

Process and Impact of Niels Bohr's Visit to Japan and China in 1937: A Comparative Perspective

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At the beginning of the twentieth century, Japan and China, each for its own reasons, invited the famous physicist Niels Bohr to visit and give lectures. Bohr accepted their invitations and made the trip in 1937; however, the topics of his lectures in the two countries differed. In Japan, he mainly discussed quantum mechanics and philosophy, whereas in China, he focused more on atomic physics. This paper begins with a detailed review of Bohr's trip to Japan and China in 1937, followed by a discussion of the impact of each trip from the perspective of the social context. We conclude that the actual effect of Bohr's visit to China and Japan involved not only the spreading of Bohr's knowledge but also clearly hinged on the current status and social background of the recipients. Moreover, the impact of Bohr's trip to East Asia demonstrates that, as is the case for scientific exchanges at the international level, the international exchange of knowledge at the individual level is also powerful, and such individual exchange can even promote exchange on the international level.

Introduction

A dominant figure in the development of quantum mechanics and the founder of the Copenhagen school,¹ Niels Bohr (1885–1962) was the first to use the quantum approach to build the theory of atomic structure. In 1921, he founded the Institute for Theoretical Physics at the University of Copenhagen (officially named the Niels Bohr Institute in 1965, after his death) and became its director. Research at Bohr's Institute, both from an experimental and a theoretical perspective, focused first on atomic structure, then gradually morphed into the study of the atomic nucleus, and then, pivoted to quantum theory in the 1920s. Bohr put forward the famous principle of complementarity

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¹ The Copenhagen School is centered on the theories developed by Niels Bohr as well as researchers from the Institute for Theoretical Physics at the University of Copenhagen. Famous scientists of that era, such as Max Born, Werner Heisenberg, Wolfgang Pauli, and Paul Dirac, were the representative figures of the Copenhagen school. See Sanqiang Qian, "Commemorate the Centenary of the Birth of Niels Bohr," *Physics* 15, no. 4 (1986): 196–97.

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in 1927,² and then, in the 1930s, laid out the liquid drop model of the atomic nucleus and the compound nucleus hypothesis,³ which became the theoretical framework for understanding nuclear fission and exploring the release of nuclear energy.

Bohr was famous not only for his great contributions to physics but also for his tremendous internationalist spirit. He understood international exchange to play a positive role in the development of physics and to enable physicists from different countries to understand one another. As a powerful leader in science, he enlightened scholars who visited his Institute and helped them obtain excellent results – which in turn contributed to forming the Copenhagen school, whose adherents followed Bohr's lead in interpreting quantum mechanics. In 1937, Bohr received invitations to give lectures from both Japanese and Chinese scientists. Exemplifying his willingness to share his ideas and latest theories with people all over the world, he accepted both invitations. During this, his first stay in the Far East, he gave several lectures, not only to physicists but also to the public; he also communicated with various scientists from these two countries.

As a world-leading scientist, Bohr made a strong impact on both countries. Herein we analyze his influence in Japan and China and the factors that affected the long-term impact of his visit. This paper reviews the details of his trip to Japan and China, compares the impact Bohr made on each country, and discusses the reasons why his

² The principle of complementarity, which was formulated by Bohr in 1927, is both a theoretical and an experimental result of quantum mechanics and is closely associated with the Copenhagen interpretation. It holds that objects have complementary properties that cannot be observed or measured at the same time. See George M. Hall, *The Ingenious Mind of Nature: Deciphering the Patterns of Man, Society, and the Universe* (New York: Springer US, 1997), 409. Andrew Whitaker, Einstein, Bohr and the Quantum Dilemma: From Quantum Theory to Quantum Information (Cambridge: Cambridge University Press, 2006), 414.

³ The liquid-drop model in nuclear physics is the description of atomic nuclei formulated by Bohr in 1936 to explain nuclear fission. According to the model, nucleons (neutrons and protons) behave like molecules in a drop of liquid. If given sufficient extra energy, such as through the absorption of a neutron, the spherical nucleus may be distorted into a dumbbell shape and then split at the neck into two nearly equal fragments, releasing energy in the process. See Renfen Yu and Baoshu Liao, *Nuclear Energy: The Infinite Energy* (Beijing: Tsinghua University Press, 2011), 32–33.

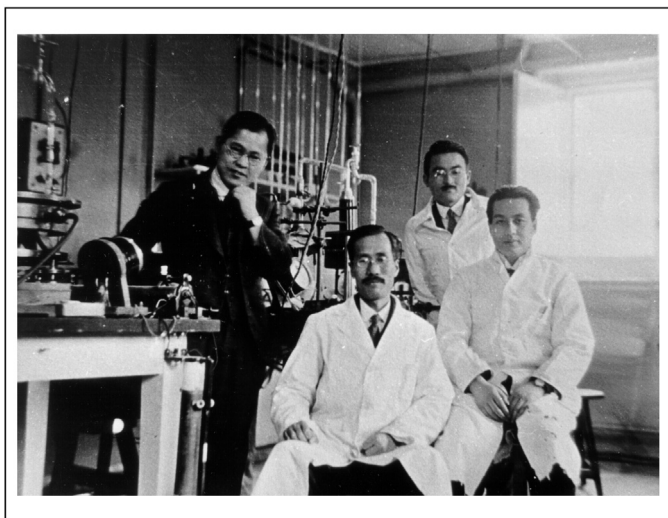


Figure 1. The “Japanese team” in the Niels Bohr Institute in 1927. From left to right are Yoshio Nishina, Shinichi Aoyama, Takeo Hori, and Kenjiro Kimura. Image courtesy of the Niels Bohr Archive.

visit to Japan and China, although made in the same year, had such different outcomes.

