3 million dollars and they'd get some computers and stuff and go away and everything would be business as usual. Well, when Mr. Ewald came to the Florida Association of Colleges and Universities (FACU) to make his announcement about the commitment of the McKnight Foundation, he indicated that they were willing to invest $15 million. Fifteen million dollars in trying to make a difference. Ten million dollars was a challenge to our governor that if the Legislature would match the $10 million with $5 million

they would put that into a permanent endowment. This would support twenty-five doctoral fellowships for African Americans in perpetuity. Five million dollars were granted to set up the programs and to fund them for 3 years. This all started in 1984. Since then we have 25 doctoral fellowships funded at $16,000 a year for 5 years of guaranteed support. We pay for three years of support. The institution pays for the other two. We have a $80,000 commitment behind each one of our fellowships.

What was very interesting when I started this endeavor about eleven years ago was the litany we heard from leaders in higher education and industry. You will still hear these statements depending on which conversation you choose to ease drop on, depending on where you are. It went something like this - number one, you know they're absent from the Academy which tell you an awful lot about them -- meaning African Americans -- that you know if they are really interested you'd see more of them present but the reason is you know they have very poor preparation at lower education levels especially when it comes to mathematics and science. These are not the people who get into those courses that really prepare them for the more elite kinds of endeavors once they reach higher education. There's really a lack of interest. African Americans do sociology and education real well but with math and science, that's a whole different subject and when we send out the material and they never apply. We have the money and we look for them and they're not in the pipeline, they don't apply.

We have had the good fortune of blowing all of that out of the water. We have averaged approximately 325 - 355 applicants a year, more than 50% of them have been in the hard sciences and science related fields. Our GRE scores have ranged from 680 to 1550. What I really like about this book, and I gave Fred a copy yesterday, is that my co-author Dr. David Stamps, who teaches quantitative methods and is a sociologist at the University of South Florida, did all of the Chi squares so people would think it was legitimate. This one has a whole bunch of tables for you. One looks at GRE scores. Over 60% of our successful students had GRE scores less than a 1000. Our first graduate in engineering, the first African American female ever to graduate in engineering from the University of Florida, had an 840 GRE score combined. She graduated in record time, with a 3.4 cum and is now on the faculty and won Teacher of the Year Award in Fred's College of Engineering!

Word has gotten around the country that we only deal in math and science and that's not true. We deal in the most critical disciplines which are those areas where African Americans are most underrepresented in the Academy. But, somehow, the message gets to people that we only do math and science. Well, that's fine. We knew it was very important for us to succeed in math and science because the rest of it will topple very quickly. This whole issue of the GRE scores is a very potent one. We have a student at FSU who had a 680 combined score, welfare mother of two, worked her way through the Job Corps and a community college. From community college she worked her way through Delaware State University, got a BSW. From there she worked her way through the University of Delaware, got a MSW, and came to us. I fought like hell to give this woman a fellowship and the committee just couldn't bring themselves to awarding a fellowship to someone who had only a 680 GRE score.

After a year in the program at FSU, this woman was teaching the statistic sequence to undergraduates at FSU and FAMU. Last year she was chosen Teacher of the Year and now she is the Associate Director of the Social Welfare Program at FSU. And I could go on to give you other examples, but what I'm trying to tell you is IQ is nothing but a number. "I will" is much stronger than IQ. One has to demonstrate that they believe certain kinds of things. The philosophical premise I believe and try to drive into the young people is one that states where you start out in this world does not have to have any relationship to where you end up.

I explain two things at every single gathering about me. I was born out of wedlock to a teenage mother who only had a 4th grade education. Nobody in my family ever had a high school diploma. Lived in public housing on the railroad track. I go through the whole thing and say, I am here, and you are here, now let's just get on with it. Barring brain damage, anybody can learn. I've been saying that for more than a decade. When I finished speaking recently to teachers in Palm Beach County, a white woman came up afterwards and said Dr. Tribble, I didn't want to disturb you while you were speaking but I just wanted to let you know that I teach exceptional students. I want you to know that even kids with brain damage can learn. I told her that I would never make that statement again without giving her credit because she is absolutely correct.

If you could see the list of our graduates which I'd be glad to share with you and see the fields that they are in, you would agree that they are second tier but not second rate. What I mean is that we didn't go out looking for the highest GRE score or the highest GPA we could find. We continued to look for people who want to give back to their community. When they write that statement, I want to see that they are interested in making their community better and helping others who are going to come behind them. Do they work with stridence? They may do their work, they may do their research but, believe me, the African American students and other students will find them to be extremely solid when it comes to being committed to learning, and to partnerships.

We consider ourselves to be a quasi public entity created by the Florida Legislature, but driven by private sources, with one third of the financing from the Legislature. Everybody's calling us up asking what's going to happen based on Podberesky, who is a Hispanic and whom I am having difficulty understanding. I'm sure there's a whole story behind it and the Banneker Scholarship at the University of Maryland and the latest Supreme Court decision. How are we going to continue? I think we're going to continue because restricted money has to be spent as the donor says it's going to be spent. I don't think they are going to be able to come after us. We may have to get rid of our public involvement and make up that other part of the endowment with private money to make sure they can't come after us. Even when the Legislature gives money for particular reason, and it goes into a new corporate pot, it protects us from the challenge that is going to continue to be made on race based scholarships.

The issue of partnership with industry, and one of the problems I'm having for those of you from industry, is that you have short term thinking driving the train. You only want to give money when you can get the graduate immediately, when they earn their degree. What you miss is that

it's very important to have faculty in electrical engineering and chemical engineering and in mathematics and science so that they can produce more students who have the ability over the long haul. If I tell you that I'm trying to produce Ph.D.s who will go into the Academy. You tell me that's not what you want and I'm telling you that's shortsighted. I'm telling you for every faculty member in engineering that I can place who will have a 20 - 30 year teaching span, that the potential for them turning out more students who are going to look like them is so much greater than your worrying about hiring somebody for $30,000 a year. You don't see the value and I think it's short sighted. You also don't see the value in new models. If I'm producing in academia a researcher and they've got a nine month contract, there's no reason why you can't sign a 5 year deal to take them every summer and let them do research for you. What's wrong with that? Or to take them every other semester and have them work for you. But don't take them away from the Academy because we have too few to go around.

The issue in the Southeast is the desegregation of American higher education. There's only one way to desegregate American higher education in this country and that's to produce as many Ph.D.s, as rapidly as you can, from the groups that are most underrepresented. These groups are African Americans, Chicanos, Puerto Ricans and Native Americans. Somehow if you start taking them all as soon as I can produce them and start giving them a fat check, then I can't make a difference in that pipeline over the long haul. That's not to say that your money should not be spent to really meet the objectives of your particular company, but I think you ought to be thinking of more than just the short term because we are finding that an awful lot of people, even after they spend time at Bell Labs as Anitra and Roderick did, their commitment has always been to come back and give back. So you may get them for 3 or 4 years but it is not for the long haul. We're indoctrinating them. It's just as real as I can stand here and tell you. They got to come back and they got to give back. If it takes them 10 years, if it takes 15 years, they're coming back. I think what you want to do is be a part of the solution, that is, let's put as many of them in front of the classroom as we possibly can. They're going to make a difference in your work force in more ways than one. And one of the big differences they're going to make is with White students.

