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U.S. COMPETITIVENESS IN THE 21ST CENTURY

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PARTICIPANTS

STROBE TALBOTT
President, the Brookings Institution

DR. LAEL BRAINARD
Vice President and Director, Global Economy and Development Center
The Brookings Institution

DR. SUSAN HOCKFIELD
President, MIT

BRUCE MEHLMAN
Co-Founder, Mehlman & Vogel, Inc.

BERNARD L. SCHWARTZ
Retired Chairman and CEO
Loral Space & Communications, Inc.

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P R O C E E D I N G S

MR. TALBOTT: Good morning, everybody. I am Strobe Talbott, the President of the Brookings Institution, and I would like to welcome all of you to the official launch of the Bernard Schwartz Forum on U.S. Competitiveness.

This is a new series of focused, results-oriented, solution-oriented discussions on a subject of vital importance to our own Nation and to the world. Competitiveness, in most contexts, suggests a win-lose game but not in the context that we are talking about competitiveness today, which is how the United States can take full advantage of the open global economy for the good of its own citizens and for the good of the peace and prosperity of the whole world.

This forum is made possible by Bernard Schwartz, the retired Chairman of the Board and CEO of Loral Space and Communications. Bernard has devoted his career to investing in ideas that matter, ideas that have an impact in the real world and in real time. That is a big part of what Brookings is all about. We are all privileged that he has chosen to invest in this institution and this initiative.

We are also honored to have with us today, Susan Hockfield, the President of MIT, and Bruce Mehlman, the former Assistant Secretary of Commerce for Technology Policy. Susan is a premier scientist in her own right and a leader of a premier institution. I might add that she is a friend and a former colleague from when we were both at Yale. Bruce has grappled with the issues before us today from inside the Executive Branch, and he is going to give us, I am sure, wise counsel on how Government policy can stimulate and sustain innovation which is so vital to competitiveness.

Another key participant in today's proceedings is my colleague, Lael Brainard. She is the Vice President and Director at Brookings, responsible for the work that we do on the Global

Economy. While she is a regular on this podium, today marks her debut in a new capacity. She is the first Brookings Scholar to hold the Bernard L. Schwartz Chair in International Economics. Since this is the first endowed chair to be given to Brookings since I came here four years ago, I take personal pride in this development, and I want to express my special gratitude to Bernard for his generosity, his vision, and, I might add, his trust and his confidence.

Lael also has MIT on her resume, as I am sure Susan is well aware. Lael did path-breaking research at MIT on Strategic Trade Policy and the relationship between offshoring production and U.S. jobs. She then became a White House Fellow and quickly rose within the ranks of the Clinton Administration to serve as the Deputy National Economic Advisor to the President and Deputy Director of the National Economic Council as well as Sherpa for numerous economic summits. Lael was deeply involved in both policymaking and diplomacy on a whole range of issues including the Asian financial crisis and China's entry into the WTO.

As the holder of the Schwartz Chair, Lael will hold our work at Brookings to the very highest standards of open-mindedness, hardheadedness, and independent thinking that have characterized Bernard Schwartz's leadership as a corporate statesman.

I would now like to ask him to come say a few words. Thank you.

(Applause)

MR. SCHWARTZ: Good morning. Thank you, Strobe, for those nice words and for the commitment I think is very important.

The Brookings Institution is a critical participant in America's dialogue on all policy issues. It provides a credible forum for open examination of shifts in our social, political, and economic framework. I am proud and pleased that today's events in announcing the initiative to examine

America's competitiveness in a global economy is being launched under Brookings' auspices in the Bernard L. Schwartz Forum.

We are indeed fortunate that Brookings has attracted such a distinguished list of experts to take part in today's discussion. We are fortunate indeed, also, that Lael Brainard has agreed to chair this effort. Lael's experience, education, and leadership make her particularly well equipped to question current orthodoxy and to conduct an open-minded examination of America's strengths and weaknesses in our global world.

The purpose of this initiative is to challenge a common ideology shared by many an academic economist's viewpoint. Economists and policymakers and many of the media have adopted and made up their minds with respect to many of the big issues that face us today. That common view generally forecasts a decline in America's standard of living, an increasing imbalance in our trade accounts, and an increasing imbalance in the effect of the acceleration of outsourcing with its consequential loss of manufacturing jobs. This common wisdom cites a continuing escalation of our twin deficits, our low savings rates, the crushing liability of social security and pension costs, and the high cost of medical insurance. All of these, in short, may predict America's inability to compete in a new, flat world.

There is an optimistic school of thought, however, that rejects that conclusion as underestimating the strengths of the American society and its economy, its ability to transform science into the marketplace, the advantages of its free capital markets, its mobility of labor and capital, its intellectual property, its inventiveness, and its resilience. On the other hand, the optimists believe our competitors face immense social, political, and cultural challenges which will undermine their competitiveness.

The purpose of the effort that we are starting here today is to examine these issues with an open mind. The debate needs to be informed by answers to questions like: Why isn't our economy behaving as it is expected to? An imbalanced trade account, low savings rate, fiscal deficits as far as the eye can see, driven further by an unbudgeted war, one might expect the combination of these forces would bring about high interest rates, steep inflation, a crowding out of investment resources, and a decrease of business capital investment, but we have not seen these negative results. And, in fact, although there is some creeping up of interest rates and there are some slow inflationary pressures, the economy continues robustly with historically low interest rates, low unemployment, and high cash availability.

We should be looking at new questions that have not been asked. For example, has the magnitude of wealth creation that the world has experienced over the last 50, 40, 30, 20, 10 years, has the magnitude of that wealth creation somehow compensated for the low interest rates in the United States? Have we sufficiently accounted for the impact of transaction velocity in global economics when we talk about the normal standards of applying the economic calculus to our current situation? And just as the policymakers failed in the 1990s to understand the impact of productivity gains because they could not be measured, so, too, we must make sure that we do not fail to take the new issues that are not part of the current economic calculus to see if they have an important impact. It is imperative that our policymakers understand the forces at work and the remedies that are available. The wrong conclusions will lead to bad policy.

I also believe that we are not in a zero sum game, that the American economy has been managing globalization for 230 years, and that a prognosis that "We cannot live beyond our means; we will pay for it, but I don't know when," that is not the answer.

This initiative will bring the resources of the Brookings Institution under the leadership of Lael Brainard to bear on these issues and inform our public debate. It is both important and timely, and I am pleased to welcome Lael and our fellow panelists today to what I hope will be a very interesting discussion. Thank you.

(Applause)

DR. BRAINARD: Well, thank you. This is a tremendous honor to hold this chair. Your gift and your vision are going to enable us to take a fresh look at how America will compete and flourish in the coming decades.

I think to come up with some intriguing new answers and to start off that consideration and to start giving us some of that vision for the future, we are delighted and honored to have Susan Hockfield kick off this series, both because of her own deep and personal involvement with the scientific endeavor and also her leadership of one of the best institutions of science and technology on the planet, to be honest in my view, the best. During her tenure as the 16th President of MIT and the first life scientist to head the venerable institution, Dr. Hockfield has been a very powerful advocate of strengthening the Nation's education system, an issue I believe she will discuss today.

DR. HOCKFIELD: Thank you, Lael, and congratulations on being named the first Bernard Schwartz Chair. It is a wonderful recognition of the work you and the Brookings Institution have done on these issues.

I want to also thank Strobe for suggesting that I take part in this exciting series. I welcome the chance to share ideas with Bruce Mehlman whose career has been devoted to keeping the American economy innovative.

I think most of all we all need to give our greatest thanks to Bernard Schwartz who has made this morning possible. In his life, he has combined a remarkable career in business with farsighted

concern for the fundamental issues facing our Nation. As we just heard through a set of incredibly insightful comments, he has set an interesting and provocative agenda for this particular initiative.

