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INNOVATION WITH CHINESE CHARACTERISTICS

A Roundtable Luncheon with

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P R O C E E D I N G S

MR. BUSH: Ladies and gentlemen, I'm sorry to interrupt your conversations, but I think we should get on with our program because it's going to be a very interesting one. Linda Jakobson is the Director of the China Program of the Finnish Institute of International Affairs. She is based in Beijing. She is a long-time observer of China. She has written a number of books. One of them is called "A Million Truths: A Decade in China." It's a really outstanding portrait of the Chinese people and life in China. I recommend it to you. It's one of the best journalist portraits of China.

She wrote me a few months ago telling me about her latest book, "Innovation with Chinese Characteristics: High-Tech Research in China" which will be published by Palgrave in July 2007, and offering to do this program. The book I think goes to one of the most important questions about the future of China and that is the question of creativity in the system, and so Jeff and I on behalf of our respective programs leapt at the opportunity to do this program. Obviously you leapt at the opportunity to come and hear her, so without further ado, I give you Linda Jakobson.

(Applause)

MS. JAKOBSON: Thank you, Richard, for that kind introduction. Good afternoon, ladies and gentlemen, honored guests. It's a great pleasure to be here at Brookings. I would like to extend my thanks to both Jeff Bader and Richard Bush for this invitation. It is wonderful to see so many old friends. I'm not even going to try and name them all. Just thank you for coming. Today is a special day. For once my better half, Chris, can be here with me to listen to me speak. That doesn't happen often, and the icing on the cake is that his brother Kevin is here as well. So a very special day.

I'm going to speak about China's technological ambitions. Like Richard mentioned this is broadly speaking the topic of a book I've been working on for about 2 years with five China-based specialists. These specialists have written the chapters about information technology, nanotech, biotech, and energy. It is a book about the kind of high-tech research which is being done at the moment in China. I myself have written the first chapter which provides an overview of science and technology generally speaking in China and especially the ambitious goals that the Chinese leaders have in this sphere.

About half the chapter is devoted to the challenges that China faces when it tries to fulfill these goals and it's these challenges and the political dimensions of these challenges that I'm going to focus on today in my talk.

I think for anyone who was watching the science and technology environment in 2006, it didn't come as a surprise when the government unveiled its 15-

year S&T plan. The Chinese government is adamant that China is to become one of the world's leading S&T nations by the middle of this century. And perhaps even more ambitiously, the government has said that the nation is to transform into an innovation-oriented society within 15 years.

China's leaders of course have several reasons to want to see the nation become a techno superpower. First and foremost, I think they see raising the level of the S&T capability of Chinese enterprises as essential for economic development to continue. As the world economy becomes more knowledge driven, so will the importance of being able to acquire knowledge and also of course to apply knowledge. Though China has made very impressive economic strides during the last few decades, China relies very heavily still today on imported technology.

I think the most illuminative statistic in this regard is the one that tells us that 88 percent of all of China's high-tech exports come from companies which are either foreign owned or Taiwanese owned, so globally China is a borrower of technology and not a creator. In the long run this will definitely impede China's ambition to become one of the world's most vibrant economies.

Intertwined with these economic imperatives of course are also the political ambitions, the military ambitions that the Chinese government has when it wants to see China rise to become a great world power. S&T is needed to boost the nation's prestige, for example, by sending a man to the moon, and it is also needed to modernize the People's Liberation Army. The legitimacy of the Chinese Communist Party rests above all, and I think in this audience I don't have to say it, on the leadership's abilities to ensure that economic growth continues, and secondly, to instill a sense of national pride in the population about all the achievements that China has already made.

I am going to quote Hu Jintao, China's President, "Science and technology, especially high technology, is increasingly becoming the focus of competition and comprehensive national strength." So nationalism is without doubt an important component in any equation looking at the tools at the disposal of the communist party to keep its grip on power. So in sum, China aims very high in science and technology, Chinese leaders have decreed that the cornerstone of the future development of S&T must be indigenous innovation. This is in Chinese (*zizhu chuanxin*) it's a concept which is extremely difficult to translate accurately. As is true in many aspects of China's modernization drive, this concept (*zizhu chuangxin*) is very contradictory, it's also very controversial. It's a topic that I've looked into quite a bit and I hope maybe in the Q and A we will get back to it. But even when you think more broadly about the S&T environment and the goals that China has as far as S&T is concerned, contradictions and controversies abound.

On the one hand, we all know there are several indicators that show that China has already made impressive strides in the field of S&T. You can look at the number of academic articles that China researchers are publishing in international journals, you can look at the amount of investment that's made into S&T, you can look at for example the number of patents that the Chinese are filing.