It is the White student who doesn't believe that we can learn and he or she struggles everyday with an African American professor trying to figure out whether or not they're telling them the truth. I wish I was being facetious. But you can talk to the Fellows, you can talk to our Council of Elders who are senior academics around this country, and every day they go through that with White students challenging their discipline, when these folks don't know fecal matter from shinola. It's really something after you struggle getting through science, math and technology to get a Ph.D. to have some snotty nose from Chitterling Switch, Georgia challenge you on a daily basis. It takes away from all that you want to do. I wish it was a minor problem but it is a major problem.

One of our Council of Elders is Dr. Fatima Jackson who is a biological anthropologist with all of her degrees from Cornell University, with honors, and the University of Maryland. The stories she tell of the students at the University of Maryland in her classes everyday would have you sit there and say "Well, my God, how do you continue to do this?" You just want to backhand them

and say get away. It really is a challenge. It's just not a matter of producing them but then getting them in the classroom and getting them to stay based on what happens to them. One issue that we find that will contribute to our success is doing something about isolation.

In this particular area of math and science, African American students, in particular, are isolated at a very early age, especially if they are in an "integrated setting" and I put that in quotes, that means a mixture of folks. That isolation gets more intense the higher they go. To the point that when we first sent our science student to the University of Florida in many of the labs that they went into, the only time that those folks had ever seen an African American in a lab was to clean them. To see a student sitting for 18 - 20 hours at a time looking at test tubes and experiments was not something they were used to doing and we've got a lot of other places where that is still true in a number of departments. If you want to grow the work force, we've got to put people in the Academy to help develop the workforce. Can it be done with quality, absolutely. Every last one of our graduates are employed.

We're managing to keep over 65% of them here in the state of Florida by making competitive offers not for any other reasons. They don't have to stay, they have nothing to pay back when they're finished. We're averaging 4 years and 10 months to the degree when the national average is 7.2 years. Why, because we monitor their progress. There are a number of things that I'm not going to get into about GRE scores. We not only give our Fellows $16,000 but we also give a $300 computer allowance a year for 3 years to make sure that all of them have a working PC. We also give them $600 for books, over and above their stipends, tuition and fees. We also give them a $300 medical allowance. They came and said, "do you know that if one of us gets sick in a serious way, we don't have major medical?" I had no way of knowing. The $300 won't get the whole thing done but it at least helps them to make sure that they will at least invest in some major medical insurance. We have a travel fund. Our Fellows can present a paper with a faculty member or otherwise, any where in the world. We will pay 50% of their cost to get there.

We sent some of Fred's students to Switzerland. We sent one young man who just came out of Fuzzlogic to Japan. We will do that but the idea is to make their home institution invest 50% in their welfare and our belief is that if we can get them invested, we've got a good chance of getting them out successful. I only brought about 6 of these because they arrived before I left home. I do have six copies. If any of you are interested, I guarantee you there are some data in here that you can use that nobody has put in writing and that you can document in the history of graduate education. If you are interested, just see me afterwards. Fred, thanks for the opportunity. I'm sorry I didn't come dressed for the occasion but who cares. Thank you very much.

Science in the National Interest

A Southeastern Science Policy Colloquium

Panel II: New Issues for Science and Technology in the Year 2000

Paul Waugaman
Southern Technology Council
Research Triangle Park, NC

Let me tell you, the acts get tougher and tougher to follow. I'm here to bring us from a high plain of discourse to practicality and that is to deal with the issue of university-industry technology transfer which is becoming significant for basic science supported by public funding. What I think I was asked to talk was how we can do that better and how that links up with the concept of transferring or translating science to technology and basic research into results that are commercially valuable. And that, I think is a major portion of where we're going with a public science and technology policy and how we get there. I want to talk about a study that I did with Dr. Lewis Tornasky at the Southern Technology Council (STC) on how well we're doing technology transfer from university laboratories to the marketplace. We are working in the Southeastern Region and why did we do this? The Southern Technology Council is responsible for looking at how technology is developed and disseminated in this 14 state regional for the purposes of economic development.

Southern universities represent a huge public investment - about $4.3 billion in research and development is accomplished in the universities in this part of the country. They can be part of an expanded economic development strategy that includes growing technology based companies as well as attracting companies. Dr. Mulkey at lunch talked a little about the Southern economic development strategy of bringing companies here and that's not working anymore. The kind of companies that were attracted here 30 and 40 years ago are not stopping in the South. They are going right to Latin America, they're going off shore or they're going to Southeast Asia where the kind of labor that was our stock and trade in the Southeast is much less expensive. States and universities elsewhere in the country are doing better. They are providing benchmarks and what we have found is just as educated people leave this region, research opportunities are leaving this region as well. We've called that sort of an intellectual balance of trade. What about our study?

Last fall we surveyed a series of 40 institutions in this region. This was the second time we conducted this survey as we built on the original study that included 27 institutions. The study was partially supported by the Epscore Program of the National Science Foundation. We collected information that would allow us to develop performance benchmarks which are standardized and independent of institutional size. We collected information which assessed the impact on state economic development. The report was published on the benchmarking study in April and I have a few copies for distribution.

If you're interested I'll be happy to let you have one or take your card and send you one. We also have a practice, best practice, study that looks at universities practices that work in developing startup companies and that report should be completed in August.

What did we find first about technology transfer performance? I want to digress here a minute. Those 40 institutions that participated in this study represent about 95% of the academic R&D expenditures in this region. They were selected because they had invested in patenting and licensing in technology transfer or because they had recorded in 1993, or before, at least one patent assigned to a faculty member or assigned to an institution. There were no Historically Black Colleges, or universities in that sample. This distresses me a bit because I think that there is room to grow academic research programs in this area to consider all of the Historically Black institutions in this region..

What we found between the first study and the second was a rapid growth in licensing activity. More deals are being done. The institutions rival some of the national leaders in terms of the number of licenses per $10 million of research expenditures and in terms or royalty returned on investment. We had institutions in the range of 4%- 12% among our benchmark institutions. The vast majority of intellectual property from these 40 institutions is licensed out of state. Seventy-one point four percent (71.4%) of the licenses and 96% of royalties come from out of state or 84% of the royalties come from outside the region. In other words, we're not even licensing from Louisiana to North Carolina. We're licensing from Louisiana to California or North Carolina to Massachusetts. The licensing of start up companies is relatively low. Only 11% of the licenses went to start up companies.

There is an institutional disparity that is reflected in the ranges published in the study. We published ranges of data for the participants. Institutions in the Epscore states generally score lower on the performance rating. Who was good? We promised everybody that we would keep the information confidential, but when we got the best in the class nobody minded too much. We found that the largest number of licenses per $10 million of research were among the following institutions: Georgia Tech, North Carolina State, University of North Carolina at Charlotte and University of North Carolina at Charlotte, Tulane, Clemson and University of Virginia.

