Keynote Address I

Introduction

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Ambassador Wolff welcomed the delegation from China and American participants on behalf of the Science, Technology and Economic Policy Board of the National Academies.

The United States and China have been cooperating in science for at least 70 years, noted Ambassador Wolff, a prominent trade attorney who chairs the STEP Board's Committee on Comparative Innovation Policy. Prior to World War II, he noted, the U.S. allocated precious air cargo space to ferrying scientific instruments, materials, and current treatises over the Himalayas from India to Chongqing so that Chinese scientists in exile could continue their work during Japan's occupation of China.

The modern history of U.S.-China science and technology cooperation began on June 5, 1965, in the same National Academy of Sciences building that is the site of this symposium. On that date, the Academy decided to create a committee to foster academic communication and exchanges with China.[1] The Council stated: "We hopefully believe the U.S. scientific community can contribute to a lessening of tensions between peoples and nations by endeavoring to create the basis for scientific discourse between Chinese and American scientists."

That move was important, given the historical context. "You have to remember what great difficulties there had been in the recent past," Ambassador Wolff recalled. U.S. troops had been in battles with Chinese troops in the Korean Peninsula, and there was a very, very strong anti-People's Republic of China attitude on the part of some members of

[1] For historical background on Sino-U.S. cooperation in the 1960s and 1970s, see Kathlin Smith, *The Role of Scientists in Normalizing U.S.-China Relations: 1965-1979*, Council on Library and Information Resources, (http://china-us.uoregon.edu/pdf/Smith's%20NYAS%20article.pdf.)

Congress. So it was a difficult period for this academy to begin to reach out to colleagues in the Chinese sciences to build bridges."

The Cultural Revolution soon intervened, however, and it wasn't until the 1970s that small numbers of U.S. scientists began to visit again. There was strong American interest in China's studies of botany and seismology, Ambassador Wolff noted, areas in which China was advanced. The Chinese scientific community, meanwhile, was interested in topics related to the nation's industrial and agricultural priorities, such as computer science, petrochemical engineering, mineral extraction, telecommunications, mechanized agriculture, and industrial automation.

Exchanges resumed in earnest after the Nixon-Zhou Enlai 1972 Shanghai Communiqué.[2] In 1978, Deng Xiaoping suggested there was potential for expansion of bilateral exchanges. Ambassador Wolff, who served as U.S. Deputy Special Representative for Trade Negotiations at the time, noted that the first high-level science delegation to China that year was led by a colleague of his, Frank Press, then President Jimmy Carter's science advisor and later president of the National Academies.[3] That trip, he said, "provided the foundation for the formal bilateral understandings to foster science and technology cooperation that followed." Soon afterward, China's Ministry of Science and Technology and America's National Science Foundation resumed formal cooperation.

The Sino-U.S. partnership in science and technology played an important role in helping the Chinese scientific community recover "from the dislocations of the Cultural Revolution," Ambassador Wolff said. "American universities were and are an enormous source of education for Chinese students. Investment in China by American and other foreign corporations was and is an important source of technology for China."

Now, the U.S. is starting to benefit. "We may be on the threshold of some reverse flow of investment, from China to the United States, and China's graduate students enrich the research environment of American universities" Ambassador Wolff observed. "The fruits of major research activity that will take place in China will be available to other countries as well." One recent sign of this trend, he noted, is that Applied Materials Corp.'s chief technology officer is moving to China to improve production of solar-panel equipment.

Perhaps just as important as the flow of scientific knowledge is the exchange of ideas on science and technology policy, Ambassador Wolff said. He recalled a comment made at a 2006 conference in Beijing by Richard C. Atkinson, the former director of the National Science Foundation. Mr. Atkinson explained that in the 1970s "there was very little economic theory or data about investments in R&D and economic

[2] The Sino-U.S. Joint Communique, also known as the Shanghai Communique, was issued on Feb. 28, 1972, following President Richard Nixon's historic seven-day trip to China.