Let me begin with an insight from one of MIT's most distinguished economists, Robert Solow. Professor Solow was the first of the growth economists, and he challenged the static model of classical economics and its explanation of economic growth as derived from capital supply and labor supply. He found, and perhaps this was not surprising, coming from someone who was working at MIT, that over time more than half of U.S. economic growth had come from technological innovation. Professor Solow won the Nobel Prize in 1987 for this work, but as a Nation, we are only now beginning to grasp its implications.

An important moment came in January in the State of the Union Address. There, in a really striking departure from the classical economics that has so long shaped the thinking of both of our parties, President Bush drew, in a very explicit way, the connection between economic growth and investments in research and talent. If we accept Professor Solow's argument that growth stems from technological innovation, then how we organize science and technology becomes very important, and I believe that our organizational model will have enormous implications for American competitiveness in the decades ahead.

During World War II, MIT's Vannevar Bush became FDR's Science Advisor, and on his watch, science and technology were integrated, sheltered under a single flexible organizational umbrella. The R of Research and the D of Development were truly connected, and the results were remarkable. Much of modern electronics has flowed from the work at the radiation laboratory that was set up at MIT to develop radar, and radar was, as you all know, the war-winning technology. Los Alamos, in its turn, followed the same model.

At the end of the war, Bush wrote the most famous polemic in the history of U.S. science, *Science: The Endless Frontier*. There, he argued that Federal Government should not abandon the great system of scientific advance set up during the war. Instead, it should hold onto a residual role in its funding of basic research. Bush's was essentially a pipeline model, segregating the stages of research and development and focusing the Federal role at the very earliest stage. R, Research, and D, Development were separated in the belief that research activity early in the pipeline would result in development, in prototyping, and in products. Under the system that emerged, the role of the university was to perform fundamental research.

The pipeline model, however, does not reflect the modern relationship between science and technology. That model assumes a one-way flow from science to technology, from basic to applied, but the one-way flow is actually a two-way street. The relationship between semiconductor electronics and semiconductor physics is one good example. There, the applied work transformed the fundamental research, not just the other way around.

Vannevar Bush created a model that has been enormously productive. The Federal Government supported basic scientific research that industry could not, and those Federal investments fueled the emergence of the modern American research university which integrates research with education and has become the envy of the world.

But Bush worked in a very different context from our own. The economy of the late 1940s was a corporate economy, characterized by mass production, by great national markets, by national factory systems, and by scale not product individualization. The corporations that dominated that economy were interested in incremental rather than radical innovation. Technology was not intended to be, as we now put it, disruptive, and we built great industry lab systems to support incremental innovation.

Now about every 50 years, the United States is hit by a great disruptive innovation wave, where new technologies bring fundamental changes to organizations, the economy, and society. I hardly need tell you that we are in one of those periods right now. Our mass production economy is being superseded by a knowledge economy based on information technology, and the models are very different. The emerging economy based on information is, so far at least, flat and collaborative, and it relies on networks.

We can see this emerging economy in changes within manufacturing. During the 1980s, the U.S. mass production model faced a tremendous challenge from a Japanese model focused on lean manufacturing and quality. In response to that challenge, American manufacturing emulated Japan's model, seeking tighter integration between suppliers, assemblers, and customers. Now, our manufacturing sector is becoming disaggregated, distributed, and dispersed, a radical departure from the integrated model of a decade ago.

We see a new rise in contract manufacturing. Perhaps the best example I know is the ubiquitous Apple IPOD. Everyone walking the corridors of MIT has these plugs in their ears and wires coming down. The Apple IPOD was brought to market in less than a year because it was designed around component parts that were already being made by a number of other companies. Speed to market is critical for today's new technologies, and disaggregated manufacturing is a crucial competitive strategy.

This new economy, based on information technology, is driven by startups and by entrepreneurs who seek not incremental innovation but radical breakthroughs. It relies on new sources of capital, venture capitalists, angel investors, and IPOs, and is also forcing a new kind of research organization, one that is less integrated into established enterprises and increasingly virtual.

And, yet, another manifestation of the tendency toward disaggregation, the great industrial labs are being redefined, that is, when they are not actually being swept away. With this change, the university has stepped into a much more central role in the innovation system. Fortunately for our Nation and our economy, a number of U.S. universities were ready for this change in research organization.

Now, it won't surprise you if I use MIT as an example. At MIT, the defining experience of the 20th Century was the convergence of engineering with the physical sciences. Starting in the years before World War II and drawing on the discoveries in physics early in the 20th Century, MIT President Karl Taylor Compton developed strong science programs alongside our existing engineering programs. Our experience with the Rad Lab proceeded to demonstrate conclusively that strong science would support advances in both science and engineering. After the war, MIT developed a new engineering curriculum that is anchored in basic science. Since then, our interdisciplinary laboratories have created strong connections between engineering and science and have supported the collaboration that is the essence of innovation. As a result, we have been able to make fruitful connections with an emerging entrepreneurial culture. MIT is certainly not the only university to do this, although I have to say, we have been particularly successful at it.

The Electronics and Information Revolution, which has profoundly changed how we live and how we work and how we communicate, emerged from the convergence between the physical sciences and engineering. Today, we are now witnessing a parallel convergence between the life sciences and engineering, growing out of the post-war discoveries in molecular genetics. The new life science industries draw on the innovation systems and entrepreneurial culture developed in the Information Revolution. The information and life sciences industries have eroded the old divide between R and D, and the same process will increasingly take place in other innovation sectors.

What you might call an upstairs-downstairs relationship between the academe and industry is over. Careers involving both sectors are now commonplace even for our most distinguished faculty.

So, while universities continue to train the next generation of researchers, we also increasingly serve our society's discovery center. Universities themselves fit the emerging organizational and entrepreneurial models of the knowledge-based economy. They are relatively flat; their research cadres are relatively non-hierarchical and relatively collaborative; and they are built around knowledge networks. Our task now is to intensify the creative relationships we have already built with the knowledge-based economy to create new connected models that supplement the long established pipeline model.

In recent decades, our Nation has evolved a new model for economic comparative advantage in a global economy. David Ricardo's early 19th Century Theory of Comparative Advantage was resource-based. The model for the 21st Century is innovation-based.

There is inherent risk. As MIT's own professor, Paul Samuelson has noted, others can model your innovation system and capture the innovation advantage. Our global competitors understand this well. Our comparative advantage will depend increasingly on our national investments in R and D and in science talent.

I have to confess that I am worried about the outlook. Federal R and D spending, the basis of the university contribution to the innovation system, has been falling when measured as a percentage of GDP, from 2 percent of GDP in the mid-1960s to eight-tenths of 1 percent of GDP today. While Federal investments in the life sciences doubled between 1998 and 2003, Federal investments in the physical sciences and engineering have stagnated over the same period and actually going back 30 years. Now, we are seeing welcome public new attention to these issues, from the American Competitiveness Initiative that President Bush announced in his State of the

Union message to legislative activity in both houses of Congress. But, as you know, these kinds of proposals must make headway in a very constrained budget environment.

At the same time, we are not doing a good job in attracting young people to the fields most crucial for innovation or giving them the skills they need. Science and math education is a prerequisite for innovation. In China, 49 percent of Bachelor's degrees are awarded in Science and Engineering. Of course, you might wonder what the equivalent figure is in the United States. It is 15, 15 percent. At the same time, we are falling behind both the European Union and Asia in Doctoral degrees in Science and Engineering. In short, while we still have a science lead, as a Nation, we are not in a good position to sustain it.