We found that the schools with the largest number of licenses within a state were: Central Florida, working a lot with the companies between here and there, University of Alabama at Huntsville, University of North Carolina at Charlotte and University of Mississippi. Others who were doing well in this area are: University of Miami, University of Georgia, University of Alabama at Birmingham, University of Florida, North Carolina State and again, Virginia. In state royalties Huntsville, Mississippi, South Carolina, Birmingham, Florida and Virginia did very well again. We were curious. Why were some of these institutions doing so well in local economic impact and any others were not doing so well? We wanted to look at it. We wanted to look at start up and spin off. It seems to be fairly arcane: are there things that successful institutions are doing better?

We noted a weakness - there are not a lot of firms that are technology springs in the Southeast. New business startup in terms of economic development can accomplish a lot with a little and it can sort of serve as a way to really speed up the economic engine. Every university invention is appropriate for business startup. We recognize that and we were told that by people who know a lot more that we do and have a lot more experience than we do at doing it and we understand that. However, what we found was there are some conscious efforts that an academic institution and a business community that is aligned with an academic institution, can do to promote the development of startups. What were some of those things? Again, this is a preview of the report we hope to finish in a month or so.

There are some institutions who have consciously accepted an economic development mission and have made that clear to their faculty, to their trustees, to their stockholders. For that institution this is really a part of what they do. One way that they do economic development is to promote the development of business startups, by using their research results. There's a linkage to a business development infrastructure in the community such as business incubators, venture capital networks and entrepreneur support networks. In many cases there is novel early stage financing which permits ideas to germinate and gain value before an in institution has to spend money.

The state of Georgia, for example, has the Georgia Research Alliance which has a specific program of support for development and transfer of concepts. Those institutions that do well pay attention to the faculty culture and promote s sense among the faculty that it's okay to invent, that it's okay to work with companies, that it is okay to take time to develop a venture. Now, that gets into the issue of conflict of interest, and sometimes that requires a careful look at state law and how states treat faculty at public institutions.

Lastly, there's the ability to be flexible when you make deals. All right , where do we go from there with these findings and with this effort? We disseminate. This is one of our opportunities and we appreciate the chance to bend your ear. We will make a presentation to the southern governors in September. I didn't mention it but the Southern Technology Council is part of the Southern Growth Policy Board. We are organizing a conference that will be held at the University of Mississippi in November. What we would like to see come out of that is some very focused state activity that looks at strategies within a state, within a state community on how to really get and promote more attention to startups and spin-offs. What will have to be done in the particular environment of be that state will be discussed at that conference and we hope to discuss and bring forth some of these best practices.

We care continuing our efforts with the encouragement of the National Science Foundation we hope to receive support to develop more outreach efforts that will help institutions and we'll be able to work institutions one-on-one to help improve performance. So that's what we're about and I think this is really an interesting effort to really move the management of science and conduct of research and development in academic institutions at higher state of relevance. Thank you.

Science in the National Interest
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Breakout Session: K-12 Education

Melvin R. Webb
Professor of Biology
Clark-Atlanta University
Atlanta, GA

1. Families, communities, institutions and organization must work together and share in the responsibility of insuring that all children enter school ready to learn

2. Colleges and universities must take definitive steps to improve the quality of preservice education

   - Cooperative efforts involving schools of education, schools of arts and sciences/enqineerinq and school
   - districts
   - Development of clinical staffs
   - Revise promotion and tenure procedures to include rewards for work in the pre-college arena
   - Develop innovative programs in teacher education-mathematics and science majors for elementary education, secondary level to include research internships as SEM majors
   - Increase emphasis on the use of technologies and how to integrate them into the teaching-learning process
   - Research on teaching and learning
   - Provide opportunities for academic enrichment through programs such as Saturday Science Academies, Summer Science Camps, Research Apprenticeships, Summer Science, Engineering and Mathematics Institutes

3. All children must be exposed to a standards-based curriculum-that is to say that all students be exposed to the same curriculum developed from the dame curriculum framework, K-12, particularly in SEM

4. Develop a clear and concise definition of contemporary scientific and technological literacy

5. Specify the core content and skills-what students should know and be able to do in precolleqe SEM

6. Cooperative efforts with business, industry and government to work with schools-provide role models and current career information-expand these efforts to include retired SEM Personnel and technology

7. Colleges and universities become proactive in reclaiming their role in the in-service and professional development of teachers

8. Summer internships for teachers in business, industry and national laboratories
    - Promote the importance of homework as it relates to academic achievement and achievement indicators such as SAT scores

9. Eliminate tracking and ability grouping in all schools at all levels

10. Make college and SEM career options known to children beginning in the middle school years

11. Promote the attainment of the ability to speak at least one foreign language

12. Promote the active engagement of parents in the education of their children

Science in the National Interest
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Panel III: The Role of Academia in Developing the Labor Force

John T. Wolfe, Jr.
President
Savannah State College
Savannah, GA

Thank you very much, Dr. Turner for that introduction. Good morning, I am struck by the irony of this Colloquium in the State of Florida. As I reflect on an experience in childhood, here at Kennedy Space Center, where the shuttle that is about to go into space today, or in the next few days. Ecology, mice and my childhood memories take me back to mighty mouse. I am sure there are people in this room who remember the cartoon about the mouse that did not succeed, and Mickey, the mouse that did succeed. There's another irony in this Colloquium. It relates to the characterization of institutions of higher learning and the badgering that has gone on most of yesterday and today with respect to hierarchy that I find very intriguing.

I want to start by talking about Savannah State College. It is Historically Black College that was founded in 1890 and is located on a salt march estuary of the Wilmington River section of the Atlantic intercoastal waterway. It is one of the few institution on the eastern seaboard that has such a location. In fact I do not know of another one that does on the eastern seaboard, which makes it ripe for the kinds of ventures that we have discussed yesterday and today.

As I go into my prepared remarks I will reflect on some reading that I've have recently undertaken mainly as a means of escape from the vulgarizes of being a College President. I have begun reading works in quantum mechanics, systems theory, and information science. For example, the book of noble laureate and theoretical physicist, Mary Gellmonds "The Quark and The Jaguar" is my current challenge. I would recommend it to you. It is this story of finding the connections between the basic laws of physics and the complexity and the diversity of natural world. Gellmond is the founder of the Santa Fe Institute where scientist are investigating the similarities and differences among the complex adaptive systems.

The study of systems that learn or evolve by utilizing acquired information is very important for this Colloquium. Academia is such a system. So is government, as well as industry. All seen slow in some respects to learn or evolve using acquired information to meet societal changes. I think our first speaker this morning made a number of references to this problem. Roberts submit that there is an expanding body of evidence that suggests heightened sensitivity and responsiveness to the utility of information in at least two areas. They have been alluded to most of yesterday's presentations. One is a marked decline in the number of bachelors degrees awarded in science and technology between 1986-87 and 1991-92. For the region that we're talking about, it was a 10.5% decline. Second, the United States superiority in science and technology is at stake. Yesterday's speakers made clear the multitude of conditions and issues that impact an investment in the scientific enterprise at a rate that is commensurate with its

relative importance in this society. I offer, therefore, a point of view on the topic before us from the perspective of a small liberal arts college president who has taught, and continues to teach language and literature to students - some of whom pursue science. That's critical because there has been only one speaker, the speak last night, to make specific, explicit reference to this. I'm sorry the speaker this morning did as well. Most of the references have been by inference. Thinking is perhaps the most critical of all the areas that we deal with in academia-especially in the sciences and technology.