But on the other hand, China's S&T environment has been criticized as detrimental to creativity, as corrupt, and as very politicized. All of these criticisms were made during research interviews that I conducted over the course of the last 18 months. I should add that there are scores of articles in China that also very forthrightly criticize the S&T environment in China today. In these publications as well as in my research interviews, the general quality of Chinese research was deemed low and policymakers looked upon as overbearing. So all of these contradictions have to be taken into account when one tries to assess how realistic is this goal to make China an innovative nation.

Two interjections before I go to the specifics. The Chinese government is grappling with innumerable challenges simultaneously. I know that for this audience here this is a given, but I still think it is very important to say it out loud. The most pressing problems are poverty and health care. Nearly 500 people in China live under $2 a day. Environmental degradation is already causing health risks. I have pointed out that modernization is being pursued at a stupendous price. So improving the S&T environment is just one of many, many tasks.

Then secondly, despite the fact that it is only one of many challenges, the Chinese government feels a great sense of urgency when it comes to S&T. The population is aging rapidly. In a mere 13 years' time, about a sixth of the Chinese population, about 240 million, will be over the age of 60. And when one bears in mind that the whole goal of the reforms have been to catch up with the West both economically and militarily, the coming two decades are seen very understandably by the Chinese government as a crucial window of opportunity. After 2020, an increasing portion of government expenditure will be needed to care for the elderly.

So now I turn to the hurdles that China needs to overcome to build a strong national innovation system. First, the education system. China has dramatically expanded higher education within the last decade. About five times as many people have the chance to get a university education in China today than just 10 years ago. But a recent assessment by the McKenzie Global Institution evaluates that only about 10 percent of science and engineering undergraduates in China are globally competitive. When living in Beijing, you nearly weekly hear from either managers of multinational companies or managers of Chinese state-owned enterprises that have gone global that there is a genuine lack of talent. China desperately more specialists who are well educated, talented, and also able to maneuver within this very unique Chinese S&T system.

The quality of education in China is in my view one of the biggest obstacles for China to achieve its goals. First, the number of teachers has not increased to correspond with the huge increase in students. For example, one professor can supervise 25 Ph.D. students. Second, most of the higher-education enrollment growth during the recent decade has been the result of private education. This is a very complex issue in China. Maybe this too is something we can talk about in the Q and A, but suffice it to say that the quality of education varies greatly in private colleges today.

Third, academic corruption is really a factor which has a very negative impact on the quality of education. In the last few years there have been many articles and a few excellent books published in the PRC about corruption that is linked to postgraduate recruitment, master's and Ph.D. theses evaluation, theses publishing and so on. Also plagiarism is very commonplace. This is at least in part a result of enormous pressure on everyone from students to lecturers and professors to produce published publications, published articles. They need them to be able to be promoted, in order to graduate of course, and also to receive research money.

And above all, in spite of the many, many educational reforms which have taken place in China in the last 25 years, teaching methodology is still very largely based on rote learning. Chinese students tend to be great test takers but they are not known as problem solvers. Also Confucian traditions of deferring to authority are not really conducive to creativity. Even at elite universities one hears young researchers and graduate students complain that one is really not supposed to question a professor's views. So despite the massive amount of state funding that has gone to some 42 universities, I think it will take years, really years before these universities genuinely fulfill the government's goal that they become world-class institutions. This is one point where I know that many both in Europe and the United States disagree with me when you look at some of the test results of students coming from those universities, but I always say that one high-class department doesn't yet make a whole university world class.

Then finally, the concentration of talent in a small pool definitely drains the energy of those who are talented. In China, if you are considered competent you are given multiple tasks and responsibilities. The number of professional hats as I like to say that are worn by a Chinese academic is often unbelievable and I question whether anyone can be competent as a professor, as a research institute director, as a member of a committee advising the government, as a board member of a spin-off company, and at the same time keep abreast with one's own field of research. I think that one or perhaps all tasks inevitably suffer.

Briefly to the other major problems. Besides the economic system, the next big hurdle is a phenomenon that I call linkages. The so-called stovepipe syndrome has its root in the centrally planned economy that still plagues the Chinese science and

technology landscape. In China each research entity tends to be a little island on its own with very little contact with other research institutes. This is true of other government organizations and state-owned enterprises and so on. Of course, this problem affects modernization processes in China more generally speaking.

In part this is a legacy of the past, in part it derives from the present very top-down political system, as well as the strong competition for government funding, for talented people, and ultimately power within the system. The government encourages collaboration especially between enterprises and between research institutes, but de facto weak linkages remain a real major structural challenge in China.

