·科学技术史·

中英科技交流与中国核工业的早期发展

Sino-British Scientific Interactions and the Early Development of China's Nuclear Industry

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摘　要：本研究着眼于20世纪中期中国核工业的建立和发展，探讨冷战背景下中英科技交流与合作，涉及留英科学家、科学机构与团体、政府机构、国际科学家组织等多个交流主体与维度。1949年前后，留英中国核科学家相继归国，带回了先进的技术知识和丰富的生产经验。中国也将英国视为突破美苏技术封锁的关键门户，通过民间、半官方等多种形式与英国科学界建立联系，具体表现为中国科学院与英国皇家学会的交往；驻英代办处对科技交流的指导作用；对外贸易部主导的以贸易为名义的技术考察。此外，中国以英国为窗口，积极参与国际核外交与核对话。英国对中国核工业早期发展影响深远，而发展核工业的迫切需求也推动中国在这一时期积极开展对英科技交流。

关键词：中英关系　科技交流　核工业　冷战

Abstract: This study investigates the establishment of scientific links between the People's Republic of China (PRC) and the United Kingdom (UK) in the mid-20th century, focusing on the early development of China's nuclear industry. Sino-British scientific interactions took place across multiple dimensions, involving various institutions and individuals. Around 1949, UK-trained Chinese nuclear scientists returned to China, bringing advanced technological knowledge and extensive practical experience. The PRC regarded the UK as a crucial gateway to overcoming the technological blockade imposed by the United States (and later the Soviet Union) and sought to establish scientific relations with the UK through semi-official and unofficial channels. Specifically, these connections manifested in the interactions between the Chinese Academy of Sciences (CAS) and the Royal Society of London, the guiding role of the Chinese Chargé d'Affaires Office in London in facilitating scientific and technological exchanges, and the technology investigations led by the Ministry of Foreign Trade in the name of trade. Additionally, the Sino-British scientific network extended to the international arena, allowing China to engage in nuclear-related global organizations and events. This study highlights the significant British influence on the early development of China's nuclear industry, revealing the extent of its British influence. It argues that China's urgent need for nuclear science and industrial advancement was a key driver of its scientific engagement with the UK.

Key Words: Sino-British relations; Scientific interactions; Nuclear industry; Cold War

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Nuclear weaponry marked the dawn of a new era, plunging the world into the Cold War—a prolonged period of geopolitical tension between the United States and the Soviet Union that influenced global affairs in the second half of the 20th century. In this context, nuclear research became a high-priority sector of national scientific and technological (S&T) development in several major countries. [1] During the first two decades of the Cold War, the UK played a pivotal role as a global hub for the circulation of nuclear scientific knowledge, maintaining close connections with leading nuclear powers, including the United States, the Soviet Union, France, and China. [2]

In 1955, the PRC made a strategic decision to develop its nuclear industry in response to perceived nuclear threats and coercion from America. Soviet aid was critical to China's nuclear weapons programme, attracting significant scholarly attention. [3, 4] In recent years, related studies on transnationalization of China's nuclear science have tended to focus on the contribution of American-trained Chinese scientists. [5] However, the scientific relationship between China and the UK—both nuclear powers—has received comparatively little attention.

Notably, in the first half of the 20th century, many young Chinese physicists pursued studies in the UK, and some of these scholars became instrumental in the development of China's nuclear industry. Fundamental technologies, such as nuclear emulsion detection and cyclotron construction, were introduced to China through UK-trained scientists. [6] Furthermore, despite its diplomatic isolation in the early Cold War, China maintained continuous scientific engagement with the UK through networks, organizations, and international events. These exchanges enabled China to gather crucial scientific and technological intelligence, evaluate developments in the UK's nuclear research and industry, and participate in international scientific discourse.

This paper highlights the UK's role as a key gateway in China's nuclear development, offering a fresh perspective on the transnational history of nuclear science in China. By examining the overlooked Sino-British scientific relationship, this study contributes to a broader understanding of the global dimensions of Cold War-era scientific connection.

