Forum on INTERNATIONAL PHYSICS

August 2020 American Physical Society aps.org/units/fip/

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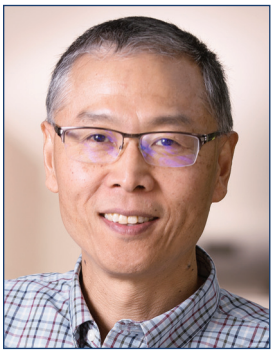
Entangled Worldlines: Four Physicists Whose Transnational Trajectories Reshaped Physics and Diplomacy in China and the United States

Zuoyue Wang



In their thoughtful 2019 report on "Openness, Security, and APS Activities to Help Maintain the Balance," members of the American Physical Society presidential line recounted a recent listening tour at several federal agencies to hear their concerns over risks from international scientific exchanges, especially those with China. In their analysis, the APS leaders pointed out that while there were real threats, overreactions could "endanger US physics, which relies upon international participation in research." In this essay, based on a talk at the March 2019 APS meeting in Boston, co-sponsored by the Forum on International Physics and the Forum on the History of Physics, I would like to argue that from a historical perspective, US-China scientific exchange and mobility contributed not only to scientific development in each country but also to solving global problems such as the nuclear arms race and proliferation.

At the center of the story were four American-educated Chinese physicists whose worldlines were entangled with each other and with national and international politics in China and the US: DENG Jiaxian (1924-1986), Tsung Dao LEE (1926-), Chen Ning YANG (1922-), and ZHU Guangya (1924-2011) (family names in all caps). Compared to Lee and Yang, who are well-known to APS members as the Nobel physics laureates in 1957 and long-time leading American physicists, Deng and Zhu are less well-known in the US, but they are pivotal figures in the development of the Chinese nuclear program.

How did their trajectories first intersect? Both Yang and Deng's fathers were professors at Tsinghua University in Beijing in the 1930s, so they got to know each other well in their childhood. Both also went to Kunming to study physics at the famed wartime Southwestern Associated University, which was formed in 1937 based on Tsinghua, Peking, and Nankai Universities, then in exile from the Japanese invasion. It was also there that they met Lee and Zhu as fellow students in physics.

In 1945, Yang was the first in this cohort to leave China for the US, eventually settling down at the University of Chicago to work for his PhD in physics. The next year Lee and Zhu followed suit, having been sent by the then Nationalist Chinese government to the US as part of a scientific mission to learn to make atomic bombs. Lee and Zhu bonded with each other both before the trip, in a small physics seminar given by their (and Yang's) professor Wu Dayou (Ta-You Wu), who was the leading physicist of the mission, and during the long voyage across the Pacific. Arriving in the US, members of the mission quickly realized that US national security restrictions would not allow them to fulfill their purpose; they dispersed into American universities to pursue non-classified research and graduate studies. Lee joined Yang at Chicago, while Zhu entered the University of Michigan to work for a PhD in nuclear physics. In 1948, Deng also entered the US, pursuing a PhD at Purdue University.

Surviving photographs indicate that Deng and Zhu separately interacted with Lee and Yang but probably not each other in this period in the US, although both were active in the Chinese Association of Scientific Workers in the USA, which was influenced by the Chinese Communist Party. Yang was also listed in the association's membership (Lee was not) but he did not recall participating in any of its activities.

In 1950, when Zhu and Deng received their PhDs they both decided to quickly return home to the newly established People's Republic of China. Many others with similar intentions were not so lucky as the US dramatically restricted their exits between 1951, in the shadow of the Korea War, and 1954-1955, when the US and China negotiated in Geneva to allow exits of those students who still wanted to return to China in exchange for China-held US prisoners of war. Back in China, Deng conducted research in the Chinese Academy of Sciences while Zhu taught physics at Peking and the Jilin Universities. They would work closely with each other in the late 1950s when both were assigned to work on the Chinese nuclear weapons project. Deng was put in charge of the theoretical division, and Zhu became the enterprise's overall technical organizer. Meanwhile, Lee and Yang decided to stay in the US and collaborated fruitfully on a number of research projects, including the non-conservation of parity in weak nuclear interactions that would win them the Nobel prize in 1957. Personal frictions, however, led to an end of their celebrated partnership in 1962.