[3] Frank Press served as presidential science advisor from 1977 through 1980 and as president of the National Academies from 1981 to 1993.

development [to make] the case to the Congress for federal support of research." The NSF, therefore, initiated a study exploring that link. Decades later, Dr. Atkinson noted, a report by the President's Council of Economic Advisors concluded that half of the growth in the American economy in the last 40 years had been due to investments in research and development.[4] "The private sector is a major driver of R&D, but federally funded research at universities plays a key role," Dr. Atkinson said in his 2006 speech.

Atkinson's message to his Chinese counterparts was that he believed government funding of university research "was a core need of scientific progress and innovation in this country," Ambassador Wolff explained. In the U.S., supporters of science and technology are in "a battle right now to make sure that government funding of basic research and development is sufficient" he noted. "Many people around this room and in the American scientific and technology community are currently trying to get through Congress a very important level of funding for university research and other research in this country. So the struggle continues and hasn't changed that much in 40 years."

The scientific communities of China and the U.S. can benefit from sharing views on best practices on national policies, he said. "Today is another step in that process of mutual exchange and--I trust--mutual benefit."

Ambassador Wolff then explained America's innovation system. A 2006 National Academies publication defined the National Innovation System, a term popularized by President Richard Nixon, as "a network of institutions in the public and private sectors, whose activities and interactions initiate, develop, modify, and commercialize new technologies." This National Innovation System, the publication explained, involves flows of knowledge among complex, inter-linked, and overlapping "innovation eco-systems" at universities, government research laboratories, large and small businesses, and other organizations.[5]

China also has an immensely rich history of innovation. "For many centuries, if not millennia, China led the West in innovation," Ambassador Wolff observed. "Not only were remarkable things invented, but they also were put into circulation for practical use." In the West, schoolchildren learn that the world is indebted to China for inventing porcelain in the 7th century AD; gunpowder, fireworks, and rockets in the 4th century AD; paper and tea in the second century BC; kites in the 5th century BC, and silk in 3600 BC. "But I don't think many outside China know that the invention of noodles dates back at least 4000 years," he said.

Ambassador Wolff then presented an extensive sampling of other, less-heralded Chinese inventions:

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[4] Council of Economic Advisors, *Economic Report to the President*, 1995.

[5] This definition is quoted from National Research Council, *India's Changing Innovation System: Achievements, Challenges, and Opportunities for Cooperation: Report of a Symposium*, Charles W. Wessner, ed., Washington: National Academies Press, 2007.

Table 1: Chinese Inventions

Invention	Date
Magnetic Compass	200 BC
Movable Type	1050 AD
Wrought Iron	5th Century BC
Blast Furnace	250 BC
Paper Money	700 AD
Paddle Wheel Boats	650 AD
Metal Bells	200 BC
Fork *(preceded chopsticks)*	2400 BC
Lacquer Ware	5000 BC
Stone Plowshares	3500 BC
Toxic Gas for War	400 BC
Use of Chromium *(for weapon tips; first used in West around 1797)*	210 BC
Golf	1000 AD
Crossbow	200 BC
Use of Vitamin-Rich Foods *(as disease treatment)*	200 BC
Diagnosis of Diabetes	200 BC
Dietary Treatment of Diabetes	650 AD
Isolation of Hormones (used for medical treatments)	1110 AD
Fishing Reel	4th Century BC
Manned Flight With Kites *(1891 in Europe)*	6th Century AD
Standardized Lumber Dimensions	1100 AD
Natural Gas Use for Heat and Light	4th Century BC
Negative Numbers *(also in Greece, but not used widely in Europe until 1550)*	3rd Century AD
Pinhole Camera *(a century before discovery by Aristotle)*	450 BC
Raised Relief Maps	3rd Century BC
Rotary Cooling Fan *(first used in West in 16th Century)*	200 BC
Seismometer	132 AD
Steel	2nd Century BC
Iodine Treatment for Goiter *(1860 in France)*	7th Century AD
Chain Suspension Bridge	15th Century
Toilet Paper	589 AD
Tune Bells	8th Century BC
Underwater Salvage	1065 AD

Only in more modern times has the technology flow begun to reverse from West to East, Ambassador Wolff noted. The flow began with innovations like the windmill from the Middle East and telescope from Europe, and continued with a "cascade of inventions borne of the industrial and information technology revolutions," he said.