Bohr’s Visit to Japan (April 15–May 19, 1937)

In Japan, the person most connected with Bohr was Yoshio Nishina, who is universally acknowledged to be the “father of atomic physics in Japan.”⁴ Since 1918, he had studied physics under Hantaro Nagaoka from RIKEN, Ernest Rutherford from Cambridge, and then Niels Bohr. He studied under Bohr in Copenhagen from April 1923 to February 1928 (Figure 1).

Nishina had persistently striven to attract his tutor Bohr to Japan. Early in 1928, hearing that Bohr was interested in visiting Asia, he immediately wrote to Nagaoka to discuss the possibility of inviting Bohr to visit Japan. After his return to Japan from Copenhagen, he maintained contact with Bohr and never abandoned the hope of having Bohr visit Japan. In his letter to Bohr on February 19, 1929, he wrote: “We are all looking forward to having both of you here next year. If you want to know anything about your journey and stay in Japan, please write to me. As soon as our arrangement for you is fixed, I shall let you know.”⁵ As the leader of a world’s top institution in theoretical physics, Bohr was too busy to make such a visit until 1931, when he at last accepted one of Nishina’s many invitations.⁶ However, because of his busy schedule, Bohr was still not able to leave Copenhagen in 1931, so he postponed his visit. On January 26, 1934, Bohr told Nishina that he would come to Japan the next year with his wife and their eldest son Christian. At the same time, they exchanged ideas about the subjects of the lectures that Bohr would present during his visit.⁷ Unfortunately, in July of that year, the Bohr family was devastated by the

loss of their son Christian, who accidentally drowned. Bohr was so grieved that he postponed his visit until 1937.

Before Bohr’s visit, two representative figures of the Copenhagen school, Werner Heisenberg and Paul Dirac had visited Japan and brought with them details of the latest achievements in Europe – quantum mechanics – which had a great impact on Japanese scientists in 1929. Heisenberg and Dirac had gotten to know Nishina when they were working in Bohr’s Institute in 1920s. After returning to Japan, Nishina sent letters to both of them to invite them to visit and they immediately accepted. From August 30, 1929, to September 21, 1929, Heisenberg and Dirac visited Japan and lectured in RIKEN and Kyoto Imperial University, introducing Heisenberg’s uncertainty principle as well as Dirac’s relativistic electron theory.⁸ In 1935, Dirac journeyed to Japan again, and during his stay Nishina wrote a postcard to Bohr to report the news of Dirac’s coming and invite Bohr to visit Japan as soon as possible (Figure 2). On April 15, 1937, the Bohrs and their son Hans arrived at last at Yokohama, Japan. The Keimeikai Foundation, which had financed Heisenberg’s and Dirac’s 1929 visit, also sponsored Bohr’s trip. Between early 1928, when Nishina first had the idea of inviting Bohr to visit Japan, until the spring of 1937, when Bohr and his family finally arrived, nearly a decade of ups and downs had passed.

Before coming, Bohr had serious discussions with Nishina on the subjects to cover in the lectures in Japan. Bohr told Nishina about his plan of “giving in a course of about ten lectures a summary of the principles of atomic theory, including the most elementary as well as the open problems.”⁹ Nishina thought that ten lectures was a huge workload for Bohr, so he asked for fewer lectures and more discussion.¹⁰ However, Bohr insisted on giving the ten lectures. He gave seven at the Tokyo Imperial University and one each at Tohoku Imperial University, Kyoto Imperial University, and Osaka Imperial University. At Tokyo Imperial University, the major theme of Bohr’s lectures was the principles of quantum theory. These lectures covered the topics of quantum mechanics, atomic theory, and the philosophy of physics (Table 1 and Figure 3).¹¹ Bohr’s lectures had a wide influence on Japanese academia, including not only physicists but also chemists, biologists, and scholars from other fields.

Nishina always accompanied Bohr at his lectures in Japan. While Bohr lectured, Nishina stood by his side, translated Bohr’s words, and explained in layman terms as best he could. Sometimes during the lectures, Bohr would write brief formulae on the blackboard; if Nishina found problems with the formulae, he would pause his translation and directly discuss the formula with Bohr, just as they used to do in Copenhagen (Figure 4). After several

⁸ Helge Kragh, *Dirac: A Scientific Biography* (Cambridge: Cambridge University Press, 1990), 74–75.

⁹ Niels Bohr, letter to Yoshio Nishina, July 2, 1936, Bohr Archive.

¹⁰ The full text is: “Ten lectures may be too much for a month’s stay. It, of course, depends on the subjects and contents as well as your attitude toward the lectures. All what is important for us is, I think, to become well acquainted with your theories and opinions about the present day problems in physics. ...We are also very anxious to show you various parts of our country and we feel that a month’s stay is too short.” Yoshio Nishina, letter to Niels Bohr, February 21, 1937, Bohr Archive.

¹¹ Kenji Yoshihara, *Kagaku Ni Mise Rareta Nihonjin* (Tokyo: Iwanami shinsho, 2001), 75.

⁴ Izumi Inoue and Shozo Ishii, *Father of Atomic Physics: Yoshio Nishina* (Osaka: Nippon Bunkyo Publishing, 2004).

⁵ “Both of you” here refers Professor Bohr and his wife Margrethe. Nishina always appreciated Margrethe for her thoughtful kindness for him when he was studying in Copenhagen. Yoshio Nishina, letter to Niels Bohr, February 19, 1929, Niels Bohr Archive, Copenhagen, Denmark (hereafter Bohr Archive).

⁶ Ryohei Nakane, Yuichiro Nishina, Hiroshijiro Nishina, Yuji Yazaki and Hiroshi Ezawa, eds., *Yoshio Nishina Ofuku Shokan-Shu* (Tokyo: Misuzu Shobo, 2006), 333.

⁷ Ibid.

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