Obviously, I haven't presented an exhaustive list of all of the challenges before us. We need to strengthen K through 12 education in math and science. We need to ensure that university education remains accessible to students from all socioeconomic backgrounds. We need to welcome international students and scholars. And we need to balance the goals of national security and intellectual openness. But if we can address research funding and expand the talent pipeline, we will go a long way toward retaining the comparative advantage the U.S. economy has built up since World War II.

Of course, the importance of innovation goes beyond even competitiveness. Think about energy, for example, a topic much on our minds at MIT. Next week, we will release the report from MIT's Energy Council that I charged last May. The Council is composed of a group of 16 faculty from all of our five schools, whom we asked to develop an institute-wide plan to address the global energy challenge. If we are going to solve the problems and address the challenges of energy supply and demand, of energy security, and of environmental sustainability, we simply have to innovate.

It is a real pleasure to be here today with so many thoughtful people who care passionately about these issues. I am looking forward to Bruce Mehlman's remarks and our discussion afterward and to our joined efforts to keep our economy vibrant and competitive in an increasingly complex global environment. Thank you.

(Applause)

DR. BRAINARD: Now, it is my pleasure to introduce Bruce Mehlman who directs the Technology CEO Council and is Founder of Mehlman Vogel and Castagnetti. Bruce is, I think, best known publicly as the lone voice in the early years of the current administration talking about the C-word when he was Assistant Secretary of Commerce for Technology Policy. It took four long years, but I think everybody on this panel, probably in this room, was delighted when President Bush embraced Bruce's agenda and announced the American Competitiveness Initiative in the State of the Union. So I am particularly delighted to welcome Bruce to talk about how competitiveness can be advanced through the policy process.

MR. MEHLMAN: Thanks very much, Lael. I guess it just goes to show how effective an organization can be when it gets rid of me, that we have seen so much progress following my departure. Thank you.

It is a real honor to be here, especially considering the folks that I am getting to follow here. Bernard Schwartz has lived all of what we are talking about -- competitiveness, innovation -- his whole life. Susan Hockfield leads it at one of the premier institutions in the world. And I feel like my contribution is perhaps only as I lecture about it from time to time, but it is an honor to be here.

It is amazing how rapidly things change. Consider the following: If you go back to 1984, our Nation was worried about the threat of nuclear war with the Soviet Empire and economic war with the seemingly unstoppable Japan incorporated. The semi-global economy in which

Americans worked didn't include the billions of citizens in China and behind the Iron Curtain, neither as customers nor as competitors. Three decades of high tariff protectionism in India had resulted in anemic growth, persistent poverty, economic isolation, and the need to borrow heavily from the World Bank.

Now, the Macintosh computer had just been introduced with a blazing 8 megahertz CPU for about $2,500 in 1984 dollars, and a guy named Michael Dell with curly hair had just started selling customized computers from his college dorm room, but even then, only 8 percent of Americans had these basic PCs. The internet was the domain of only a few thousand researchers. Our economy had finally emerged from a tough recession, although unemployment remained at 7.5 percent. While a presidential candidate warned that the only jobs Americans would get would be "selling McDonald's hamburgers and sweeping up around Japanese computers," the American economy was, in fact, poised for strong growth. Former Vice President Mondale was wrong; we created 44 million jobs in the 22 years following his warning.

By 1994, the Soviet Union had fallen. The billions of citizens in India, China, and the former Soviet Bloc were just beginning to integrate into the global economy, and they seemed eager to eat McDonald's and drink Coca-Cola -- that will teach them. U.S. PC penetration had hit 24 percent with desktop PCs faster and cheaper than those of a decade prior. While a much simpler internet had only reached about 2 percent of the population, there was a new program called Mosaic, soon to be called Netscape Navigator that would bring a worldwide web to millions. An economic recession had ended two years prior, and thanks to Lael's great work, our economy was on the move again and set for explosive growth. See, never give up the microphone.

U.S. unemployment was at 6.1 percent and would soon fall further, despite a past and future presidential candidate's prediction that the NAFTA Free Trade Agreement would create a "giant

sucking sound of American jobs fleeing to Mexico." We created over 25 million jobs in the decade following Ross Perot's doomsaying.

Fast forward 10 more years, and the world is again remade. The pace of change has accelerated further. Roughly 65 to 70 percent of Americans now have PCs, which I am here to tell you, on behalf of at least most of my clients, is too low and on average, one-tenth of the price in today's dollars and 350 times the power of the 1984 Macintosh. Michael Dell has expanded from his dorm room and done quite well as the biggest computer maker on Earth. An estimated 160-170 million Americans have internet access; more than a third, broadband. With nearly 700 million online worldwide, the number is expected to hit a billion next year. The three billion citizens of India, China, and the former Soviet Bloc are rapidly integrating into the global economy, both as consumers and increasingly capable competitors.

Now, today's unemployment rate is only 4.7 percent, lower than the average of the 70s, the 80s, and the 90s, but many Americans are again quite scared, particularly as presidential contenders, at least if you go back to 1984, give warnings that Benedict Arnold CEOs will exploit tax loopholes and ship all of our jobs overseas. And global terrorists continue to wage their war on Western civilization.

So, while so much has changed, one thing that one will notice that has remained consistent is Americans are always concerned. We are always feeling and facing competitive pressures, and we are also rising above those pressures.

Something else that has been consistent is the pace of change is accelerating, and that may be oxymoronic, but it is true. If you take a look at cars, they took 55 years to get to a quarter of the U.S. population. Electricity took 46 years; telephone, 35; TV, 26; computers, 15; cell phones, 13; broadband, just 6 years.

Are Americans ready for this pace of change, this acceleration? Well, there is kind of good news and bad news here. The good news is we have the MITs and so many private sector folks. We are the undisputed innovation leader. That is not an endowment by the Creator; it is the result of hard work, of great vision from folks like Vannevar Bush, and of investments over 50 years. But notwithstanding the fact that the rest of the world is catching up, we still have a lead. We have the most entrepreneurial economy, the best rule of law, so much of the infrastructure that is right, and Americans are great to embrace technology, says the guy with the RAZR phone and the BlackBerry.

Of course, there are some real challenges here, too. First, do we have adequate safety nets for the world in which the pace of change is accelerating? The good news is our economy and our financial systems are flexible enough that, if it is time to redeploy dollars from manufacturing, let's say, to biotechnology, the venture capitalists and others can make that happen. But if you are pillow techs working in a textile job, the future may be biotech, but you are not ready to do it.

Are we still getting, are we still making and generating the best and the brightest? Certainly in Boston that is happening, but is that happening everywhere around the Nation, and are the trend lines there positive? Are we as hungry as others in the rest of the world? Do Americans still feel like they need to work hardest and their success is derivative of how hard they are willing to work, or do Americans increasingly feel like they are entitled to success, and if that is so, how do we get folks to understand that the rest of the world doesn't recognize and won't recognize that entitlement? Most significantly, in the policy space, especially with people like Bill Bonvillian now in the private sector, the policymakers understand that we have a challenge that we need to rise up to.

The good new is I think most folks know what needs to be done. We need to make investments in infrastructure, energy, broadband, and transportation. We need to make sure our business climate is the most welcoming for entrepreneurship through welcoming of global trade and intelligent about how taxes are applied, particularly to innovative activity. The U.S. R and D tax credit is significantly lower than and not necessarily as flexible as many nations around the world, and we are seeing that is one of the main reasons why so much corporate research is globalizing.

Regulation and litigation climates, are they welcoming innovative activity? Ask the vaccine industry; they would say no. There are very few vaccine makers in the United States in part because of a combination of regulation and litigation. It is just not the smart thing to be in.

We need to continue to invest in innovation, research and development, protecting intellectual properties, so there are returns on investment.