The decades-long separation between Deng and Zhu, on the Chinese side, and Lee and Yang, on the American side, was finally broken in the early 1970s when the reopening of US-China relations under President Richard Nixon made it possible for first Yang and then Lee to make visits to China. Yang's request to meet with Deng in 1971 in Beijing apparently helped alleviate political pressure on the latter during the still ongoing Cultural Revolution attacks on elite scientists (the initial protection for those engaged in secret projects had weakened by then). Upon his return to the US, Yang debriefed and received personal encouragement from Edward David Jr., Nixon's science adviser. When Lee landed in Beijing in 1972, Zhu was among those to meet him at the airport. Two years later, Zhu would accompany Lee to meet with the Chinese leader Mao Zedong. During these visits in China in the late Mao years, both Yang and Lee used their prominence as Nobel laurates to advocate for the legitimacy and support of scientific research and education.

In the late 1970s, with Mao's death, the end of the Cultural Revolution, the launching of the Chinese reform drive, and the formal establishment of US-PRC diplomatic relations, Lee, Yang, and many other Chinese American scientists, including Chien Shiung Wu, APS president in 1975-1976, began to participate more actively than ever before in promoting scientific research and education in China as well as US-China exchanges in these areas. For example, Lee spearheaded the influential CUSPEA (China-United States Physics

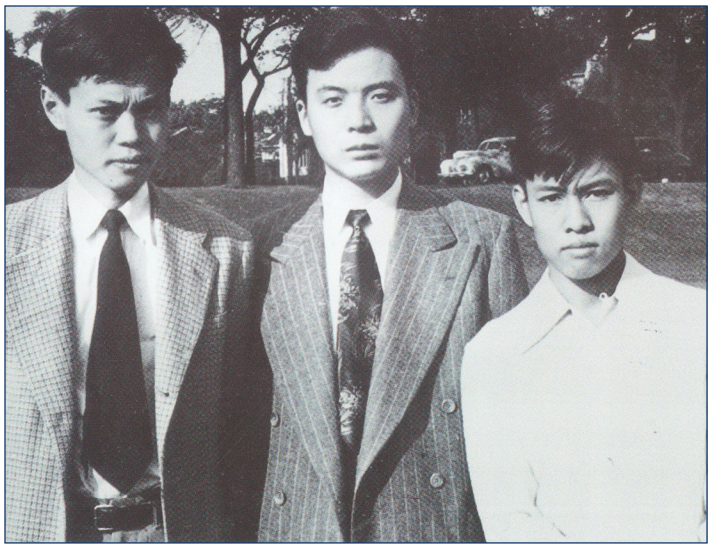


Figure 1. C. N. Yang, Deng Jiaxian, and C. P. Yang (C. N. Yang's younger brother) in Chicago in 1949. Courtesy of Professor C. N. Yang

Examination and Application) Program in 1979, which in the ensuing decade, brought about one thousand bright students from China to the US to pursue graduate studies in physics.

Once the CUSPEA students finished their studies, some of them went back to China. Still, a majority have, like Lee and Yang in the 1950s, chosen to stay in the US and become an important part of the American physics community or branched out into other endeavors. Benefiting in part from the excellent reputation of the CUSPEA program, hundreds of thousands of other Chinese students (including Deng's daughter Diandian), mostly in science and engineering, have come to the US to pursue graduate studies in the last four decades. A majority of these students have decided to stay after completing their studies and have become a key part of the American scientific, technological, and educational workforce.

In the 1980s, Lee also played a key role in official US-China scientific collaboration in high energy physics, especially the design and building of the Beijing Electron-Positron Collider (BEPC). Since BEPC was largely inspired by machines at the Stanford Linear Accelerator Center (SLAC), Lee helped convince Wolfgang "Pief" Panofsky, his close friend and founding director of SLAC, to serve as the official American advisor to the Chinese government on the project in Beijing. For his tireless efforts to make the BEPC a Chinese and international scientific success, Panofsky earned widespread respect and admiration in China.

Perhaps unexpectedly, Lee and Panofsky's active involvement in the BEPC also led to a remarkable episode in US-China scientific diplomacy that brought Lee, Zhu, and Panofsky together in the promotion of international nuclear arms control. These events took place against a geopolitical background in the mid-1980s when President Ronald Reagan departed from his initial hardline position on the Soviet Union and started to negotiate with the reformist Soviet leader Mikhail Gorbachev to reduce each other's nuclear arsenal. Panofsky, a long-time advocate on nuclear arms control and then chair of the Committee on International Security and Arms Control (CISAC) of the US National Academy of Sciences, sought to capitalize on his reputation and connections in China to bring Chinese scientists into the bilateral discussion on this subject with his committee. He did so with the knowledge and approval of the US government. Everyone recognized that if the US and the Soviet Union were to reduce the sizes of their nuclear forces dramatically, it was necessary to bring other nuclear powers such as China into the discussion.