For the past decade, Chinese leaders have stressed that innovation is vital to the nation's future. In 1999, Ambassador Wolff noted, General Secretary Jiang Zemin said in a speech at a conference on innovation: "In today's world, the core of each country's competitive strength is intellectual innovation, technological innovation and high-tech industrialization.[6]

Six years later, Party General Secretary Hu Jintao introduced a new objective, when he said that the government should "give priority to independent innovation" in science and technology work. Mr. Hu also said the country should "increase core competitiveness and strive to make science and technology innovation with Chinese characteristics a reality."[7] He also said the government must "create a policy environment beneficial to technological innovation."

The United States also has grown increasingly concerned about advancing innovation. Ambassador Wolff cited the landmark 2007 report titled *Rising Above the Gathering Storm,* [8] produced by a committee of the National Academies. The report said that the government should design science and technology policy to:

> *"…ensure that the United States is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marketing; and create high-paying jobs based on innovation by such actions as modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access."*

There are many similarities between the innovation goals and policies of the United States and China, Ambassador Wolff said. "Each wishes to enhance the prospects for successfully initiating, developing, modifying, and commercializing new technologies." Both countries also "want a substantial part of all stages of the innovation system to be located within their own national boundaries." This does not necessarily mean that each product must be developed locally, "but at least a healthy share of the

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[6] Jiang Zemin, General Secretary of the Communist Party of China Central Committee, keynote speech to the National Technological Innovation Conference, August 23, 1999.

[7] Speech by Hu Jintao, General-Secretary of the CPC Central Committee, November 27, 2005.

[8] National Research Council, *Rising Above the Gathering Storm: Energizing and Employing America for a Better Economic Future*, Washington: National Academies Press, 2007.

spectrum for products in general" so that a large number of high-quality jobs are created to bring economic benefits t their populations.

The focus is different, however. Chinese leaders seem to be more concerned with the "front end of this process this process – initiating and developing new technologies," he said, while the U.S. is more concerned with the "back end," the commercialization of new technologies."

There also are some similarities and differences when it comes to policy. "We should learn something from each other by comparing these two sets of national policies," he said. Both the U.S. and China recognize the need to support science, technology, engineering, and math education from the primary school level to advanced degrees, he said. They also both "recognize the importance of supporting university research, which has not been true of every leading trading country," he said. The U.S. and China both support research parks, regard protection of intellectual property as important, and "see a global interest and a national interest in creating renewable energy technologies and associated equipment industries and utilities," he said.

Policy differences between China and the U.S., however, "require examination," Ambassador Wolff said. One is U.S. immigration policy. As a result of tougher American immigration and work-visa policies, he said, the U.S. is having a harder time retaining highly trained, foreign-born talent with advanced degrees in science and technology.

Another issue is U.S. defense spending. Early investment by the military was instrumental in the commercial success of integrated circuits, the Internet, large aircraft, and GPS navigation systems, Ambassador Wolff pointed out. Government demand, which is not as fast moving as private commercial demand, had also be a drag on the pace of evolution of technology. Today for the bulk of products that are not exclusinvely used by the military, commercial demand is a powerful catalyst for development. "The involvement of government is something like booster rockets for the Space Shuttle, which must not remain attached after initial thrust," Ambassador Wolff said. "or they would make getting into orbit impossible."

The U.S., meanwhile, is closely watching a number of developing policies in China. For example, it is interested in whether China's heavy investments in infrastructure will present market opportunities for foreign companies. "There will be global commercial benefits for China from the creation of its high-speed rail industry and photo-voltaic cells, among other industrial policy programs."

