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Science and Technology Policy Issues:
Why You Should Care

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(Prepared for presentation as the Commencement
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Dr. Porter, faculty members, members of the graduating classes, their families and friends - My congratulations to you all. You graduates have spent four or more years and a great deal of money to sit here today. Hopefully you have gained some useful skills, acquired a better understanding of our world and its history, and have had some fun.

To introduce my topic today, I'd like to quote a small poem written by Kathy Wall in 1985 titled "Steps".

This step away from yesterday
Will move you toward tomorrow,
As you take with you your memories
Of the time that was yours to borrow.
And with it comes the changes,
As your future begins to unfold;
And you'll soon begin to unlock the doors
With the key that you now hold.
And as you enter new horizons,
Hold fast to the plans you've made;
But be open to new opportunities,
And never let taking chances make you afraid.
So as you step away from the familiar
And the places and people you've come to know;
Look forward to all that awaits you
And allow your dreams to take root and grow.

With this note on taking chances and your dreams for a satisfying and productive life, let me make a plea for your participation in the direction which our country and civilization in general will go in the future.

The world we live in is so complex and the issues challenging our heritage of individual freedom are so great that it is a great temptation to limit our concerns to our immediate family and friends and the small world we circulate in daily. As educated citizens you have an obligation to do more. Today I would like to challenge you to participate in one of the most important issues of the day, science and technology policy. In this era of computers, high tech household appliances, sophisticated warfare agents, global ecological threats, and even high tech toys, there is scarcely any issue which is more pervasive or will have a greater impact on the quality of our life in the future. Let's look at some examples.

For the past several years, physicists have been talking about building what may be the most ambitious, the most expensive, and perhaps one of the most provocative scientific experiments ever conducted. I am speaking of the Superconducting, Super Collider which, if built, would become the world's most powerful atom smasher.

The dimensions and objectives of this project - dubbed the SSC - boggle the mind. Its chief feature, a particle accelerator ring buried underground, would be 100 miles in diameter, large enough to encircle the island of Manhattan, and then some.

The collider would generate energies unlike anything ever experienced on earth, greater than those found in the sun and approaching those believed generated during the first moments of creation. It would confirm - or disprove - the existence of particles of matter now only imagined. It could change entirely the way physicists think about reality and the way we think of ourselves.

By the way, it could cost \$5 billion or so.

There is also the little matter of where it should go. The Ohio State Lantern in November of this year pointed out that the SSC is expected to provide 10,000

jobs and \$404 million in tax revenue by the year 2005 to the State selected for the project. Ohio, as well as Illinois, California, and Texas are all top contenders for the collider location. One can argue that money of this magnitude must be spent on human needs but I would also argue that man does not live by bread alone and the opportunity to reach beyond the known is necessary to our ultimate survival. How do we choose our priorities?

Let's look at the example of the global ozone question which has resurfaced again recently by the finding that an ozone "hole" exists over the South Pole. Policy questions are particularly difficult in this case because there is no immediate danger but if no control methods are put in place at this time the consequences on future generations may, and I emphasize the word "may", be in serious jeopardy. Our current understanding of the problem in scientific terms is still quite poor yet we have many people calling for restrictive legislation now. In this case good policy planning requires a consideration of climate changes in concert with economic trends and political agendas, particularly global politics. Our basic science programs have supported many projects in atmospheric physics and gas phase chemistry which bear on the ozone question. However, our current models are simplistic and totally inadequate to definitely answer the questions required for good environmental legislation. Let me put the question in terms of appropriate decision making. The data required to design appropriate atmospheric models will require extensive data gathering by biologists, chemists, and atmospheric scientists. The collection of that data from the stratosphere is very expensive, many millions of dollars. Ground based work must also go on to build global models that allow for an evaluation of the complex interaction between the chemistry of the atmosphere caused by natural occurrences such as sun spots and droughts and man-made additions such as halocarbons. Such modeling requires many scientific man-hours and expensive computing systems such as super computers. Thus, the choices get difficult.

Do we fund sophisticated microelectronics research which will make us more competitive and generate jobs in this country? Do we fund atmospheric chemistry or do we provide extra medical help for our growing elderly population? Do we trade defense spending for atmospheric physics? The tendency is for the general public to insist that we do all of these things simultaneously without an appropriate regard for available resource allocation. The bottom line is we

don't have resources to handle all of our needs and choices, hard choices, must be made.

Once we choose a direction we must not leave major projects unfinished and move on to new projects which are politically more appealing. Science has gotten so big and our technology so complex and so expensive that we can no longer afford to change the definition of what is scientifically important with each new political development.

But who should decide whether the nation is better served with the SSC or without it and what state should receive it? Should we have a space telescope also or instead? Or is it more important to intensify research into cancer and AIDS? Has it come to a choice between the space station and combatting the dreadful spread of teenage suicide? Is the future of data processing in biochips or in Very High Speed Integrated Circuits, or in both?

What is the nation's best strategy for keeping pace in the international technical race? Improve science education? Or is it better to provide incentives to industry to speed the process of moving from proof-of-principle to commercialization? Should we encourage big science or small science?

What role should industry play? Will the national interest be served best by a laissez-faire approach to industrial research, letting profit lead us to the next horizon? Should government itself lead, entice, cajole or threaten industry to move in directions beneficial to the nation? Who should decide what direction we should take? Thus, the questions and choices are both between technology programs and immediate societal needs and between different technology programs.