In Beijing, Panofsky quickly found out that his regular host, the Chinese Academy of Sciences, as a largely civilian entity, was not the proper partner for an effective and continuing dialog on nuclear arms control. The institution he needed to have access to was the Chinese Commission on Science, Technology, and Industry for National Defense (COSTIND). The person he wanted to talk

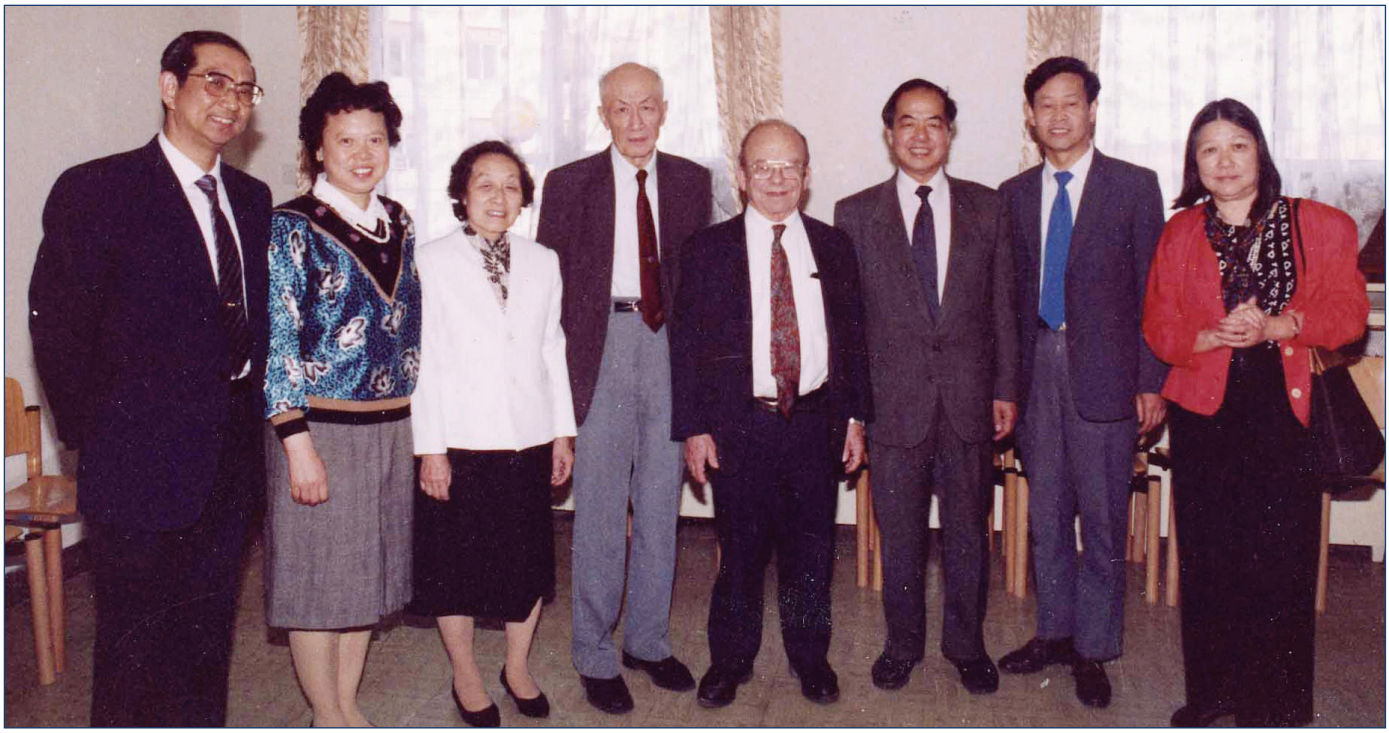


Figure 2. Zhu Guangya (4th from left), Wolfgang "Pief" Panofsky (5th from left), T. D. Lee (6th from left), and Jeanette Lee (far right) in Beijing in June 1992. Source: Courtesy of the Panofsky family and SLAC Archives.

to was nonother than Zhu himself, at the time the vice chairman of the Scientific and Technological Committee of COSTIND. He had invited Zhu for the first preliminary meeting on the topic, held at the Institute of High Energy Physics (IHEP), the institutional home of BEPC, in Beijing, on May 23, 1988, but Zhu did not show up. Even though the meeting, attended by other leading Chinese nuclear weapons scientists, was fruitful, Panofsky was uncertain at its end that his main objective of establishing a regular program of US-China scientific discussion on nuclear arms control was attainable.