We need to continue to invest, most importantly, in people, educating them. That is not only the graduate work that we still are the best at, and we need to stay the best at, but it also goes all the way back to K to 12. It goes back to science technology, engineering, and math education early on. It certainly goes to immigration. I am very concerned that the politics of immigration debate could lead to very bad results, particularly with respect to what we do at the highest, most competitive ends. We should remember that from Albert Einstein to Andy Grove, America's technological prowess has significantly been based on our ability to attract the best and the brightest to our shores, who stay here and work here.

And, of course, lifelong learning because there was a time when, if you taught a person a trade, they would work for a lifetime. We are probably at the point where if you teach somebody a

skill, they are good for about two or three years. People have to learn how to learn, and they have to learn it throughout their whole lives.

There are a couple of opportunities, I think, in the immediate term. Health Information Technology is a topic that has gotten a lot of attention recently. If you look at the trend lines in terms of the costs, let alone the quality of health that is being provided, health care, Medicare, and Medicaid are on unsustainable trajectories, both for the costs they incur in the private sector, for private citizens, and for the Government. Bringing information technology to bear in an intelligent way, in the same way it is in so many other sectors, can save lives and save money.

We need more broadband sooner and real broadband. One of the challenges with that statistic I showed you in six years is that was broadband as defined by the current flavors of DSL, which are not as fast as we are seeing in South Korea and other nations around the world. If you want to be the leading information technology, if you want to be the leading digital economy, you have to have the infrastructure in place. Immediate term opportunities are some legislation being debated right now that will reform the video franchise process. We will be most successful seeing broadband deployed in a competitive market-based way when you have cable companies competing against the phone companies to provide phone service; when you have phone companies, through video franchise reform, competing against the cable companies to provide video service; when you have independent wireless companies competing against both; and new technologies, like broadband over power line, providing yet further reasons why service providers have to innovate and have to offer more to consumers and better prices.

And lastly, the last slide, so I think I have hit my 10-minute window, we have to invest in U.S. competitiveness. The entitlement burden is $3 billion a day and growing 8 percent a year. Whether we pass the American Competitiveness Initiative which is full of great stuff and is in

desperate need of passage, or if we pass the PACE Act which Senator Domenici and Senator Bingaman put forth, or your handiwork before you left, Bill, Senator Ensign's and Senator Lieberman's National Innovation Act, we need to get policies right and get politics out of the way.

There are some real challenges ahead. I am very excited about this chair that has been endowed and the work that Brookings, which has so long been a great idea factory and intellectual leader in this town, because we need your help. We need your help to have mindshare and to cut through the politics, and to cut through the partisanship, and take what is continuing to be more and more broad endorsement of a need to competitiveness policy and push it through and over the goal line. Thanks.

(Applause)

DR. BRAINARD: After those presentations, I think we all have signed on to the call to action. Now, we need to know exactly what it is that we need to do.

Let me start with Bernard and ask you a question. I think I read somewhere, and I have to read this twice, that you grew Loral from a $7.5 million corporation to a $15 billion corporation over the course of less than a quarter-century. During that time, you will remember all the angst about entry from foreign competitors. We faced major challenges from abroad. What were the keys to being able to innovate and stay ahead of that curve, and how applicable are they to the different challenges we are facing internationally today?

MR. SCHWARTZ: Our company, Loral, was involved in a very narrow industry, the Defense Electronic Industry and Space and Technology. It is unique in terms of the broad array of businesses, in that it is closely allied to one customer and that is the U.S. Government. Many of the benefits we had in terms of support came from the efforts of the United States Government to bring to education particularly and to funding independent laboratories to bring our science along.

So, for the years after Korea, there was an extraordinary amount of support in the manner of Dr. Bush in terms of the residual relationship between science and industry, and we benefited from that to a very great degree.

One of the things we see that is happening most recently is the decrease of those funds to organizations like NASA, and JPL, Jet Propulsion Lab, and even NIH. The amounts of money that the U.S. Government directly was able to give to institutions of learning and education have markedly decreased. Also, there has been a decrease in the sense that NASA is on the leading edge of technology, and the excellence that was imposed as a discipline on space activities is now being lost, and we see that in a degradation, if you will, of the science translation into product.

In our case, in our company's case, we have the benefit of a very large stimulant of U.S. Government. But despite that, I think industry generally in the United States has been extraordinary and unique in terms of being able to translate pure science into the very difficult transition to science, to technology, to product development, to factory introduction, to market introduction, into the factory and the home. The United States is unique in its ability to be able to do that. They have a lot of stimulants to support that, having to do with a capital market that is extraordinarily effective in the United States; one that encourages new ideas, that venture capital is at a high degree of development in the United States as compared to the rest of the world. All of these things, plus a general can-do attitude on the part of American businessmen, make the transformation from science to practical application very easy.

I think we are ahead of the rest of the world in that regard, and I think we are going to continue to be ahead of the rest of the world in that regard because I think it is built in. We have to do some things, and we alluded to some of those things this morning. Education, not being the

least of it, and the continued residual relationship between science and Government, I think has to be done also. So it is important for that to happen.

I will point out that, even in the area of space which was one of the places that the United States enjoyed a leisure position since the beginning of the Space Age, it is now, from a commercial point of view, being threatened by Europeans -- France in particular, because the policies of the French Government in engendering support of the space industry -- and that is true of Europe on a regular basis. I think that you see it in almost all of the Western European countries. A need to encourage, on their part, the commercial elements of space has begun to challenge America's superiority in the economic competition. Airbus is now probably equal to Boeing in terms of commercial product, and the same thing is true with the satellite industry. We are still ahead, technology-wise, but they are now very, very competitive.

The issue of how American industry handles the issue of competitiveness is not a new thing. It is not new over the last few years. It has not made new by a new sense of what globalization is all about. America has been dealing, as I said before, with globalization for the last 230 years, and we have done it very successfully.

We have to do some things that are right, and I think the most important thing is to close the gap of the rich and the poor in the United States, to give our most important resource for people who are not clued into the information technology, and that is mostly a distinction having to do with wealth and privilege in the United States. We have to learn how to master that and give that opportunity to everyone. And, secondly, we have to make sure that the quality of our hard science programs in the schools is effectively challenged for continued excellence, to continue to keep us on the leading edge.

DR. BRAINARD: Let me ask Dr. Hockfield, picking up on the points about the Federal Government's relationship with research in science and technology. You were talking about how different the model is these days in terms of research, in terms of the connection between science and technology. The Government's model hasn't changed as much. As we think about how much we are spending, should we also be thinking about how the Government interacts with the private sector, with the university sector, in terms of making that R and D spending more effective?

DR. HOCKFIELD: Certainly, the mechanism of funding is going to be critical to getting the dollars directed to the right places, and there are any number of strands I could pick up in terms of what are sound policies that really produce the highest quality product and what are less sound policies. We can just start with funding levels, that if we continue to underfund basic research in the physical sciences and engineering, we will end up, we will remain where we are, which is not much product and not very good product.

There was inspirational kind of funding that certainly surrounded the race to the Moon as a consequence of the terror of Sputnik, but also was part of the DARPA funding which funded just the most spectacularly innovative research. DARPA has departed from that style of funding and is now funding very near term research with, one of my faculty told me, 90-day report-outs on whether they have hit targets. Well, you don't do basic research in 90 days, believe me. So the Federal policies for how dollars are used, and of course everyone is interested in helping the Nation continue to build this innovation economy, but we have to have policies that actually make it possible rather than work against it.

There is something else that has been happening to research dollars that we find enormously worrying, and it is earmarking. When I first started thinking about earmarking, I really didn't have to think about it very seriously because I have been at institutions that refuse to even consider

taking, certainly never would ask for, and don't take earmarked funds. And so, I kind of dismissed it as just a small waste. As I have studied it further, it is a huge waste. It is a waste for today, but more importantly it is a waste for tomorrow.