An obvious consequence of the weak collaboration between different entities is that China's scientific resources are scattered and not used very efficiently. There is tremendous waste within he system, yet again, I know this problem applies to Chinese society more generally. Lack of communication between the research institutions is often accompanied by mistrust. Of course, within academia everywhere in the world there is always rivalry that is related to funding decisions and funding opportunities, but the problems are worse, they are accentuated in China, because of the very unclear way in which funding decisions are made. When decision-making processes are not transparent and decision makers are not accountable on the basis of rules that everyone knows about and anyone can challenge, this leads to the cultivation of personal relations with the decision makers. We all know that this is a very fundamental aspect of Chinese society. In my research interviews, a very spontaneous observation was that Chinese researchers need to study effective system management. My co-author Yu Jun who is a Director at the Beijing Genomics Institute writes in his own chapter that in China a scientist must be political, otherwise he can survive. If he doesn't have connections, *guanxi*, he cannot secure research funding. He needs those personal connections with a decision maker.

The third problem I'm going to mention is a bureaucratic control mentality, this too of course inherited from the central planned economy days. In about 80 percent of my research reviews, the Ministry of Science and Technology was targeted and criticized for its unprofessional bureaucrats, for its attempts to control the direction of research, for its lack of transparency, as well as its overspending in megaprojects and mega infrastructure projects which gives bureaucrats a lot of face. This week we have read that the former Minister of Science and Technology has resigned and we now have the name of a new minister, and perhaps in the Q and A we can also get to that and perhaps discuss what led to the resignation of the former Minister of Science and Technology.

Then I turn to another problem, one which is again familiar to all of you, and that is weak law enforcement. In the field of S&T of course this translates very explicitly into the weak enforcement of IPR. As we all know, pirating of international

intellectual property is rampant in China. Many experts see this as problem number one that will stop China from achieving its S&T goals. Until the day that researchers, both Chinese researchers and foreign researchers, trust the system to protect IPR I don't think that China will be looked upon as a favorable location to do really groundbreaking basic research.

Academic misconduct including corruption, including plagiarism, are all systemic problems There is a professor at Zhejiang University in Hangzhou, a man called Liu Ming who has written quite a fascinating book published in the PRC about academic corruption. He traces the problems of Chinese science to the political system in China, specifically, political interference at all levels, and also the lack of independent organizations. He argues that political interference prevents the peer review system from functioning properly.

In order for us to have time for some Q and A, I am going to start drawing a few conclusions. China has several of the drivers in place, it has several of the features needed to fulfill its technological aspirations. I am going to just mention a few. They are all quite self-evident, the political elite, the scientific community, they are all very committed to improving the level of S&T in China. The government is very willing to use a lot of money to help develop S&T. The general public approves of placing a very high priority on S&T. China has a huge number of very, very talented people. I think the speed with which China has already acquired the ability to build high-quality research and knowledge centers has been phenomenal.

A few Chinese companies like for example Huawei, Hai'er and so on have already become world leaders in their respective fields. But for a genuinely strong national innovation system to emerge in China, I think four obstacles need to be overcome. Just to summarize, they are, number one, raising the quality of Chinese education. Two, reducing the bureaucratic control for science and technology policymakers to enable an environment where creativity is genuinely encouraged. Number three, improving law-enforcement to protect IPR. Then number four, implementing a system of checks and balances to introduce responsibility and accountability for grant applications, job promotion, thesis approval, and so on. Needless to say there are numerous other problems China needs to tackle in the field of S&T. Most of them are being addressed today with very specific policy measures. Chinese policy-makers are very aware of the problems.

Some of the problems I've mentioned are directly related to the one-party authoritarian system of today's China. Despite ongoing and comprehensive reform and a genuine loosening of controls in many, many spheres of society, it is impossible to ensure that academic vacancies are filled or grant money for research projects are decided upon in a rational and genuinely fair way when there are few if any genuine checks and balances, when there is no rule of law, not within society at large, and not within

academia either. In addition, of course enforcement of for example IPR protection is extremely weak.

A much more complex issue is the effect that the political system has on creativity and innovation. Can a state in which freedom of speech is restricted and stability is placed at the very top of the agenda by the government transform itself into an innovation-oriented society? Can creativity flourish in an environment that ardently deters people from rocking the boat, that constantly reminds people that the ultimate goal is a harmonious society, that is known to always hammer down the nail that sticks out? The goal of building a harmonious society after all is in my view is just the repackaging of the old political slogan "stability is the foremost goal."

So I often ask teachers in China how do you encourage students to challenge authority? How do you prod researchers to come up with novel techniques and disregard old models when at the same time you demand that these students and researchers never ever question the rules that govern society? Of course, I never get any definite answers there. There are no definite answers.