We first set the stage by briefly summarizing the peculiarities of diplomatic and scientific relations between the UK and the new People's Republic of China in the 1950s and 1960s, which so influenced the later exchanges. Then we examine some top-level Chinese nuclear scientists trained in Britain in 1940s, discussing their work and research, as well as their roles in China's nuclear project. Through examining interactions dominated by scientific organizations and government bodies respectively, we unfold China's constant and vigorous efforts to keep abreast of new trends in the development of nuclear research and industry through the UK while under technological blockade, especially after the breakdown of the Sino-Soviet alliance in late 1950s. Finally, we explore a network of interrelated international activities through which the PRC sought to promote its commitment to the peaceful development of atomic energy while expanding its expertise in the nuclear field. These initiatives were facilitated by complex and dynamic exchanges between China and the UK, highlighting the role of scientific diplomacy in fostering cooperation and knowledge transfer despite geopolitical tensions.

I. Special Diplomatic and Scientific Relations Between China and the UK During the Early Cold War

During the early Cold War, Britain pursued a distinctive and independent approach in its policy toward China. It was the first Western power to officially recognize the legal status of the PRC, establishing diplomatic relations at the level of Chargé d'Affaires in 1954. While the UK shared certain strategic interests with the U.S. regarding China, it consistently prioritized economic relations over geopolitical concerns. [7] This pragmatic diplomatic approach led to British opposition to the U.S. embargo against China, reflecting the UK's broader desire to engage with China in a non-confrontational manner. In turn, Mao Zedong viewed Britain not as a direct threat to China's security, but rather, as a potential counterbalance to the Soviet Union. [8] Relations

between China and the Soviet Union had significantly deteriorated by the late 1950s, and Britain, along with other European countries, could serve as a diplomatic counterweight in this context.

This relatively positive diplomatic and economic relationship between the UK and China proved favorable for scientific exchanges. Even in the climax of "learning from the Soviet Union" in the mid-1950s, China and the UK continued to maintain a steady flow of scientific and technological personnel, literature, and equipment. [9] Prior to 1966, Britain was considered the most important Western country for China's international scientific collaborations.

A significant factor contributing to the scientific liaison between China and the UK was the involvement of British left-leaning scientists. These scientists, motivated by a combination of scientific internationalism and personal values, made great efforts to foster Sino-British scientific exchanges and to integrate China into the global scientific community. Unlike their American counterparts, British left-wing scientists were able to visit China legally before 1971. [10] Notable figures such as Kurt Mendelssohn, Cecil Powell, and P.M.S. Blackett played pivotal roles in promoting these exchanges. Upon returning to the UK, these scientists highlighted China's scientific achievements and institutions through articles, broadcasts and speeches, advocating for the strengthening of Sino-British scientific ties. These British scientists cultivated transnational scientific networks with prominent Chinese scientists such as Zhou Peiyuan (周培源), Qian Sanqiang (钱三强), and Li Siguang (李四光), Qian and Li both had training experience in the UK. These networks were not only scientifically productive but also demonstrated a remarkable degree of durability, enduring through the political tensions of the Cold War.

II. UK-trained Chinese Nuclear Scientists

The historian of science Wang Zuoyue has emphasized the dominance and high quality of Chinese scientists and engineers trained in the U.S., arguing that their contributions illustrate the transnational character of China's early scientific endeavors, which transcended Soviet influence. [11] However, it is crucial to recognize that Chinese students returning from Europe, particularly from the UK, also played a significant role in the development of China's scientific and technological landscape. Among the 469 academicians of Chinese Academy of Sciences elected in 1955, 1957, and 1980 respectively, 389 of them were trained abroad before 1949, including 72 who had studied or worked in the UK, which accounted for 18.5% of the academicians with overseas training experience, a proportion second only to that of the graduates trained in the United States. [12]