One of the fantastic strengths of the area of American science I know best, being a life scientist, is the funding out of NIH. NIH funding is largely and has largely been awarded based on peer review, merit-based peer review. You have a collection of people who themselves are maintaining the highest standards of quality in a field. When you depart from that and have funding going because of some political or personal interest rather than merit, you end up funding less good work. But that doesn't just have an effect for today; it has an effect for tomorrow, because when less good work at an institution gets funded rather than the very best work by a different institution, that less good work and those funds support graduate education and undergraduate education, so that the next generation of scholars and researchers are being educated in not the highest quality environment, and we produce the next generation of faculty and researchers that are, frankly, just not the highest quality. It has a very, very long lasting negative impact. I think we have to be very careful about how our research dollars are funded.

Often, people ask me: Well, how much money could you possibly put into research? You scientists, all you want is more. I have to say I take this criticism seriously. It is true; as a Nation, we are spending lots and lots of dollars. I don't know that we know very much about how to invest dollars in basic research more efficiently.

Basic research, curiosity-driven research, it is an inefficient process. We don't know where the breakthroughs are going to come. I think about, actually, I would say the enormously visionary war on cancer, and it is criticized because we didn't cure cancer through the war on cancer, but I can tell you we put in place the understanding of the mechanisms of cell division and cell

processes that have provided the foundation for what we are now seeing as real cures, new ways of diagnosing, and new ways of curing cancer.

The problem is that funding basic science is inefficient, but we have to be sure that, even with those inefficiencies, we are making it as possible as imaginable, that those dollars will be used. So, funding of merit-based peer-reviewed work, not funneling money into earmarks, and being sure that the Federal dollars are being targeted to the things that only the Government is able to fund.

The Bell Labs that was the fount of fantastic innovation, industry-supported, this is a phenomenon of the past. It is gone. And so, it is even more important that the Federal Government fund the basic research and that we have the policies that allow industry to pick up that basic research once the direction of its application becomes known.

DR. BRAINARD: Let me ask Bruce a question, and then I want to open it to the audience. Just first, Bruce, when you flashed up that map, I thought we were taking a detour into partisanship for a second. I was looking at California and saying, when did that get to be a red state? When did I miss that?

We, I think, have got a lot of agreement on some of the highest priorities, and they require money at the Federal level. I guess the question is: With the set of priorities that we have now and with the set of constraints that we have now, where are we going to get that kind of funding, and where are we going to get the political will to be able to actually pay for this innovation agenda?

MR. MEHLMAN: Well, I am not a budgeting expert, although one thing that I think is imminently clear is where there is the will, there is the way. I think if we can work on the will, the dollars are there. I mean the President has proposed doubling NSF, doubling NSIT, $50 billion over 10 years, which would go a long way toward marrying a lot of the physical sciences with

what has been very well done under both President Bush and President Clinton, doubling NIH. So I focus a little bit more on the will than finding the dollars, and I would love to see loopholes or I would love to see things like earmarks closed. That would be great.

It seems to me the biggest challenge, as somebody who, on behalf of the Tech CEO Council and others, has been pushing competitiveness for a while, is it is not clear even yet that competitiveness can compete. Competitiveness is a crisis, but it is a slow crisis. I heard the National Association of Sciences' President -- I am forgetting his name right now -- describe it as when you boil a frog, I want to make sure it is not my analogy; it is his. He said, if you took a frog and you threw it into a scalding pot of boiling water, he would jump right out; but if you put a frog into room temperature water, and you turn up the heat, you would boil him because he wouldn't notice it was getting hotter and hotter, and things would seem fine until things were too hot. It is a creeping crisis that we are facing with respect to competitiveness.

I very much agree with Mr. Schwartz. We can and I think we will overcome it, but the first step is acknowledging it, and it is competing against four other crises that have more headlines. One is a security crisis, whether it is 911 or Katrina or a sense that your data, your personal data is at risk, and therefore, why don't we stop the internet or rebuild the internet to change the way things work.

In addition to the security crisis, there is a bit of a consumer protection crisis in my mind. It tends to lead to a lot of litigation, but there are fears that significantly impair research and directions in life sciences, and many of them are very legitimate, but worrying about consumer protection is more appealing and better for a politician who is trying to get reelected or elected often than worrying about global competitiveness of the Nation.

I think we face a lot of protectionism. A lot of workers, who, through no fault of their own but through the global dynamics, lose their work, complain. In the old days, there was a theory that blue collar workers in America were at risk, but white collar college-educated folks had lifetime employment guaranteed. One of the things I think we are seeing is that is no longer true. I think Mr. Schwartz was very perceptive in suggesting a focus on American income inequality is really important, and it is why I mention the safety net. It would be terrible if, to protect American workers, we stop pursuing global free trade or we stop pursuing market-based competitive dynamic economies where industries can succeed and industries can fail.

But the only way, politically, we are going to have the will to keep pushing the right policies for a competitive America is if we concurrently have in place policies that protect people or at least give people the opportunity to fail without being unable to feed their families or without having to foreclose on their home. How do we make sure everybody gets an education, everybody has access to broadband, and everybody has a fighting competitive opportunity? If we can't get that right, then the politics of fear and protectionism will prevail.

And then, lastly, it is inherent in your question, is the politics of the cash crunch where I didn't get into the slide, but entitlement spendings, which were $3 billion a day and growing 8 percent a year, are going to take over everything. It is just not realistic to think we can make the investments in research and in infrastructure and in being competitive and having the right corporate and other tax structures that we need to have to be competitive if we are not willing to take on the electrified third rail politics of social security and Medicare/Medicaid reform. As they are currently designed, they are making promises for our children that we know we can't fulfill.

Nobody wants to be the person who tries to step up. The President tried. He was not successful in any way, shape, or form when he tried in 2005 to reform social security. Whether

you think his reforms were right or wrong, it has been a bipartisan acknowledgement by Daniel Patrick Moynihan and others. We need to fix those systems because they are not sustainable, and they are definitely not sustainable in a competitive America.

DR. BRAINARD: Let me open it up to the audience. There are microphones and if you wouldn't mind identifying yourself, that would be terrific. Right up here?

MR. O'NEILL: Yes, I am Don O'Neill, Center for National Software Studies.

My question goes to if we spend a lot of money on research -- basic, applied, and so forth -- it gets commoditized for benefit of anyone who has the knowledge, skill, energy to utilize it, and folks abroad seem to be more eager and able with their education and so forth to take advantage of our very transparent knowledge that we create through our own investment here. So I am worried about the commoditization of R and D benefiting others more than we are able or willing to take that benefit for ourselves. Do you have some comments on that, please?

MR. SCHWARTZ: I would like to address that. I think the issue is real, and the protection of intellectual property rights has been on the agenda of our international experts for a long time, unsuccessfully. They have not really managed the situation because, in that regard, there is a certain amount of flatness in the world, and there are no boundaries to information and knowledge.

But I think there are skill sets that translate the information into an end product, into a commercial activity. In that regard, the United States has a very big advantage in the know-how, in the infrastructure of business, the help of Government to bring back capital markets, all the things we know about. And I think that, in order to remain competitive, it is not our God-given right that we are going to win that race. We have to do the right things to make sure that we benefit from the innovations that we bring to bear and take advantage of innovations that are brought to the surface by others as well.

I think that if we maintain a free capital flow in the United States and free labor mobility and good education skills, improve education availability to our citizens, make sure our immigration policy is bringing in good brains into the United States and protecting good brains from going out, I think we can win that competition, but it shouldn't be ordained that we are going to win it. We have to do certain things that allow us to win it, to give us the tools to do so. I think it takes an effort on our part.