I think the continuous success of PRC students within academia in the United States and in Europe is certainly proof of the ability and capability of Chinese researches when they work in an academic atmosphere in which creativity and critical thinking are encouraged. I think that already is one part of the answer. And perhaps another part of the answer is a statistic I by chance came across, and that is that 64,000 science and engineering Ph.D. holders who were born in the PRC today work in the United States, 64,000.

There has been a lot of hype in the media about returnees and the big input that they have had in Chinese S&T developments in the past few years, but to be honest, from the Chinese government's point of view, a great disappointment has been the very small number of qualified and talented Chinese who have genuinely returned to work in China. The input of these 64,000 Ph.D. holders in this country would be sorely needed in China, but they have chosen not to return. I elaborate a lot more on this subject in the book. I don't think now time permits me to do so. But I would like to mention that I found it very interesting that Tom Friedman last Sunday, last week in any case, in one of his columns about a new biography about Albert Einstein, wonders is China's authoritarian system going to actually be a ceiling for innovation in China, and he talks about the need for rebellious thinkers when he talks about innovation. So I think that he also is thinking very much along the same lines that I've talked about for you here.

To conclude, I think that efforts that China has made and continues to make toward technological excellence will certainly bear fruit within. Already during the next decade, perhaps even sooner, we are going to hear news about groundbreaking research which has been in China. There are several pockets of excellence especially

within IT, nano, bio, perhaps even other fields which I don't know about. But considering the enormity and the extent of the major hurdles that have to overcome to build a national innovation system, I think it is highly unlikely that the transformation could possibly take place within 15 or even 20 years. I think China is going to proceed to develop its capabilities in S&T in the same way it has traversed the whole reform road over the past few decades, bit by bit, one step at a time, progress is going to be piecemeal. At the end of the day whether or not China achieves its ambitious goals in S&T depends on how societal reform progresses in China. The S&T landscape faces very much the same problems as society at large. Thank you, and I look forward to your questions.

(Applause)

MR. BUSH: Thank you very much, Linda, for that exhaustive institutional diagnosis and the more cosmic perspective at the end. We now open up the floor to questions. When you ask your question, please identify yourself and your affiliation if you have one. There should be mikes so that everybody can hear. We will start with Susan Lawrence.

SUSAN. LAWRENCE: Thank you, Linda. That was a brilliant talk. Just one small piece that you didn't talk about in this book and I was just curious to hear your thoughts on. Microsoft and Intel both have big research labs in China and have hired a whole lot of Chinese scientists. There's been a lot of criticism within China that they are picking the best of the crop in China, but there has also been criticism in the West that those centers, the companies may be making a mistake putting them there because anything that they develop there will be very quickly stolen. I'm just curious what you make of those centers and what role are they playing in China's S&T development.

MS. JAKOBSON: Shall I answer one by one? Thank you. I had a problem in my book trying to get all the things I had learned into 30 pages. Now I had to say everything in 30 minutes, so obviously a few important points were missing. This internal brain drain which Susan is referring to is really a problem in China today. In other words, it means that those Ph.D. holders and master's degree holders from the West who are returning to China are being gobbled up by the multinational companies who increasingly are establishing research centers, and so in a way, China doesn't benefit from them. In a Rand report, the authors ventured that one day some of the more daring of these will go out and start their own companies and in that way China will benefit from their expertise as well. But to be honest, at the moment it is a very segregated world that the multinationals live in. It's as segregated as the rest of the research community that I was trying to describe, and so, yes, what Susan mentioned is definitely a problem and talked about a lot, that the best, the brightest, and the most talented returning from abroad and also the ones of course being educated in China are going to multinationals.

As far as how much the research results are then going to be copied and stolen, we have someone from Microsoft here, and I wonder if you would like to comment on that. No, really, I think this is a very important question.

QUESTION: We have seven global research facilities in Europe, here in the United States, India, and China. Clearly the talent is there, very top-notch talent. Intel, Microsoft and other foreign multinationals hire the best of the best. We have no apologies for that. The talent is there and they are doing cutting-edge research that is going directly into our products, speech-recognition software, there is really, really very fine work that went into our new Vista product.

I've also discovered we have hundreds of interns that we hire from Chinese universities. They are not just summer interns, they are year-long. We hired some of them, but most of them we don't. They go on and many of our researchers go on to other companies, they could go on to other multinationals. So we are actually giving the Chinese researchers we think experience that they need to thrive in a global innovation environment.