At this critical moment, as I have recounted in a recent article ("Controlled Exchanges" in *How Knowledge Moves* edited by John Krige and published by the University of Chicago Press in 2019), Lee came to Panofsky's rescue. Lee had supported the cause of nuclear arms control back in 1963 when he lent his name to a statement by a number of Nobel laureates endorsing the Limited Nuclear Test Ban Treaty. The treaty had been negotiated between the US, the Soviet Union, and Britain, a process in which Panofsky had participated in as a member of the US President›s Science Advisory Committee (PSAC), and was then being debated in the US Senate as a part of the ratification process (it passed). Lee now returned to the endeavor by helping Panofsky to become connected with Zhu. As Panofsky wrote happily in his diary the night after his preliminary meeting at the IHEP, "T. D. Lee arranged for me to have lunch tomorrow with Zhu Guangya, who is really the key person to make the decision on the future of arms control discussions."

So, on May 24, 1988, with Lee and his wife Jeannette present, Panofsky met Zhu for lunch in Beijing. Once again, Panofsky recounted with delight in his diary that night his first encounter with Zhu and their informal discussion on nuclear arms control: "Zhu pointed out that there was some 'political sensitivity' in setting up a similar committee of scientists in China but the conversation ended by [Zhu's] saying 'I will do my best.' Nothing better could be expected at this point."

What we learned many years later, from Chinese sources, was that Lee not only set up this crucial meeting between Panofsky and Zhu but also mobilized his own scientific and political capital in China to help make it possible for Zhu to lead the Chinese efforts in arms control discussion with the US. For example, he wrote a letter to Marshal NIE Rongzhen, the chief organizer of the Chinese nuclear weapons program still influential in Chinese policy-making, to vouch for Panofsky's goodwill in his scientific and arms control activities in China and to request permission for Zhu to engage in dialogs with Panofsky. It is not definite but possible that this letter contributed to convincing the Chinese government to approve Zhu's proposal to set up the Chinese Scientists' Group on Arms Control (CSGAC), which has held continued discussions with CISAC nuclear arms control. Both Panofsky and Richard Garwin, the longest-serving member of CISAC, believed that the CISAC-CSGAC dialogs contributed to China's involvement in nuclear arms control, including in the area of nuclear nonproliferation.

What can we draw from this brief examination of the complex and intersecting experiences of these Chinese and American physicists? Historically speaking, one conclusion is that overall US-China geopolitical relations have always framed bilateral scientific interactions and affected the experiences of Chinese American scientists like Lee and Yang. At the height of US-China tension in the 1950s, Deng, Zhu, Lee, and Yang all had to make fateful choices to either return home or stay in the US, understanding that such decisions could separate them from their families or each other for the foreseeable future. In the late 20th century, as US-China relations reopened and improved, they participated in promoting bilateral scientific exchanges, even in sensitive areas such as nuclear arms control, as demonstrated by the active roles of Panofsky, Lee, and Zhu in initiating the CISAC-CSGAC dialogs.

In recent decades, close ties have developed between the US and China in many fields but the latter's rise as an economic and technological power has led to increased frictions. Yet, it is precisely at difficult times like this that we need to remind ourselves of the long-term benefits of open scientific exchanges, of attracting international talents like Lee and Yang, and of upholding American principles of justice, including equal protection, due process, and nondiscrimination regarding national origins. What is potentially at stake is not only the vitality of the American scientific enterprise, as the APS leaders rightly pointed out, but also the solution of global problems such as the nuclear threat and climate change.

Zuoyue Wang is a professor of history at the California State Polytechnic University, Pomona. He is the author of In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America *and is now working on a book on Chinese American scientists and US-China relations. He was elected a fellow of the American Association for the Advancement of Science in 2019.*