MR. MEHLMAN: Just two points in response: One, the commoditization of software is certainly a concern for many in the software industry. The entire economy uses software. One of the things Catherine Mann of the International Institute for Economics found in a study she did in 2004 is the commoditization of information technology hardware led to greater hardware adoption, more companies going on the internet, more companies using software, and it was a net $230 billion gain to the American economy. So, as I think of commoditization of software, I think of software users, and I can't wait for more of it to get commoditized sooner because that benefits so many people who use the software.

As for the software creation, I am also following closely and very excited by the whole open source Linux movement which I think is both a software phenomenon, but it is a broader research phenomenon.

A lesson is it is not a zero sum game, and the more research is made available, as long as we are educating our folks, as long as we have the premier research institutions, the more knowledge that is available to anybody to stand on the shoulders of and to use, the more successful America is going to be, as long as we have the people and the infrastructure in place.

DR. HOCKFIELD: I would only add that intellectual property protection is important at some point, but when it is exerted too early, it is inhibitory itself. One of the things about a

networked world is that science happens everywhere, and it happens everywhere collaboratively. If we isolate ourselves and our scientists and engineers from one another and other people in the world, we will inhibit innovation. We have to be very careful where the production actually sits, so we don't inadvertently stymie what we are actually trying to support.

DR. BRAINARD: There is a question way in the back there.

MR. MARSH: Good morning, it is Dana Marsh (?).

I want to ask a related question, not one that has come out but I do think one that is relevant to this discussion, and that is the cross-border R and D that is being done, let's say, by United States corporations abroad. What evidence is there, or might there not be much evidence, that this is an area of concern? Is this an area that we should try to encourage? Is it something which at all should be part of this debate? If it is an area of concern, is there some Government policy that you might suggest be done in that area, or is this something that ought not to be something we are concerned about?

MR. SCHWARTZ: Again, I will take the lead. I think that we ought to be playing in that regard, as far as Government regulation is concerned, on an equal playing field. For example, European and Asian countries can buy a majority or all of a U.S. company. We cannot do that in reverse. Now, sometimes there is a political backlash that prevents certain kinds of transactions from happening, but generally there is no inhibition upon capital being invested in the United States to take over American companies. We cannot do that in France. I could not buy 51 percent of any kind of establishment in Mexico, in Canada, in France, in Asia. That is not a level playing field. So my feeling would be that if we had a level playing and level accommodation of other kinds of circumstances, currency control and other things, capital flows, rule of law, that is a

competition that I would welcome. I think the United States could do well and not lose out on that kind of basis.

MR. MEHLMAN: My impression, in talking to a lot of companies that are globalizing their R and D, is there are good reasons that we should not be concerned about and reasons we should be concerned about. Obvious factors, the rest of the world is a lot bigger in terms of population, in terms of size of market than the United States. You want to do your research often near your customers and your growth areas. One of the challenges Japanese car makers found with the SUV trend is, by having not done nearly as much research in America, they were behind. They weren't as close to their market as they wanted to be, and so they missed Detroit by many years in what proved to be the hottest area of auto growth. So you are seeing, certainly, information technology and a lot of technology companies want to be near their customers.

While MIT does its very best, even they have to cap their annual enrollment, and therefore smart people are left stranded elsewhere around their world, and of course most of them want to stay where they are. India and China and other nations are improving their educational institutions. For corporate America, if a U.S.-based company wants to be successful, they want to have the best talent on their team wherever they can be found. So, doing research in other countries where other people have been raised and educated and where they want to live is a way to access that talent.

Reasons to be concerned, I would think, would be, as Mr. Schwartz alluded to, when policy discourages research or encourages it to go abroad. If you don't allow, through smart immigration policies, the best and brightest to come here, a company that wants to be competitive is not going to let a foreign competitor beat it because we are going to play with the best team that America can field. Corporations want to play with the best team anywhere because that is going to make them

the most innovative and competitive. So, if we are not letting the best and brightest in, that is a challenge.

Things like the H1B cap at the business level hinder the ability to get the best researchers and sometimes encourage folks to go where the researchers are because you can't get them in here. Tax policy--if you want to build a semi-conductor fab, it is going to cost $1 to $3 billion to set it up. A lot of countries like Ireland or Israel and China these days and Taiwan, offer significantly more advantageous tax circumstances, and companies have to make a decision in part based on their ability to get the most return on their dollars.

I think there are things policymakers can do to address the areas that ensure we get the most research that we can possibly get here at home, but I don't think folks should be pushing the alarm bell about the fact that multinationals that want to be competitive are investing for research globally.

DR. BRAINARD: Back over here.

MR. RAPOPORT: I am Alan Rappaport from the National Science Foundation.

Before my question, I would like to make a quick comment about the last question. Cross-border R and D flows are going both directions with a lot of R and D coming into the United States. Not quite as much is going out, but it is in growing on both sides.

Almost everyone has spoken about the Federal research effort, but I want to say something about the industry research effort. I don't know if it is well known, but industry supports academic R and D and has been the fastest growing source of support for about 30 years until about 2000. But in the beginning of this century, not only has it fallen in relevant, it has also fallen in both current and constant dollars from over 7 percent back in the late nineties and it is, I think, below 5 percent now.

I have sort of a multi-faceted question. One, does anybody believe there is a problem? Two, do you have any idea why it is occurring? And, three, if you think it is a problem, what can be done to sort of reverse this negative trend?

DR. HOCKFIELD: Can I just comment on why it is a problem? Not only is industrial support of research dollars less, but they also are increasingly targeted. MIT has the largest amount of corporate dollars of any school in the United States, except for Duke. The Duke Medical School has a lot, has even more. But what we are finding is that in the past, while we could enter into relationships with companies that would allow us a lot of territory in which to co-discover things and carry out basic research, what we are finding is that these dollars are coming in more and more project-labeled. We are happy to partner with companies to help develop technologies and make discoveries that will lead to their products, but on the other hand, the funding of what I call the seed corn is coming less and less from industry.

It is a problem also because of the Bell Lab situation that I described earlier, that we don't have the kind of large industry-based research laboratories that we once enjoyed. So I think that, in terms of just where the resources are coming from in order to fund the basic research that is the foundational element for an innovation economy, I am very worried about it.

MR. MEHLMAN: There are probably two "nevers" here in town. One is never risk a fight with somebody who has far more experience and who knows more than you do, although maybe I will. The other, of course, is never go hunting with the Vice President.

One thing that I would be interested in your response to, but certainly we hear from some folks in industry, is that one of the reasons that we may be seeing some of the trend is people like Stan Williams at Hewlett-Packard suggesting that universities in the post-Stevenson-Wyler or post-Bayh-Dole world are a lot harder to deal with; and that in the old days, at least Mr. Williams

would say, you go, and you want to do collaborative research, and you talk to the scientists, and you would be able to do it. Now you first have a lot of lawyers sit in a room for a pretty long time and negotiate who is going to have the intellectual property rights to whatever is being discovered, and at least according to this testimony to the Senate, that makes the search for other universities, including others around the world or other research partners who are less demanding, attractive.

Now I know very well, universities don't agree with this, and so I am prepared to be totally rebutted. Before you do that, one question: Are you part of the NSF team that does the indicators?

MR. RAPOPORT: Yes.

MR. MEHLMAN: You guys do outstanding work. Please keep it up.

DR. HOCKFIELD: I will rebut. If I didn't, I wouldn't be doing my job. It takes two to tango. Let me back up a little bit.

The whole process of recent technology transfer is a set of policies and a set of practices that I think arguably you can trace back to MIT and Stanford, who together have developed what we consider high-end tech transfer. There are companies that do complain to me on occasion that MIT is hard to deal with. Mostly, I find the companies praising the ease with which they can deal with MIT.