Some of that comes back to us, that's our intent, but people have long careers and many move on. It's going to be a gradual process over time. We just went through a series of meetings 2 weeks ago with Bill Gates and our leadership with Chinese leadership and they recognize the contributions that we and other foreign technology companies are making with our research facilities there. We want to keep the body of our research in the U.S., talent is critical, but we have to do a lot more in terms of improving our own schooling system in it and when the immigration laws are restrictive as well both in terms of bringing graduate students and allowing them to stay and then H1Bs, we need to go where the talent is. So we feel like we're contributing. Certainly the Chinese leadership recognizes that.

On the question of intellectual property, certainly we keep that in mind, but it is not stopping us from doing the most cutting-edge research abroad that we have. And we have actually had some progress on intellectual property and on the piracy front with the help of the Chinese government over the last 18 months, some very significant progress, where the Chinese government has required all computer makers to install legal software before they sell their products.

There are broader questions about whether China as it rewrites its patent laws, its standards laws, puts out a new competition law it is going to apply those laws neutrally or whether they will tip the balance in favor of domestic intellectual property to domestic companies. There's a genuine debate going on in that within China (inaudible) playing field, but again there is real debate going on and I can't say which way it's going to come out.

MS. JAKOBSON: Thank you. I would like to add that I know in the pharmaceutical field for the first time now there are two major companies, the Danish company Nordisk or something like that which I am not pronouncing correctly, and also an American Boston-based company for the first time are going to do basic groundbreaking research in their research centers. Until now they have been more applied research centers, so they are going to take that risk that if they come up with something quite unique it could be copied. But of course, with pharmaceuticals, being near the customer and patients, to be honest, is extremely important.

ERIC MCVADON: Eric McVadon, Institute of Foreign Policy Analysis. Thanks, Linda, and do tell us the story about why the S&T minister lost his job. Let me expand that and say what are the implications of the new choices? All of us of course have paid attention to Yang Jiechi's position as the new foreign minister, but the other ministers maybe we haven't paid so much attention to.

One of the reasons I mentioned that I think as I was racing out of my hotel room in Beijing the other day Marshall was reading to me out of "China Daily" and citing some of the same problems that you did, so is China's stating these problems a first step or is this just lip service?

MS. JAKOBSON: Thank you. I'm going to start from the end and go backwards. I do think that China is making a lot of progress by addressing the problems because before you acknowledge that the problem is there, you can't really manage it or even think of a solution. So the fact that they're talking about most of the problems that today plague China quite openly is a first step. How many more steps are needed, that's another matter. But, yes, I do think that's important.

About the minister, and I have to thank my better half for all this information because he dug it up for me yesterday. He is a very interesting man, this new minister. He is not a communist party member. His name is Wan Geng. He is under 60, he's about 58, and he a member of one of the smaller official parties. He is a fuel-cell expert with a Ph.D. in Germany and spent a lot of his life in Germany. He is fluent in both German and English. So he is a very new type of science and technology minister. The reason the previous S&T minister, Xu Guanhua, lost his job was age. It was expected, definitely, before the Party Congress, all of the ministers who were over age would be replaced. But it was a bit of a surprise that the foreign minister, the minister of land and resources, and then the S&T minister all were replaced this early on before the Party Congress. I have been out of China for a week so I can't tell you why it happened, but the few people I have contacted in China have been surprised themselves. I think I've answered the question. There are lots of questions. Yes, the gentleman here on the left.

QUESTION: (inaudible) I am actually from South Korea and I have seen a lot of my friends come to the United States and get trained and some went back and

didn't go back. So when I looked at the issues that you raised in terms of China, I see the same kind of issues in Korea. In the 1960s when the Koreans came in, a lot of them remained, hardly a few went back. When they went back they were given a big desk, a secretary and nothing to do, a big salary. That was because they didn't have the infrastructure nor the demand for these types of services. But over time it changed and now most Koreans coming into the United States go back.

The same thing with IP. Even back in the 1970s and the early 1980s, if you go to Korea, you could find any textbook, a bootleg for $5 or $10, where in the United States it would cost $600. If you go back to Korea now, you're not going to find a book like that, they are going to be all legal, and now Korea has got onto this bandwagon for IT. The reason is because now Korea is on the other side, it is producing more IP than copies.

So I think the kinds of problems that you're describing seems to be a transition and that China is facing a transition period. The question really is what can China do that will facilitate the movement toward the right direction, like the same thing that happened in Japan and in Korea? And do you have any recommendations for that? Like for example, in Korea I think that the liberal democracy and capitalism is really what fueled this movement.