My view of the academy is a mixed one because we have been inconsistent in our commitment to the development of skills, competence and expertise, as a part of all degree programs, especially in the sciences and their respective disciplines. You see, there would be no scientists or mathematicians without science or mathematics teachers to teach them. There are no science or mathematics teachers without the theory and knowledge created by scientists and mathematicians. Thus, it may seem that the role of academia is really clear. "Science in the National Interest" does suggest that. Today as in 1957, and I pick 1957 because it was the year of the launching of SPUTNIK, for scientist and for linguists it was also a critical year. The linguist Chompsky published as his doctoral dissertation the syntactic theory which took information sciences and applied it to the study of language theory. This created a revolution in the teaching of language.

In systems theory there is a principle of behavior called the Law of Requisite variety which states that in order to control an external variable a system needs to have within a level of variety in its responses that matches the variation exhibited by the variable or system that it is attempting to control. What are we attempting to control? In this region, the quality, the character, and the shape of the labor force. Represented here today are various adaptive systems -- industry, government academic and the scientific community. Each in its own way is seeking ways to create and utilize knowledge to forge and strengthen partnerships that will build and sustain a skilled and competent labor force to serve the national interest. Perhaps the most important consideration therein, especially for academic, is the need to recognize the impact of fluctuation. The fluctuating size of the variability within the pool of talent we seek to develop dictates a variety of responses.

Several speakers have alluded to the variability in organizations that are responding, particularly in the higher education community. This is a concern because the 50 top research universities in America can not teach all Americans science. They don't have the capacity. Secondly, I would submit that many don't have the inclination to do so. We need to start dealing with some basic realities. It requires variation according to our respective resources, the diversity and breath of program offering, and support services in the sciences and technology. Institutional diversity is the most important part of this and is dictated by problems we face today. The tone I heard yesterday was for a certain level science and technology. But we can't have this level without some structure.

You need laboratory technicians and lower level people who do the things that enable education to occur. Where do they get trained and who trains them? The top 50 universities in America? Some do, but not all. What we learn for meetings such as this provides a basis for the adaptation and modification both in the variety and coordination of responses. However, our immediate problem is in matching our responses to the fluctuation and variation exhibited by the pool of talent we seek to develop. This is the Law of Requisite variety. I would also submit that any form of "hedge" money is an impediment to developing the kind of labor force that we've been talking about. It requires a variety of responses that matches variability in that pool - that diversity which must be in that pool. At the same time, it requires creating and maintaining a flexible, adaptive infrastructure that evolves as a consequence of new knowledge to meet the labor needs 20 years from now and 50 years from now. This requires some of the following: A projected analysis of trends impacting degree programs and labor force demands to be reflected in colleges and universities course offerings, creation of programs and career ladders consistent with the needs of business and industry that do not currently exist, and with variable time frames for completion. A reference was made yesterday to the fact that we do not pay attention to how people learn and we don't do so in colleges and universities across al disciples. People learn by seeing, by doing and by hearing. We tend to teach as we've been doing here today. That is, somebody stands up in front and talks. People across this country are beginning to get into that as the question about distant learning was raised a moment ago - that's one model.

Another important piece is conversation of various kinds occurs in anticipation of economic downturns. We must extend the academy's proactive involvement in human resource development to the preschool level. I'm not just talking about as resource people, but going into the communities and becoming intimately involved in impoverished school districts. That's critical to development because talent is not a function of the institution, its a function of the pool. The variability is there and we don't deal with that systematically in higher education. The Academy's responsiveness role is time sensitive.

Let me offer some concrete examples of the Academy's role and I'm going to give the George flavor to this. We're in Florida but I'm going to give the George flavor because I believe there are some things going on in Georgia that are unique to higher education in America and The relations to the problem that we are dealing with. If you know your geography you know that Georgia is the largest state in terms of land mass east of the Mississippi River. Some interesting things have been happening in Georgia.

Since 1983, here has been a 66% increase in student enrollment in higher education in the state of Georgia. Savannah State College alone has had a 92% increase in enrollment since 1986, currently with slightly over 3300 students. This is an interesting phenomena because in a number of the transparencies that were presented yesterday, there was reference repeatedly to Georgia Tech, a premier institution of the state of Georgia - no question. Black student enrollment in the state of Georgia for this past academic year accounted for 66.5% of the enrollment growth in the state. I would go back to those who used Georgia Tech as a reference and ask how many students recruited out of Georgia Tech were African-American or other minorities. A critical question in the use of the human resource pool of the United States of America.

Another important piece is visionary leadership, partnership and opportunity. All go together. In the state of Georgia because we have what I would consider to be a visionary Governor in Zell Miller, some things are happening in state government and higher education that should be a model for the rest of the nation. One is reading a state in accord with the respect to the importance of academia, particularly the diversity of institutions. There are 34 institutions in the University System of Georgia-2 year and 4 year research institutions. Three are Black institutions, Savannah State College, Albany State College and Fort Valley College. They all have a particular proactive role to play in the education of the citizens of the State of Georgia and in the Southeastern region. We get students a Savannah State and throughout the system from all over the region. These are some examples of Georgia State Initiatives. A recent partnership with the Department of Adult and Technical Education focuses on seamless education system. The P16 initiative mounts an all out assault for improving elementary and secondary education. No matter how good we purpose to be at the higher education level, we have no value if the people coming to us are not well educated with basic skills, among which I would rank thinking as the most important with writing and reading being next.

In February of 1992, the governor created the Governor's Council on Science and Technology Development and this is what its vision statement says: "The state will focus on existing resources and dedicate future investments to the development of its research and educational capabilities and to foster a state wide environment in which technology based industries can prosper and other industries can benefit from existing and new technologies." Through these efforts, we can continue to improve the standard of living for every Georgian. Something else we need to be mindful of the whole arena of higher education with emphasis on affordability and access. If the door closes, there are no scientists, engineers or teachers. Be aware that in Congress recently William P. Luther , a Democrat from Minnesota and Dick Zimmer, a Republican from New Jersey have asked The General Accounting Office to look at affordability and access in higher education which has a serious impact on the issues before us. Someone mentioned yesterday the need to provide for the best and brightest.

Yes, of course, by all means. But best and brightest, as I mentioned a moment ago, tend to come from those talented schools and the prestigious schools. However, the best and brightest can also be found in impoverished communities and there are literally millions of examples I regret the decline of Catholic Schools where sisters, brothers and priests taught because that's where I attended high school. We all recognize the absence of discipline in the school, at home, and on college and universities campus across this nation which impacts directly, and explicitly, on the quality of work force that we get and deal with.