There are different kinds of concerns that lead us to the practices and policies we have. One of the things that a research university provides is an environment where people can do unfettered and open research. So there are a lot of constraints that companies would like to put on the research they fund at the university that we believe would be inhibitory to the basic tenets that allow us to provide an educational and expansive research environment. A lot of the things that companies would like us to do are things that we believe work against our educational mission.

We also believe that the expanse of possible claims that many companies want to advance is just wrong and is overreaching. So it is a negotiation. There are schools that are harder to work with than others.

I have to say the model that we are currently using is the 20th Century model and, as I said, is a model developed by Stanford and MIT. Do I think it is perfect? Absolutely not. One of the things that I find frustrating and I think all of us find frustrating is the time to delivery, how long it takes something that is a basic research discovery that may have an indication that it will be useful to actually get out and find fertile soil in which to grow and mature as a real technology. I think what we all need to work, and I have a group of people thinking about it already at MIT, is how we can actually speed up the process.

I, myself, in my own research have run into some of the astonishing impediments that one can enter into in dealing with industry. I would say that, from the university side, a lot of it looks like overreaching claims on products of the university that we can't, in any kind of honest way, yield to one particular industry interest.

MR. SCHWARTZ: May I just make a small comment?

The issue of industry support for R and D and basic science and Government are not in conflict with one another. They have different missions. I think we need them both, and we have to sustain both.

But I would like to address the issue that was brought up a little bit earlier, and that is whether or not we can afford to do the things we want to do. That is the issue that I am hopeful that our initiative is going to face fully. I believe that there we have no choice, as a Nation, to have the Federal Government continue to have involvement in the funding of basic research and R and D and education in this Country.

If you look back at our history, the most important innovations that have occurred, the most important developments and economic developments that have occurred were stimulated directly by the Federal Government, starting with the Louisiana Purchase which was a purchase of a resource, the introduction of railroads during the Civil War by Lincoln, land grant colleges which was a direct benefit of the Federal Government directly to education, the TVA and rural electrification. Throughout our history, Government's responsibility was never questioned as to whether or not it was good or bad and whether or not it was affordable.

Today, both of those themes are being attacked. Is it good or bad for the Federal Government to be involved in these things? I think we have to examine that as a society, and I think it will come down resoundingly, yes, it is. More importantly, today, is can we afford it? It is in that connection that I believe our initiative can examine whether or not affordability should be the issue or whether, in fact, we can afford these things and come up with ideas of how to amortize the cost against the productive gain that society will have over a period of time.

We don't have a capital and operating budget in the United States that prevents the Federal Government and Congress from investing in long term capital needs because that is really an operating cost, and we have an operating deficit. We don't allocate the operating deficit to that which is an investment in productive capability that brings enormous wealth and capability back to the Country. We have to learn how to do that, and we have to do that soon. I am hopeful the initiative will look at that.

DR. BRAINARD: Let me take this one question back here, and then I am going to come up to the front to Clyde.

MR. ROSEN: I am Howard Rosen.

Bernard, I would actually like to follow up on your point that you just made. Is there a qualitative difference between the spending that the U.S. Government did on NASA and the spending that you suggested that the French Government is doing now on their space agency? If I understood your comment correctly, in the past, we were doing that alone, and now we need to do it more because others are doing it. And my other question is: Should we really be encouraging that kind of a race?

MR. SCHWARTZ: The second question is?

MR. ROSEN: Should we really be encouraging that kind of a race of subsidies?

MR. SCHWARTZ: The second question first, it would be a good idea if it were not a race because, as it was commented, ideas don't respect borders. The ideas and good information and knowledge are going to go across borders. So it should not be a race. It would be best if we were in cooperation with other countries but recognize that, once it gets into the commercial world, there is going to be competition within our own borders and there is going to be competition with other nations as well.

The issue of the contribution that NASA made to the scientific environment was more than just examining space issues from a scientific point of view and how to translate that into a practical way of getting out into space and getting more knowledge. It set a tone for the entire Country, the excellence that was shown by NASA. Very much encouraged and reproduced by institutions like MIT and Stanford was the tone of centers of excellence. The issue was not just making the activity work and looking into areas that were new. There was an encouragement, the kind of investment when you don't know the answer, in other words, the adventure of science investment.

There was no requirement for a pre-ordained success that was measured over very short term goals. It was science for itself being encouraged, not only in the educational institutions but in

NASA as well. Once a particular science was adopted, the scientists who were involved in the development or the people who were doing the technology development into application, there was a very high standard of performance, and I find that there has been an erosion of that standard of performance.

I think you could probably address that issue much better than I.

DR. HOCKFIELD: I addressed it a little bit before with earmarks. This is the problem with near term funding. Near term funding erodes the quality, and without the highest level of peer review, you can't fund the highest quality work.

DR. BRAINARD: I am going to turn to Clyde in a second.

Let me ask you, just on one thing that you raised earlier, this notion of inspirational funding. Do the compare and contrast between just spending more in lots of different areas versus setting a few national goals. Which would be more likely to stimulate greater scientific advance, greater building of knowledge? I could guess what some of those goals would be, but what would be your candidates?

DR. HOCKFIELD: It is a fascinating issue. If you read the story of the science in World War II that led to the development of functional radar or the bomb, it is quite extraordinary because this was an army of physicists who were actually delivering a product. Physicists normally don't like to deliver a product. Physicists think thoughts that most of us can't understand. Actually, those thoughts do lead to new technologies but pretty far down the line. So it has to be a balance.

A lot of the discoveries that we enjoy, having found their way into products, are things that no one would have possibly imagined, and I can list dozens of things that were discovered just because people were curious about something that eventually led to a product we are using.

Actually, this year's Nobel Prize in Chemistry is one of them. Dick Schrock at MIT, a professor in the Chemistry Department, got the prize for a process called metathesis which is a way that carbon-carbon double bonds are formed and remade. You can watch him describe it because MIT puts all this stuff on the web, so you can get on our web site and watch it. There is this kind of gleam in his eye when he describes it. He said, I just like to make new matter. I mean this is a guy who just loves discovering new things. But already, this process has found its way into industrial production for pharmaceuticals and plastic coatings. It is just one example of the disconnect.

That said, that we have to have some amount of funding, I don't know what the right amount is just for research without a clear target. Mission-oriented research has been enormously productive. The discoveries of physics, the basic science that was discovered on the way to radar gave us the information in computer revolutions. The basic science that was discovered in the war against cancer has really led to important discoveries and new therapeutics in biology, many of which don't have anything to do with cancer.

And so, I think one of the things that the Nation needs is inspiration, inspiration around these goals. Rather than whining about, oh, we are losing, we are losing, we are losing, to actually think about ways in which we can win in important goals. Obviously, MIT's Energy Initiative takes up one of these big challenges. Are we going to solve it? You know, I don't know, but if MIT doesn't try, we are under-serving the world. The kinds of research that will come out of MIT's Energy Initiative are going to spill into lots of other things.

One of the fabulous things about the race to the moon was all those great things that we got kind of as side products. What was it, Velcro and Teflon and all these weird things that were just great improvements to our lives. So we have to allow that to happen.

When we have a mission, the mission can't be too nearsighted because if it is too nearsighted, then we lose much of the good that comes of it.

DR. BRAINARD: As a mother of two young children, I will attest that I would have been much later this morning in the absence of Velcro. So the productivity goes throughout the system.

Clyde Prestowitz?

MR. PRESTOWITZ: Hi, I am Clyde Prestowitz from the Economic Strategy Institute.

I have two questions. The first deals with whether there is a problem or not. Bruce, you made the point that, if you need to get the funding, there has got to be a sense of crisis or a sense that there is a real problem. And yet, I have to say I thought your presentation kind of implied that there is not a problem. You said that Vice President Mondale was wrong. Everything proceeded very well from the 1980s. You listed all the great advances that we have seen over the last 20 years. So I had a little bit of the impression that maybe there is not really a problem. On the other hand, Professor Hockfield and Mr. Schwartz are suggesting that there is more of a problem. I would really like to explore this rift in the panel and find out what is the nature of the problem if there is a problem.