MS. JAKOBSON: Thank you. A very important comment, and you hit the nail on the head. I think one of the fundamental things that happened both in Taiwan and in South Korea was the peaceful transition to a democratic form of government. The rule of law is just so important when we're talking about protection of IP being put in place. So just as I ended my talk, the S&T environment in China faces very much the same problems as society at large. Is it possible to protect IP if you don't have rule of law? I question that seriously. So if we saw movement toward a more pluralized system of government, I'm not even going to use the word democratic, but a more pluralistic decision-making process where one could have more genuine elements of the rule of law, I think that would already send hopeful signals for the S&T community. At the moment we're not seeing that.

QUESTION: (inaudible) thank you very much for your presentation, Linda. I enjoyed that. But to follow-up on that last point, you mentioned the changes now, the question is, to achieve an innovation society. What happens if China doesn't become a pluralistic society, much less a democratic society? What happens if they don't overcome these four hurdles, if they don't listen to your suggestions? Then what are the prospects? There are lots of things happening now without a pluralistic society and political system that is showing tremendous progress. So the question is, can they get there even if they don't change the political system?

MS. JAKOBSON: That's actually the core question here. I think there are definitely sectors where we have already seen a lot of progress and we will continue to see progress without a ceiling necessarily arriving. I think in space technology and anything to do with the military system, we know that by putting enough resources and talent into these programs we are going to see immense progress. I don't think democracy and that type of technology research goes hand in hand. But this aim that China is going to be an innovative-oriented society across the board with a national innovation system, that is more what I was trying to describe. I definitely think we are going to see pockets of excellence, like I said, we already have seen pockets of excellence, and this will continue. China has already made such tremendous strides and progress in the field of S&T that is going to continue regardless of all the political problems that society is facing. Yes, at the back, please.

QUESTION: (inaudible) Air Force of Scientific Research. This kind of goes along with what you were just saying. What in your opinion are those areas where you are seeing the excellence? A key concern fundamental research within the Air Force is looking at is where is China approaching the same level of S&T excellence as the U.S., where have they possibly gone beyond us. Specific areas would be nice. Thank you.

MS. JAKOBSON: I should of course be a good author and say you'll have to wait until the book comes out and then you'll see, because I am now quoting my own co-authors. I am not a scientist. I have always made this very clear. I am a political scientist, so I rely very much on others' expertise. I really do have the country's leading experts in IT, nano, and bio writing the book with me. But for example, within biotechnology, genomics is definitely something where China already today according to experts is on par with the United States and Europe. There is a lot of gene-related research where people expect groundbreaking results, and stem cell research. China banned human cloning, but just about everything else goes. So obviously they are going to be able to progress much faster, this is something that is addressed in the book by a Chinese American who has worked both in the United States and China, than Europeans and Americans where often there are legal constraints, for example. So there are pockets of excellence within these four sectors: IT, nano and biotech, and then energy was chosen for political reasons for this book, it is such an important topic also as far as the environment is concerned. So it is really bio, IT, and nano where I think there is going to be groundbreaking research within maybe even 6 or 7 years. And then space technology which is not part of the book, military technology, I am sure there are pockets of excellence, but military application is not at all a focus of this book. Yes, beside the previous gentleman in the back.

SCOTT HAROLD: Scott Harold, Brookings. Linda, I wonder if you could say something about the extent to which the one child policy, an area which you might think that probably doesn't have much relationship to innovation, but actually most of the studies in the U.S. that study innovation that I'm aware of have said that often

times it's second children in a family who have to go through the process of finding a new path. I wonder do you see any evidence that the one child policy actually would have any impact on constraining China's innovation.

MS. JAKOBSON: I'm a second child. I have definitely found my own path having spent nearly 20 years in China. But joking apart, I have seen absolutely no studies on this. But on the other hand, and I hope I'm not quoting her wrongly, Kathy Chen of the *Asian Wall Street Journal* wrote an article about the spoiled brats who are the one and only child of their parents and the only grandchild of four grandparents who are going to grow up so spoiled that they will be rebellious and they will tear China apart and start again. So maybe they will be the rebellious thinkers that Thomas Friedman says that Albert Einstein has said that we all need, so who knows, who knows? But I haven't seen any really good work on that. I think it's a good question.

QUESTION: (inaudible) Chinese Embassy. You mentioned many problems on education with science and technology. I agree with you on most of your points. But it seems to me that in business circles have different perspectives about China's future even in science and technology. I talked to a friend of mine who is the vice chairman of a big high-tech company. He visits China last year and he came back to talk to me and said I think that I made a mistake. I didn't move my research and development center to China like Microsoft and Intel did. It seems to me that they are very optimistic about finding experts and talented engineers and young scientists in China. That's the comment. I have a question.

The question is I was very surprised to see in your introduction you are based in Beijing at the (inaudible) Research Institute in Beijing. I came here a couple of years ago. Just 3 years ago I didn't see many foreign institute in China. It seems to me China is more open to receiving more foreign institutes in China. I think it's a good idea that you are doing research on China. Many China experts don't touch the point about China. China is changing so fast.