I want to close on a couple of other points about Georgia and mention two things about Savannah State. One thing that has come out of Governor Zell Miller's leadership that I think is an example of what can be done to improve the pool has to do with the Hope Scholarships and the

use of Georgia Lottery Revenue. I know that a number of states have a lottery. They are the using the funds for all kinds of sundry purposes. However, I think that the Georgia system is visionary. In 1993-94, its first year, they provided scholarships for 43,000 students. Last year in 1994-95 there were scholarships for 80,000 students some $52 million dollars. The projection for 1995-96 year is for 225,000 students scholarships. They did some important things. Hope scholarships were available to Georgia students who had a B average in high school. As scholarship recipients they would have tuition and fees paid if they went to college in the state.

A survey revealed that 28% of the students who graduated from high school this is a serious indictment of elementary and secondary school systems and received Hope Scholarships last year, could not maintain the B average in college. Typical of modification of the strategies rather than address the cause, we adjusted on the other end. That is, removed the 3.0 requirement and gave them a second change. This will increase the pool of students. Two other dimensions have been added. There is an emphasis on what they is called Perma scholarship which provide for up to $10K toward the cost of majoring in a critical fields: middle grades education, science and mathematics education and selected other areas for grades 7-12.

Another thing that the Lottery fund is used for is to helps small school like Savannah State. The Governor created what is called the Equipment Technology and Construction Trust Fund. In 1993-94, the fund contained $70 million. Last year there was $14 million and it is expected to be between $28-$32 million this year. This fund provides for the acquisition of scientific equipment and construction of scientific buildings on a 1 to 1 dollar match using non-state funds. Last year Savannah State was able to come up with $300,000 and we got $600,00 for scientific equipment which we would not have been able to raise. These are visionary kinds of things for partnership with government.

Distance learning is another important dimension. We've been able to move into creating three distance learning centers on our campus in less than a year as a mode of delivery that we solely need. In closing, let me mention some institutional initiatives we have put in place at Savannah State have a direct bearing on the creation a labor pool. We believe at Savannah State that small or large, if you are an institution of higher learning, you must take initiatives to impact the pool of talent across all disciplines. However, the focus today is sciences. What is entrepreneurship? We believe that people trained in all disciplines on our campus should be exposed to entrepreneurship and the example I frequently give relates to the sciences where a young man or woman in chemistry or biology graduates with a BS degree. They go work in government, they to do graduate school or they go into private industry. Typically, if they do well and are competent, they will advance--they might get sent back to school or they may get other kinds of training through the company or organization. Typically, they end up managing over a period of time, but where in the educational process have they been given management exposure? It's a critical deficient in al of our education.

Another thing we've done at Savannah State is to create what we call the US Africa Trade and Technology Center. We went to Congress asking for $4.1 million, we got $300,000. We used that $300,000, and Fred yesterday spoke of leveraging, to get another $300,000 from the state of Georgia. It will be a conduit for small businesses, particularly in technology areas. These are the kinds of things that don't typically get talked about in forums such as this where small institutions - 3000 students are doing things that contribute to the scientific infrastructure of this country. Another program we call the Center for Advanced Water technology and Energy Systems. This Center has raised a million dollars from the Department of Energy to create a center that provides training for developing countries in the water purification, irrigation area and alternative energy sources--sustainable energy sources - wind and solar.

These are the kinds of things that small colleges, small Black colleges can do to support the infrastructure. That's the role that all colleges and universities can and should play. It comes from a forging of a partnership, having visionary leadership and capitalizing on the opportunity. The things that are being done in the state of Georgia are not likely to continue if things occur in Congress that we hear about if the economy continues to slow down. The resources will not be there and it will require even greater visionary leadership. I thank you.

Science in the National Interest
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Panel II: New Issues for Science and Technology in the Year 2000 and Beyond

Russell Wright
Acting Director
Environmental Services Division
Environmental Protection Agency
Atlanta, GA

Let me say first that I'm glad to be here with you. This journey started out about a month ago when Carol Browner, who is my agency's administrator, was invited to give this presentations. For scheduling reasons she could not attend. She asked my immediate boss, John Hankerson, who is the regional administrator, to attend in her absence but due to prior commitments, he could not attend. He, in turn, asked me to attend. I, too, had a conflict; however, it was suggested that I attend. So I've been juggling my schedule for the last month. If you see me weaving a little bit it's because I left Kansas City this morning at 5: 00 a.m. to be here. Nevertheless, I am happy to be here because science and technology is something I enjoy talking about. Having this assignment, I am reminded of a statement Winston Churchill made when he said, "I was not the lion, but it feels to me that I should give the lion's roar."

I will talk to you about where the Environmental Protection Agency would like to take science and technology. As a scientist, I'm on the implementing side of policy. All of our policy is generated and approved at the Washington level, therefore, all that I say to you today is basic information that we have investigated and researched over the years, and in some cases speaks to what we envision for the year 2000 and beyond. As you may know, the Agency is entering what a lot of us perceive as a new generation of environmental protection. As such, the development of a vision of environmental protection for the year 2000 was undertaken by a science advisor group that Carol Browner and David Gardner, assistant administrator, who was commisssioned to look at science needs that relate to environmental protection for the next 5 or 10 years as the short term, and the next 20 years as the long term.

Let's spend a few minutes talking about some health related issues that I think you would be interested in and some special project activities that we are involved in the state of Florida. Human health affects and long term health problems, and the social disorders associated with them, are often induced by factors that are enhanced by environmental degradation of some sort whether it's air, water, waste disposal. Over the years we have observed areas of human health effects and associated ecosystem effects that we should pay particular attention to as we move forward in the year 2000 and beyond. I think that every environmental media has some potential impact on human health effects. The manner in which the Agency addresses those effects will have a great impact on stress and disorders from a social standpoint and a human health standpoint. I think you will find that even with the information highway coming on line, there's still a big concern about the stress imposed from the environmental highway itself and how

people can either be included or excluded. When you start looking at the economic equity issues, you are forced to start looking at the area of environmental concerns. The massive increase in population in certain areas of the country will require agencies like EPA to become more proactive rather than reactive when it comes down to protecting the environment and human health.

This leads me to another area of concern that we have and that is global climate change. A lot of you, especially those here in the State, who are involved in the science arena may be aware of the Everglades study that we're involved with here in South Florida. My office is responsible for the investigation of mercury in the Everglades ecosystem. There are about 23 other agencies involved with such a study. One of our major roles with this study is the investigation of mercury and its effect on the Everglades. I believe based on our preliminary data and information that we have a pretty good handle on exactly what's happening to the soil, the water and its potential contributing factors.