The second question I have is this. I think that we are conditioned to the notion that in global competition, we, the United States as the leading developed Country, want to move to higher ground. Our future is high technology. We talk, we urge that we spend more on basic R and D, improve our education system, turn out more PhDs, bring in more smart people from India and so forth.

The question mark I have here is that, as I interview in Silicon Valley and talk to the venture capital community and talk to high tech executives, increasingly I am being told by these people; for example, the VCs, the venture capitalists are saying, look, we are not funding new startups

unless they are moving not just their production, but unless they are moving their development and even their R and D to China or to India. They say that in a context of a world in which the value of the dollar is being managed by a number of central banks outside the United States, in which, as you pointed out, Bruce, foreign governments are often making targeted offers of capital grants, tax holidays, etcetera in order to attract specific industries and specific technologies to their shores, which under normal market conditions would probably be in the U.S.

This suggests the potential of a world in which you increase your spending, and maybe you have four or five really smart people in Palo Alto or in Cambridge who invent all kinds of fantastic things. And we think if they invent those things, that is going to produce welfare in the United States because we will then produce those things and develop them in the U.S. But, in fact, they can easily, under the circumstances that I just mentioned, be developed and produced elsewhere. So you could almost argue that increasing our R and D spending in those circumstances would get us very little return and therefore might actually be a waste of spending.

My question then is: Is that the situation we are in, and if so, then do we need to deal with these issues of the dollar and targeted investment incentives in our trade policies?

DR. BRAINARD: Let me do the following. Since we are at the end of our time, let me give an opportunity to each of the panelists to both address Clyde's question and also to give us their last 60 seconds of wisdom on this topic, starting in reverse order. Bruce?

MR. MEHLMAN: Sure, I don't think you can read three billion new capitalists and not acknowledge there is a problem. As for a rift, I think we all actually agree. My point in suggesting that the Mondale and Perot doomsaying turned out to not have been prescient is I think there are things we can, should, and will do to overcome a lot of those challenges. So I am inherently an optimist, which I think Bernard Schwartz also echoed the themes when he spoke.

First, I think we are in alignment that there is indeed a real challenge. I call it a creeping crisis, and my biggest fear being politically based is that there doesn't yet seem to be the political will ready to move the first spate of solutions that we need.

With respect to trade policy, I don't know why I would even answer this, but Lael at the end will be able to undoubtedly hit the ball out of the park on the substance. I do think trade policy has to address the areas in which other nations are inhibiting a free market from operating as a free market. I think Chinese currency manipulation being a decent example.

I also think we need to be cautious about provoking high noons when sometimes a lot of developing nations have to be eased. Sometimes developing nations are more likely to see evolutionary as opposed to revolutionary changes, and bringing them into a true, fair, level playing field, market-based structure sometimes takes a couple of administrations. I think we ought to set our sights on the goal and not on an immediate satisfaction.

DR. HOCKFIELD: There are always doomsayers, and there are people who are just pessimists, but I think for each of the times when there has been a challenge, it is not that the United States has emerged out of that challenge by not doing anything. The Japanese challenge in the 1980s provoked a tremendous amount of soul searching. There was a book that came out of the Industrial Performance Center at MIT called *Made in America* that really looked at American manufacturing, and American manufacturing changed. Japan's success, perhaps, was not as great as people predicted it, but the United States actually powered up to face that challenge.

I don't think there is a single answer. The most recent book out of the Industrial Performance Center is a book called *How We Compete*. Suzanne Berger is the lead author. It actually looks at 500 successful global companies and gives what I think is the most optimistic and wonderful report, which is that each of these companies has succeeded by doing it in a different

way. Everyone doesn't ship off manufacturing to China or India, but it is the cleverness; it is innovative thinking. It is not just innovative technology that provides success. This is how the United States has succeeded in the past.

I don't believe that we are in a profoundly different model now. But if we back off from continuing to innovate, not just in terms of new inventions and new technologies but new ways of actually manufacturing those products, so that a piece of that stays in the United States or different components of it stay in the United States, then I think we really are in trouble.

My biggest concern is education, and it is not education at MIT. It is K through 12 education in the United States. It is something like only 18 percent of 12th graders a couple years ago were performing at grade level in science or math. This is just horrifying. It is horrifying, not simply because of the old saw of we need more scientists and engineers. Microsoft tells me the reason they built their research campuses in India and the U.K. is because they couldn't hire enough computer scientists in the United States. Well, my view is that Microsoft needs so many computer scientists, that even if we were producing enough in the United States, it wouldn't be enough for them.

What we have is a K through 12 system that does not produce, sure not enough scientists and engineers, but not a scientifically and engineering technology literate populous who can help, as a Nation, as citizens, actually bring forward the kinds of policies that can support the kind of innovation economy that has been this Nation's great strength over time. If I have a single place that I worry, I worry about how we are educating the vast citizenry, not the high end.

MR. SCHWARTZ: With all due respect, you question whether or not there is a problem and then you cite the problem. If venture capitalists in the United States in Silicon Valley and in North Carolina and in wherever are instructing their investing people not to invest in U.S. domestic-

based production facilities and companies, that is a problem, and it will be a problem that will have greater and greater impact on us. So that is the problem.

The issue really is education. I think it is very important, but it is part of one of the elements to cure the problem in the United States of competitiveness. The issue is national will and allocation of resources and affordability. That is what the problem is in this Country today, and it has been that way for many generations.

Today, however, we have a defeatist attitude that says, well, it is not only domestic issues we have to overcome and ensure that there is a combination of a free market society and a regulated environment to the degree that we think we need safety nets and all the other safety reforms. Now there is a pessimism in the equation that has to do with can we compete against China and India, etcetera, etcetera.

Am I optimistic about how we manage those situations? Absolutely, but let me just indicate a couple of problems. How is possible that the United States is so far behind the broadband wiring up of the Country when a country like South Korea is able to get 95 percent deployment of broadband to every school and almost every office and every home? How is that possible? It can't be because we don't have the will to do that or that we don't have the resources to do that.

How is it possible that the United States has been talking about how to attack the energy problem? We all believe that there is an answer to the energy problem, probably through technology and probably through some kind of organized Federal and industry effort, and yet we don't do it. Part of the reason we don't do and part of the reason that it goes against national will is the question, can we afford it now? Can America, in its current status with all the problems that we read about in the media all the time, can we afford to do this thing or are we going to break the bank here?

I am hopeful we will answer that question instead of having that pre-ordained in a negative. I firmly believe that the answer is yes. Not only will answering the question pay for itself, but it will create new wealth in the United States and the world and a quality of life that will improve throughout. That has been the history of mankind, humankind. I truly believe that we can do it again.

Am I optimistic? I will tell you a small story. When Richard Nixon was President of the United States, he had a State Dinner for Golda Meir who was then the Head of Israel. During the dinner, it was noted that there were more people attending the dinner than ever before for a presidential invitation. When the President addressed the group, he said at dinner, everybody but one person came here tonight to listen to Golda Meir. So then Golda Meir had something to say to those people who wanted to hear something, and this is what she said. She said, my earliest living memory was hiding behind a bush when a Cossack with a drawn saber with his horse jumped over me during a pogrom in Russia, and today, the most important men in the world ask me for advice. Why shouldn't I be optimistic?

DR. BRAINARD: I think we have heard four words this morning that aptly summarize the set of work that Bernard has set us on: curiosity, inspiration, mission, and optimism. So thank you to all three of our panelists for setting us on this course.

(Applause)

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