My question is how do you try to impact on the decision makers in China? What do you do in Beijing?

MS. JAKOBSON: I don't try and impact Chinese decision makers. I try and learn and find out what they're thinking. I don't think as a foreigner my job is to try and impact them. My job is to tell European policymakers about what the Chinese policymakers are thinking and explain what's going on in China to European policymakers, not influencing Chinese policymakers.

But I agree with you. There are so many talented people in China. Malcolm Lee has had to leave, but that is why he also said that it's a great place to start up a research center. I fully agree with you. I was perhaps talking more about the

structural problems to build a national innovation system. And I also agree with you that China has become much more open. In the 20 years I've been there it's going through quite a tremendous transformation. I fully agree with you there. The gentleman in the back.

MARK MOHR: Mark Mohr from the Wilson Center. I was wondering if you could comment on the difference between high school education in China's and universities. Are they taking it down to the high school level? One assumes that with university level graduate students there is a little bit more flexibility. Are kids still being indoctrinated in high school or are there science programs at middle school and high school levels? Thank you.

MS. JAKOBSON: That's an extremely important question. Thank you, and it's perhaps a subject that as I continue in S&T I'd really like too look into the education system in a lot more detail.

Primary school is the only level where genuine reform has already been carried out. They started in the 1990s. They are already trying not to base teaching in primary schools on rote learning. But this changes the minute the poor child becomes 11 and goes into middle school because then you start preparing for the tests that will lead you to hopefully a good junior high, senior high, and then ultimately into university. Everything is really focused on taking those tests so there is in a way a huge difference between high school like you mentioned and university because high school students in Chinese slang are considered the most unfortunate creatures on earth because you never see high school students anywhere because they're all sitting and studying. The ones who really want to get into university are sitting and cramming specific data by rote learning into their heads so that they could get into a proper university. So that is what has to be crushed and it's a political decision and it has not yet been done. So education reform has never really got past students aged 12 in China.

Then when they go to university, there are good universities. I don't want to decree that all Chinese universities have low-level teaching, but when we're talking about world-class institutions, there is quite a big difference and a big leap still to go there. And it always of course, as in the West, depends on the professor and the leader of the department and so on. There are pockets of excellence definitely in China and there will be increasingly so in the future.

JUNE LING: I'm with the American Society of Mechanical Engineering. You mentioned four major obstacles. The first one was improving education and I just wanted to reiterate some of the comments you've already made, as we're very involved in establishing mechanical engineering curricula around the world. Definitely we have a lot of partners. We have student sections in mechanical engineering from the major universities in China. Publishing journals and technical papers. We publish tens of

thousands each year. The percent coming from the science and technology community in China keeps growing double-digits. So I think education, that major obstacle, is transitional and they are on a great path.

IPR, I think that's a difficult issue, but transitional, and that can be handled by the right policies. There was some discussion on what I consider probably the most difficult one, the single-party authoritarian culture. So I wonder at this point my question is what was the fourth obstacle, because I forgot? And could you elaborate on that, please?

MS. JAKOBSON: Sure. Like you said, education is number one, then law enforcement is number two, then reducing the bureaucratic controls which really is a big problem not only within the realm of S&T but more generally speaking, and you've already mentioned the fourth one which was the checks and balances, a genuine accountability system when we look at grant applications, thesis approval, and job promotion. So it was this control mentality of the bureaucrats which you were missing. Any more questions?

LIU FU-KUO: My name is Liu Fu-Kuo of Brookings, from Taiwan. It is always good to listen to your specific observations and analysis on China. I think after the first part of your analysis on academic and education in China, I wonder as a foreigner living so long in China, how do you look into this policy circle in Beijing and Shanghai, and how effective they may be able to influence their policies? Because over time you yourself were also involved in E.U.'s delegation and engaged in dialogue with Chinese experts and officials, so could you tell us how effective that will be? Thank you.

MS. JAKOBSON: Thank you. Yes, good to see you again. One of the things I do talk about in my chapter in the book is that China is sort of, on the one hand, stuck in the rut of the old days. They turn out these grandiose plans like the 15-year S&T plan. It really harks back to the old days. And on the other hand, they're encouraging private education, on the other hand they're encouraging enterprises which are not doing well to go bankrupt and so on, so it's these same contradictions and controversies that plague the whole Chinese system.