However, we are less certain as to what is taking place in the climatological and atmospheric areas as related to the mercury and its depositions. We are finding that there are a lot of potential and/or unknown atmospheric contributors to the Everglades ecosystem. As you know, it is different when trying to totally fabricate an atmospheric model the same as you could a water model. As a result, we are having extreme difficulty in trying to decide exactly what's happening to mercury in the Everglades from a global perspective. We are faced with several key unknowns. For example, what are some of the significant global contributors? This is something I think we will be addressing for many years and I like the idea of having the time to look beyond 2000 to try and sort out what may be happening to the global environment. I think one of our greatest challenges is going to be just how are we going to assess and quantify atmospheric pollution? Institutions like Florida A&M and other universities have in the state of Florida have a great opportunity to get involved with trying to quantify what is happening to our global climate especially when it comes to mercury deposition. You will continue to hear a lot about atmospheric ozone and toxicant air pollutants. Believe me, there are still gross unknowns about how these may be contributing to the health-related impacts that are being imposed on human health and the environment.

We are scrambling to try and quantify the Region's ecosystems. As you probably know, the administrator and the deputy administrator have challenged the Agency to come up with something called community based environmental protection. What that involves is trying to quantify and segment communities and determine their ecological impact on those communities on a smaller scale rather than a larger scale. We are addressing community needs and concerns as they affect human health on an area basis. We're finding that there are a lot of challenges in the area of ecosystem protection. One of the big problems that we are facing is trying to figure our what an ecosystem is. We basically have been challenged by a couple of our other regional offices, Region 6 and Region 7, to take on the ecosystem of the Mississippi Delta and its

contributors. As you well know, the Mississippi Region covers a lot of territory. We're assessing the extent of this system in an effort to regionalize the study.

So we're trying to look at segments of Region 4, the southeastern states, and put together a partnership with academia, the states, and private sector that will address community based environmental protection. I believe that if we can keep the partnership concept in mind, and really look and correct some of the mistakes that we made in the past and figure out where we need to go in the future, we can make some progressive strides toward community based environmental protection.

As you know, we started out in the early 1970s when Richard Nixon put together the Environmental Protection Agency. We had a pretty good reputation in the early 1970s of really looking at science issues and trying to do scientific research. You also know that we lost that credibility because we got overwhelmed with regulatory policies and really lost sight of the main agenda, which is environmental protection. I have to say the present administration is really trying to focus the Agency's mission to fulfilling its objective by offering the American public sensibly, cost effective environmental protection. It is not easy. We have gotten so caught up with the paper and policy aspects of today's society to the point that we will probably be looking at year 2000 and beyond before we can really get back to what I call good science and environmental protection, something that I think the American public truly deserves and would like to have. In order for us to be successful, we need your support. The Agency is very serious about focusing in on a partnership with the academic community.

With the pressures that you can bring to the forefront of good science and environmental protection, whether it's on community based areas or regional areas, the academic institutions can really help this Agency, and other agencies that are involved in environmental matters get back on schedule and back on track with looking at true environmental protection. The state and federal sectors realize now that we all need help and no one can be expected to solve the environmental problems alone. I believe you can also be very instrumental in helping EPA, and other federal agencies as well as the state, get their agendas together and promote and participate in strong science initiatives.

One of the problems we have now, and I don't think its unique to my Agency, is that we generate tons and tons of data and information that everybody could basically use if we could only get it into a system that the people can relate to. I believe the academic community can help in recommending to federal agencies to utilize the data that you've already cumulated and make some sense out of it before generating new data. Timeliness and effectiveness are very critical in the year 2000 and beyond. One of the arguments that I have with some of my colleagues is that EPA should look into researching environmental unknowns of things and areas that other parts of the Agency would be able to use in the future. We have got to strike while the iron is hot

because time is running out. And I say the same thing to the academic community, research those things that need researching that would help make sound scientific decisions in the future.

Together let's attach some of the big issues that are facing us rather than trying to do them in a vacuum like we've done in the past. I think that we need to change the way we approach our research and look at changing the way we look at the problems that are facing us today and really make that definition of partnership a reality.

Science in the National Interest
A Southeastern Science Policy Colloquium

Panel III: The Role of Academia in Developing the Labor Force of the Southeast

Donald W. Zacharias
President Emeritus
Mississippi State University

All of us are aware that higher education is being challenged as never before to demonstrate its accountability for the wise use of public funds, to arrest the growth in costs faced by students and their parents, to improve access for all members of our society who are willing to pursue the benefit of higher education, and even on occasion to defend the intrinsic worth of a college degree.

It is all too easy and all too common for those of us in higher education to become defensive when we are stung by criticisms such as those of author Allan Bloom (The Closing of the American Mind, New York: Simon and Schuster, 1987) or Sixty Minutes ("Get Real," Feb. 26, 1995). We want to assert our prerogative to keep on doing just what we have been doing. After all, people earn bachelor's degrees from American colleges and universities. What could possibly be wrong or need improving?

In fact, however, expectations for higher education are rising, as was aptly pointed out by the 1993 report of the Wingspread Group on Higher Education titled "An American Imperative: Higher Expectations for Higher Education." That report challenged us to rethink what society needs from higher education and to examine critically how well we are responding. Among the needs cited in the report were:

- Very high quality undergraduate education.
- An affordable, cost-effective educational enterprise offering lifelong learning.
- A commitment to the American promise-the idea that all Americans have the opportunity to develop their talents to the fullest.
- a "competent and adaptable workforce."

We must agree that helping to develop the labor force of the Southeast is a high priority for our institutions, and there are many things that we can and should do that will help ensure that our graduates are ready to work or pursue advanced degrees when they leave our campuses.

Even more important to ensuring that the labor force of the future is adequate is a determination to fulfill the other, more basic needs that I cited a moment ago. If we provide high quality undergraduate education that inculcates the skills and habits of lifelong learning and is at the same time accessible and affordable, then the quality of the labor force will be assured.

In fact, we must constantly resist the temptation to focus too narrowly on the short-term needs of the workplace. In that case, we may produce graduates who are trained in knowledge that is current, but short-lived. They may be inadequately prepared to adapt to a lifetime of rapid change, which may include the need to learn skills for whole new careers.

The solution that is easy to prescribe, but somewhat harder to achieve,-is to ensure that our graduates acquire the skills that will enable them to adapt to a rapidly changing environment. I refer, of course, to the abilities to think and solve problems creatively, to communicate effectively, to use mathematics and to adopt the proclivity to keep on learning independently for a lifetime.

We all are familiar with the competing demands to educate "the whole person" and the market pressures which argue for a more intense, and consequently, more narrow vocational preparation. It is an old debate, renewed with each generation of college students, but it remains central to our discussion.

Already it is impossible to know everything in even the narrowest of technical fields. Arnold Brown observed recently that the pace of technological development is growing faster than the capability of human beings to harness it and use it effectively. People too educated in the knowledge of the moment, he suggests, may be "leapfrogged technologically" just a few years out of school. (Arnold Brown, "Human Factors: The Problems of Integrating People and Technology in the Workplace," On the Horizon, April/May 1995, Vol. 3, No. 4). A colleague in the computer science field left one university to accept an administrative position at a university several states away. He saw a need to cull his library books. The books he discarded were the books about computers published three to five years earlier, they were no longer of major academic value.