The U.S. also is watching China's policies with respect to intellectual property and whether it is adopting national rather than international industrial standards. The evolution of China's National Indigenous Innovation Policy[9] is another major issue. The question is whether "on

[9] A key objective of the Medium and Long –Term Program on Science and Technology is to "use policy tools to promote, favor, and reward indigenous innovative technologies."

balance, these policies are helpful or harmful to China," Ambassador Wolff said.

The two nations are interested in the different policy tools they are using to promote innovation. One question, for example, is how China's financial support for renewable-energy projects compares with those of others. Another topic of mutual interest is the role venture capital will play in both countries compared to other sources of capital. The related issues include "what is needed, at what stage, and is it forthcoming?" Ambassador Wolff observed. The optimum role of large corporations--including state-owned enterprises in China--as compared with small and medium enterprises—and the future role of foreign direct investment in promoting innovation are other major interests. "Each of these topics and many others will emerge from our discussions and invite further exploration," he said.

Conferences such as this one help stimulate thinking on ways to improve both nations' science and technology policies, Ambassador Wolff said. Among the fundamental questions: "Which policies promote innovation and which may retard or distort the process?" he asked. "Where are there areas for future cooperation and collaboration? Where can we find areas where working together would have the potential for creating a major benefit for other countries as well – such as finding solutions to the challenges of carbon sequestration, cheap energy-efficient bio-fuels and battery technologies?"

In his own view, Ambassador Wolff said, government support is "vitally important for progress in science, technology, and innovation." However, government should play a supporting role, "like that of a proud mother or father watching a high school or college graduate." Government direction that is "warranted and truly useful after that graduation is limited," he said. "As much harm as good can come from such interventions. That is our national experience and our bias. So interventions must be very careful so as not to be counterproductive."

The market drives perhaps as much as 85 percent of innovation, Ambassador Wolff said. "If we were clever enough to figure out where the market was headed, we would all be billionaires."

Ambassador Wolff also challenged the notion of indigenous innovation as a useful policy path. "In this globalized world, there is no indigenous innovation," he said. Before the rise of fast and easy international communication, local innovation was more common. Ambassador Wolff noted that in his books on science and innovation in China,[10] the eminent

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See State Council of the People's Republic of China, *Outline of the National Medium- and Long-Term Program on Scientific and Technological Development (2006-2020*).

[10] Joseph Needham (1900-1995) edited a series of volumes on Science and Innovation in China published by Cambridge University Press. The first of 27 volumes was published in 1954. The project continues under the Needham Research Institute.

historian Joseph Needham credited China with invention of the stirrup, which allowed warriors to stay in the saddle at a full gallop. "But the Hittites, my wife tells me, invented the stirrup about two millennia earlier," Ambassador Wolff said. "What the Hittites and the Chinese inventor did not have was access to Internet cafés to cross-fertilize their innovations for their mutual benefit."

New technologies will make such cross-fertilization even easier. Ambassador Wolff noted that Cisco has a great video-conferencing system that makes individuals at a meeting feel like they are in the same room as those across the table from them, even though they actually are on different continents. The next step will be use of holograms, which will enable people to feel the presence of others located far way and to conduct "truly virtual meetings," he said. That will save money not only on tea and pastries but also airfare, he noted.

Science, technology, and economic policy usually catch up with progress, Ambassador Wolff observed. "But policy often lags invention. It does not very often precede it." He noted that the integrated circuit and Internet "were great enablers of this new world, but the applications that add the next very large layers of value are the products of individual and private corporate achievements."

Each country and industry needs to find best practices to support innovation and inform each other of these findings, Ambassador Wolff said. "This is a secret recipe for progress. When we discover it and share it, we enrich the world." He said the U.S. and China have much to learn from each other and added that he hopes the two nations will follow up on this conference with another conference in China so that the dialogue can continue.