When I asked policymakers why do you turn out these great plans when some of them are not very realistic, they answer that plans are made to be revised. Don't worry, we'll make new plans when we notice that we haven't made the targets. The energy saving target, by the way, energy efficiency target which was published a year ago, China badly missed that this year, but it doesn't seem to bother them. They'll make a new plan and a new strategy and try and do better next year. It's not going to change the general positive thrust which despite all the critical things I say and describe, very much exists. I always forget to point this out in my talks, there is so much energy in China at the moment, there is so much positive energy in China. One has to always remember

that. But when I talk about challenges and problems, that doesn't mean to say that they're not doing a lot of things of right, the policymakers also. So I think policymakers are becoming more and more flexible and I think that's one of the strengths of the Chinese system just all together.

JACOB CHANG: I'm Jacob Chang from the KMT representative office, originally from Taiwan. I want to ask last year at about this time former KMT chairman Ma Ying-jeou was here. One of his remarks was a proposal to allow many Chinese students to go to Taiwan to study. Now it's kind of a one-way street. Mainly Taiwanese students go to mainland China. The current government goes not allow the mainland students to go to Taiwan. I would think that because Taiwan is a democratic society would it help China at all China's democratization if there are more and more exchange of students from mainland China to Taiwan. Thank you.

MS. JAKOBSON: I'm going to quote June Ling on this one. I think this problem is a very much a transitional problem. I think we are going to very soon see mainland students allowed into Taiwan to study. It's only a question of a couple of years, maybe 5 years, Richard Bush will correct me if I'm wrong, but I think we are in the near future going to see that development as well, the one-way street changing into a two-way street. There are many other ways in relations across the strait have changed.

I don't think it's the students going to Taiwan and getting to know Taiwanese democracy which the Chinese communist party is fearful of. There are millions and millions of Taiwanese who come to the mainland every week, so if they were worried about that, it's not the question of a few thousand or a 10,000 students going over there. I think Taiwan itself is an example of a democracy on Chinese soil. The symbolic value of that is very great, but not the issue of letting mainland students go there to study. I don't think that's the question because there are so many Taiwanese today who work in the mainland. I don't know the latest figures, I stand corrected, but there are at least half a million permanent residents in the Shanghai area, maybe 1 million permanent Taiwanese residents, all over mainland China. These are people who have actually gone and registered and got their household registration from the authorities. There are lots of Taiwanese who semi-officially live in the mainland.

JEREMY WATERMAN: Jeremy Waterman with the U.S. Chamber of Commerce. Returning to your comments in your opening about self-reliant innovation and also with respect to Malcolm Lee's comments of Microsoft, do you have any observations on the whole patent debate in China that's unfolding. Malcolm mentioned I think appropriately a number of pieces of legislation that are moving through the Chinese system right now. And of course there is a very robust debate within China and in particular within the government and academic circles about patents and foreign ownership of patents. I would be interested in your interviews whether that issue was raised quite frequently and any observations you may have.

MS. JAKOBSON: The patent issue is a very important one so I'm thankful that you raised it. In my research interviews, a recurring theme was that, number one, it's too expensive to apply for patents and this is one handicap that Chinese researchers have. Yu Jun, my co-author on biotech speaks a lot about this issue in his own chapter and he sees it really as a big problem and the reason that Chinese researchers haven't been applying for patents.

I want to comment a little on the first part of your question about indigenous innovation (*zizhu chuangxin*) and the controversy. Because when it was formulated officially a lot of people were very confused, not only foreigners who thought, oh no, are they going to become self-reliant again, a lot of Chinese were, A, confused, and, B, very upset that the Chinese leadership had chosen theses two words to sort of symbolize their new role in S&T. In today's world of globalization, what is indigenous? I mean, even in a small country like Finland you can ask what is indigenous when you have Chinese, Indian, Dutch, French, you name it, American, working in the Nokia Research Headquarters coming up with groundbreaking IT technology research. But for China which has such an amazing mix of talented people, where side by side you have PRC nationals, ROC nationals, returnees with an American or Australian passport, and a mixture of goodness knows who overseas Chinese working all together. What is indigenous? Or is this *zizhu chuangxin* supposed to only allude to Chinese culture, civilization, and not necessarily the nation.

So people were very upset that the Chinese government had chosen these specific words to kind of symbolize their great goals and I think they haven't quite got over it yet. I've spoken with very high-level S&T officials who opposed this and did not want it, but it was the top leadership who made the decision. I think that the top leaders have been extremely disappointed with how little indigenous, I mean Chinese homegrown innovation has come out of China in the last 10 years and this emphasis on indigenous is a way of really highlighting the Chinese government's disappointment regarding that. Thank you.

(Applause)

MR. BUSH: Thank you all very much for coming and for your excellent questions. But most of all, thank you, Linda, for a very stimulating presentation on a subject that I guarantee will not go away.

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