Inextricably linked to advances in technology, of course, is the information explosion which poses similar problems. The rising flood of data that engulfs us all is outstripping our ability as individuals to deal with it. So we oversimplify, nuggetize, capsulize, and "bullet" information until we can manage it, and we lose illuminating nuance as we go, reducing issues to their lowest common denominator. Or we retreat from the confusion, unable to distill sufficient usable information from the sea of data, becoming less decisive in the process. Please don't mistake me for an information-age Luddite. I send e-mail, make calls on cellular phones, fax, and surf the net with enthusiasm. But I also experience the frustration of data overload, and realize that it is compounded by the ease with which I can accumulate, if not assimilate, enormous quantities of potential information. As Brown notes, we need for people to regain control of the process, rather than being driven by the technology.

How will our graduates cope with a future that will grow increasingly complex? The solution does not lie in better mastery of web search engines and the like, although, of course, we want them to be proficient in the use of such tools. Our real challenge is to equip the next generation of decision-makers to master technology without letting it master them. They must be led by vision and not by tools. At times, the higher education community in its response to technology acts like the three-year-old child when given a hammer. Suddenly, everything needs an indiscriminate pounding.

This is not the message, I suspect, that most of our students or their parents expect or necessarily want to hear. The single greatest motivation for attending college continues to be the quest for a good job and a good income, and an intense focus on marketable skills naturally appears to be the surest and shortest route to that goal. But the goal will prove to be ephemeral if it is achieved at the expense of a solid grounding in the primary skills for living and learning.

My point, abbreviated as much as possible for this discussion, is that the first and most important thing we can do to prepare the labor force of the future is to preserve and protect, and in some cases restore, the core values of a liberal education, ensuring that graduates possess the fundamental skills that will guarantee their ability to function effectively as decision makers in a democratic and global society. With this in mind, I want to touch briefly on three points and then on some programs we have in place at Mississippi State to develop the work force of the future.

First, we must ensure that our core curricula are sufficient to provide all students with the necessary skills and competencies that ought to be universally expected of college graduates.

Then, we must have the mechanisms and the attitudes in place to help students succeed. Too many capable students fail to persevere, and the reason too often is the laissez faire attitude, certainly outmoded today if it was ever valid in the first place, that a university is a pond in which students must sink or swim of their own accord. I say we have to make certain that we have a mutual understanding with our faculty and staff that retention is a priority, that it is not sufficient merely to offer access to the institution, but that access must be accompanied by the genuine opportunity to succeed.

Finally, we must monitor and assess the competencies of our graduates to determine whether they are meeting the prescribed educational goals, and we must be willing to act on the findings to rectify the shortcomings that emerge. We also need to develop closer contacts with employers,

graduate schools, and people in private practice in the professions for which we prepare students. We need to listen to what they can tell us about the strengths and weaknesses of our graduates.

I hope I have established that I believe in the value of a broad, liberal education as the foundation of the college experience. Having done that, let me add that there is without doubt another dimension to "a very high quality education." If we are to provide an effective workforce, we cannot stop with the core I have just outlined. It is well established that students learn better by doing than by listening, and we ought to be aggressively seeking ways to provide them with opportunities to learn in the ways they learn best.

One of the most successful ways we have found to do that at Mississippi State is through the Cooperative Education Program. With almost 800 students currently participating with about 450 employers, we have one of the larger programs in the country. You are all familiar with cooperative education programs in which students alternate periods of on-campus study with paid, hands-on experience in their chosen field. For us, at least, it has been an amazing success story. Students repeatedly report that the blend of academic and "real-world" experience adds value to both. The program has the obvious benefit of helping students pay their way through college. Employers love it. They demonstrate their esteem for the program by regularly hiring their co-op interns upon graduation.

Some academic programs at Mississippi State, working through the program, have made a substantial internship experience a requirement of the curriculum, the chief example being the major in Professional Golf Management, which has placed co-op students in about 40 states. The degree itself is in marketing. The School of Architecture, whose bachelor's degree is earned through a five-year program, also has developed a unique year-long internship through Cooperative Education, with impressive results.

Another avenue to hands-on experience is through undergraduate participation in faculty research. I can't think of a more effective method of learning to think creatively while acquiring the practical techniques of a discipline than by working shoulder-to-shoulder with a professor who is developing new knowledge or helping an industry to solve problems. At Mississippi State this year, undergraduates were involved in efforts ranging from ways to recycle the fabric scraps from the manufacture of upholstered furniture, to building an experimental jet aircraft from composite materials, to understanding the motivations of shoplifters. We even had high school students from the Mississippi School for Mathematics and Science working alongside nuclear physicists on campus one day a week in support of the development of the Radioactive Ion Beam at Oak Ridge National Laboratory. Involvement in research provides yet another way to help students meet college costs. About 1,000 undergraduates earned more than $2 million at Mississippi State last year working at jobs provided by sponsored research.

We also must make sure that our graduates are proficient in the use of technology while understanding that the amazing tools at their disposal cannot substitute for the ability to think, communicate, or calculate.

The School of Architecture at Mississippi State apparently was the first in the country to require all undergraduates to acquire and make daily use of laptop computers, for note taking as well as for tackling design problems, replacing, to some extent, the pencil and sketchbook. Students completing internships in major architectural firms have reported that the computer-aided design skills they acquired in the classroom already are the norm in the workplace. We also are among the first to introduce our undergraduates to the use of virtual reality in architectural design, yet that technology, too, is well established in the larger firms. We will need to move at a pace faster than that at which universities are accustomed to adapting to change if our students are to be technologically ready to work when they graduate.

No one imagines that universities alone can do the job of preparing the labor force of the future. Only about 70 percent of today's high school graduates will complete four years of college. But it is not enough to say that we will do our part, and leave it to the community colleges, vocational schools, and elementary and secondary schools to do likewise. We must work together, and universities have an obligation to reach out and share resources and expertise with other sectors of the education enterprise.

A program sponsored by Mississippi State's Division of Continuing Education helps prepare community college and technical instructors who are helping train the workforce of the future. The National Institute for Technology Training offers an annual summer workshop that gives instruction in such areas as fiber optics, work-based learning, multimedia production, and school-to-work mentoring.

Our campus also is home to a Community College Network that provides audio and video links among 16 community colleges, Mississippi State's Cooperative Extension Service, and the University of Mississippi Medical Center. This year-old venture was established to provide nursing and allied health classes to sites around the state, along with courses in topics such as parenting and evaluation of agricultural and extension education programs.

To prepare the work force of the future, we must find ways to ensure the full participation of women and minorities in fields such as science and engineering which they have not traditionally pursued in large numbers.

One key to attracting these underrepresented groups to the fields in which they are badly needed, I believe, is to start early in the recruiting process. Programs such as the Minority Health/Science Enrichment Program, funded at Mississippi State by the Office of Minority Health of the U.S.

Department of Health and Human Services, encourage 10th grade minority students to enter health, mathematics, and science fields. Students spend three weeks on campus taking classes and working in laboratories, and they are paired with mentors who live geographically close to them. The mentoring network provides support for students as they continue high school and enter college.