It is no longer a luxury in this technological society for scientists to muse on the societal impact of their work. It is an absolute necessity for scientists and technocrats to recognize how their work affects people. On the other hand, it is essential that educated members of the public develop an awareness of and some familiarity with science and technology issues.

Any mechanism for determining science policy should include expertise on the

workings of society - historians, social scientists, journalists, and humanitarians. And business people, health professionals, artists, many present or future parents - owe their professions and their children an understanding of how science and technology issues affect all of us.

Now some of you may be thinking about being parents, but I am sure that many more of you are thinking about getting a job. There are some very interesting statistics available on where new jobs will come from. For example, the National Science Foundation has reported that 80-90% of the nation's new jobs are being created by new small start-up companies, not by the major industrial firms. In fact, with some of the mergers and reorganizations taking place, the number of jobs that major industries provide is actually declining. Many of those small start-up companies creating new jobs are managed by people who got their start by working with major industrial concerns. So a very large percentage of the small companies would not exist without those major industrial firms. This feeder system has worked reasonably well, so we have some responsibility to keep it going.

The U.S. loss of competitiveness in many arenas of the global market is well documented. We have lost marketshare in automobiles, electronics, and machine tools and one of our hopes for the future, high technology, is in serious trouble. A recent report prepared for the Joint Economic Committee of the U.S. Congress by Quick, Finan and Associates in October 1986 shows that the U.S. position in high technology has severely eroded since 1980. In 1980, the high-tech industries produced a trade surplus of \$27 billion. In 1985, the high-tech surplus was \$4 billion. The estimate for 1986 is a trade deficit.

Our country's productivity, although growing at an average annual rate of about 0.3%, is low in comparison to the gains in productivity made by some of our most worrisome competitors. For example, Japan's average annual rate of productivity growth is nine times ours. South Korea's is sixteen times ours.

Many popular publications give the impression the country is buying into the idea that we are going to become a service economy. I am afraid we have actually sold the idea that a service economy will enable everyone to get good jobs and enjoy our current standard of living.

But I don't think that will happen. We do expect, correctly, I think, that the proportion of jobs in the service sector will grow, but they must be supported. In my opinion, they must be supported by manufacturing industries that still make products in this country, or, at least, by a base of U.S. headquartered manufacturing companies. A service economy by itself will not sustain us, but a service economy built around our ability to compete in the industrial arena will. There is a very big difference between these two concepts and I think we need to be aware of that difference. Just because the number of service jobs has to increase does not mean that we can shift completely to a service economy. For example, look at Great Britain where the economy is in difficult trouble and unemployment is very high. Even the service jobs have begun to flow elsewhere. Banks and other services will go where the manufacturing is. If that happens in this country, technological leadership is likely to follow.

Unless we turn this around, neither you, nor your children will have access to the standard of living that we currently enjoy.

How can we turn this around? Studies show that the biggest contributor (44%) to productivity is technological innovation. Technological innovation comes from scientific research and development. We need to encourage, not discourage, scientific R&D. We need to encourage the kind of economic climate that will make innovation flourish. We can do that by selecting our tax policies, educational goals, regulatory policies, immigration policies very carefully with an eye to avoiding conflict and inconsistency.

To accomplish this, we, the voting public must become aware of the consequences of our votes and in many cases, our apathy. We might note here the pitiful number, 36%, of registered voters that bothered to vote on November 4 this year. We all must take some responsibility for science policy, along with the scientists, the government agencies, the White House and the Congress.

You, as college graduates, have the ability and the incentive to carry some responsibility for the directions our society takes in science and technology. No matter what your field, a college degree tells the world that you have had, and have taken, the opportunity to think in a disciplined way. Whether you

continue to do so will make a very great difference in your own lives and in our society.

We are in danger of becoming a society guided by a scientific elite. As fellow members of society, the experts will act in what they believe to be your best interest. But you should not assume that they will do so - the temptation to act first in one's own interest is great and there are bound to be conflicts.

I am not asking you to become experts on the technical details of thousands of scientific projects. I am not asking those of you who chose to study business, the liberal arts, or agriculture to go back to school and get another degree. Those of you who have science degrees do not need to try to amass expertise in every field of science. But all of you will need to grasp the issues surrounding science and technology.

How to prepare? To match the exciting new developments in science and technology we have some excellent people able to write about them grippingly and knowledgeably. I refer you to a recent article in the National Geographic about the immune system and its role in cancer and AIDS. Photos of the body's defense system, taken with the electron microscope, are stunning. Other periodicals, such as Smithsonian Magazine and Discover, can introduce you to readable science issues. But don't waste any time. Science '86 died this year for lack of readers like you and Scientific American is under new management.

Some of the best writing on science and technology issues appears surprisingly enough in the Wall Street Journal. Excellent TV series like Nova, can give you a new perspective.

Don't let others make your decisions for you. Science and technology touch your life in almost every way imaginable - the food you eat, clothing, home, car, medicine, job you hold. In a free society such as ours, you have not only the privilege but the obligation to participate appropriately in the debate and to insist on quality science and technology policy. With all due respect, these issues are too important to be left to the politicians and the technical experts.

Let me close with this thought. The common wisdom is that the flower child generation of the sixties has been followed by the "me" generation of the eighties. Helen Hayes, the grand old lady of American theatre wrote "The ten o'clock newscasters ask us whether we know where our children are. Shouldn't they be inquiring whether we care? It's time to turn off the TV and get involved in the real world."

Enjoy your day and the life which follows.