Our College of Engineering has developed a program that introduces 9th grade girls to engineering and encourages them to take courses to prepare for college-level work. The annual "Women in Action" program is coordinated by the Society of Women Engineers.

The University Familiarization Program for Minorities in Engineering is a student-organized program that brings high school students to Mississippi State for an intensive three-week introduction to engineering. Students attend classes, participate in field trips that show engineers at work, and compete in design projects. The program has been successful in encouraging its participants to seek engineering degrees. It is coordinated by the student chapter of the National Society of Black Engineers.

The Mississippi Alliance for Minority Participation was one of the first such alliances established by the National Science Foundation. There are now some 20 alliances nationally. The program, involving the eight public universities in Mississippi, encourages minority students to pursue degrees in mathematics, science and engineering. Mississippi's alliance sought to double the number of minority students graduating from the state's universities from 1990 to 1996 and to double the number of minority graduates seeking advanced degrees.

A program called IMAGE (Increasing Minority Access to Graduate Education) is funded by the National Science Foundation as part of the Mississippi Alliance for Minority Participation. Tutoring and other programs are provided for college students in the IMAGE program, with the result that 50 percent of the minority students participating have a cumulative grade point average of 3.0 or better, compared with 30 percent of all minority students in science, mathematics and engineering curricula who have a grade average that high. The Summer Bridge Program component of IMAGE is a transition period for minority high school graduates. All eight Mississippi universities participate, each with a different emphasis and structure. The Summer Bridge Program at Mississippi State has operated since 1992, providing an introduction to areas such as physics, mathematics, chemistry, computer applications, and technical communications, as well as assistance in time management and other personal development areas.

Mississippi State, by the way, already ranks 20th in the nation in awarding bachelor's degrees in engineering to African Americans. Last year, about 12 percent of our total engineering graduates were women and about 8 percent were African-American.

Another group of students on our campuses who face special demands on their time and energy are the student-athletes. We have just completed the second year of a summer program at Mississippi State designed to help some of those students develop the social and personal development skills and self-esteem they need to succeed. We call it VIVA (Vision, Involvement, and Values for Athletes).

We also have allocated $100,000 a year to programs designed to bring university expertise to bear on the problems of public schools in our area. We encourage faculty in the College of Education and other academic units to develop close working relationships with faculty and administrators in the elementary and secondary schools.

Finally, we must recognize that one dimension of access and opportunity is determined by the costs that confront our students and their parents. A recent study for the California Higher Education Policy Center suggests that the single thing that most troubles the public at large about higher education is its price tag. (John Immerwahr and James Harvey, "What the Public Thinks of Colleges," The Chronicle of Higher Education, May 12, 1995.) Many people may be unduly influenced by reports of the tuition rates at private institutions, which seem to attract more media attention, although their fees typically eclipse those at public institutions. Many also may be unaware of the extent to which higher education's "sticker price" is routinely discounted through a wide array of financial aid and scholarship programs. And of course college continues to be a very good investment, in purely financial terms. The gap between expected earnings of college graduates and high school graduates has continued to widen over the past decade. The Journal of Blacks in Higher Education recently reported, using 1990 Census data, that a college degree has a proportionately higher payoff for Blacks than for Whites, compared with what they would have earned without the diploma. (Tamara Henry, USA Today, May 9, 1995). Nonetheless, a surprising number of parents have a real fear that a college education will soon be, or may already be, out of reach of their children for financial reasons. That fear itself can be a serious impediment to college access for some families, whatever the realities of the situation may be.

What can we do? We can of course continue the practice of discounting, setting our prices relatively high and then offsetting them at every opportunity with grants, loans, and scholarships. The future of federal financial aid is an obviously important issue in that regard, but one that may be outside the scope of this discussion. In any case, discounting is not the ultimate answer to the question of rising prices. We can benefit some students by diverting their costs elsewhere, but the piper still must be paid. If students don't pay their own way, someone else will have to.

It is easy to blame rising costs on any number of external forces, including governmental demands for additional reporting and record keeping, and that is undoubtedly a contributing factor that should be addressed. But the real question is one that most urgently demands our attention, "How can we operate our institutions more efficiently and more cost effectively?"

We must be willing to confront some of our own sacred cows. Take the astronomical increases in the costs of library journals, for instance. Faculty in every discipline can make a compelling case as to why they and their students need easy access to the full range of published scholarship in their fields. We clearly have the technological capability to make available such information electronically, and the potential to dramatically reduce costs in the process. Of course there are obstacles to such innovations, but the first and perhaps most formidable is the deeply ingrained presumption on the part of many in higher education that we should be exempt from the forces of change, privileged to bask forever in the comfort of the status quo. It won't be that way, and the sooner we recognize it, the greater the likelihood that we can determine our own destiny, rather than having it determined for us.

Students typically take longer to complete a degree than they once did. What we refer to as a "four-year" degree is increasingly a five-year or even a six-year investment, and one consequence of such elongated undergraduate experiences is a bigger price tag. At Mississippi State, we have instituted a program to encourage students to get on with it-to buckle down and graduate on time, which we have defined for purposes of this program, as four years of two regular semesters each, plus one summer term, if necessary. Students who participate in the pilot PACE (Partners for Academic Excellence) program contract with the university to take the prescribed courses in the prescribed order, meet with their advisors and heed their advice, and study, among other things. In return, we offer as incentive priority class registration and, if students hold up their end of the bargain and still fail to graduate on time, a semester's worth of free courses to finish their requirements.

One approach to improved efficiency favored by legislators and higher education critics is that we should simply make faculty more productive by requiring them to spend more hours in the classroom. I have no wish to delve at this point into the morass of arguments about what constitutes an appropriate teaching load. However, it is interesting to note that research sponsored by the Pew Higher Education Roundtable has pointed out that declining teaching loads are less of a contributing factor to higher costs than is course proliferation, which is linked to faculty specialization ("To Dance with Change," Policy Perspectives, Robert Zemsky, ed., April 1994, Vol. 5, No. 3). The thesis is that when faculty are required to teach more, their preference will be to teach additional highly specialized courses in their field of interest, rather than devoting more time to basic courses. Simplifying the curriculum, which is a goal in harmony with strengthening the core curriculum, may be one way to significantly reduce costs. Again, the primary obstacle to such an approach is the danger one faces of being labeled an academic heretic as a result of suggesting that there may be courses or programs that we could live without. There may be a place in academia for Elvis studies and the like, but the fact remains that we ought to take a hard look at what we teach, how we teach it, and why.

There are any number of equally sacrosanct areas on our campuses that should be examined. The first critical step toward improved effectiveness and efficiency, however, is to realize that we need to become more flexible, more innovative, and more opportunistic in the management of our fiscal affairs, and to resolve to act on that notion.

Higher education and our individual institutions have made vital contributions to the labor force of the Southeast over the past 100 years and will continue to do so in the future. We have many accomplishment to be proud of and I am optimistic that we will be able to do an even better job in the years ahead, if only we can bring ourselves to confront, without fear, the prospect of change.