After the outbreak of World War II, the possibility to develop an atomic bomb was first imagined by scientists exiled in Britain. The MAUD Committee ①, composed of leading British nuclear scientists, conducted research to confirm the theoretical and technical feasibility of the atomic bomb, accelerating the maturation of nuclear science and industry in the UK. Many of the MAUD members later contributed to the Manhattan Project and the UK's domestic nuclear program, known as "Tube Alloys". [13] Against this backdrop, young Chinese scientists and engineers traveled to the UK to study cutting-edge nuclear science and technology or to work in the burgeoning nuclear industry. They returned to China equipped with advanced research achievements and substantial practical experience, making substantial contributions to the development of China's nuclear industry. For example, twenty-three top scientists were awarded the "Meritorious Medal of Two Bombs and One Satellite" in 1998 ②, for the construction of the atomic bomb, hydrogen bomb, missiles and satellites, seven of whom had

①The MAUD Committee was a British scientific working group formed during the Second World War. It was established to perform the research required to determine if an atomic bomb was feasible. The name MAUD came from a strange line in a telegram from Danish physicist Niels Bohr referring to his housekeeper, Maud Ray.

②These metals were conferred by the Central Committee of the Communist Party of China, the State Council of the PRC, and the Central Military Commission of the PRC.

UK-trained experiences. The seven medals were conferred on Qian Sanqiang①, Peng Huanwu (彭桓武)②, Cheng Kaijia (程开甲)③, Wang Daheng (王大珩)④, Chen Fangyun (陈芳允)⑤, Huang Weilu (黄纬禄)⑥, and Yao Tongbin (姚桐斌)⑦.

In 1950, the Institute of Modern Physics, Chinese Academy of Sciences (中国科学院近代物理研究所) was founded in Beijing, which was the core institution of China's early nuclear science research. The key figure in the foundation of this institution was Qian Sanqiang, a top-level Chinese nuclear physicist. As Frederic Joliot-Curie's student and colleague, he came to the UK in 1945, studied nuclear emulsion technology under Cecil F. Powell at the University of Bristol, and turned his research field to the mechanism of uranium fission, becoming one of the few experimental physicists in China who studied uranium at that time. [14] After he was back in China, Qian worked at the Institute of Modern Physics, and led the manufacture of home-made nuclear emulsion detectors. Moreover, as the key organizer of the Chinese Academy of Sciences, Qian contacted and acquainted other Chinese nuclear scientists studying or working in the UK, such as Peng Huanwu, Zhu Hongyuan (朱洪元), Wang Daheng, Dai Chuanzeng (戴传曾), Yang Chengzhong (杨澄中) and Li Xun (李薰). They were later invited to join the CAS, especially the Institute of Modern Physics, and played a leading role in China's nuclear research and industry. [15]

Yang Chengzhong and Dai Chuanzeng came to the Department of Physics, University of Liverpool, to undertake doctoral degree in 1945 and 1947 respectively. The Department of Physics at Liverpool, led by James Chadwick, had developed one of the most important research centers for the study of experimental nuclear physics, and it was equipped with the first cyclotron in the UK. [16] Yang and Dai studied Deuteron Stripping Reactions on the 37 inch cyclotron with their self-made detectors, a new and difficult field that few researchers studied at that time. [17] The laboratory gathered together several famous nuclear scientists, such as Joseph Rotblat and H.W.S Skinner, who served at the Atomic Energy Research Establishment ⑧ at Harwell. With their guidance, Yang and Dai also carried out research related to the British nuclear industry in addition to their Ph.D project. For example, cooperating with Rotblat, who was leading a nuclear emulsion research group at Harwell, Dai studied the shrinkage of nuclear emulsion to improve its detection performance. [18] Yang and Dai received training as qualified experimental nuclear physicists at Liverpool, not only skilled in the construction, use and maintenance of cyclotrons, and well versed in the manufacture of various particle detectors, but also having a theoretical understanding of the principles of nuclear reactions. They later served as leading scientists in the early development of China's experimental nuclear physics.

It is also important to acknowledge the significant contributions of non-nuclear physicists trained in

①Qian Sanqiang stayed at the University of Bristol for about three months in 1945, and he returned to China in 1948. He was the co-founder of the Institute of Modern Physics, CAS, which was the Chinese first nuclear research institute.

②Peng Huanwu was a theoretical nuclear physicist, and he graduated from the University of Edinburgh. He returned to China in 1949, and worked in the Nuclear Research Institute, second Ministry of machinery industry of the people's Republic of China.

③Cheng Kaijia achieved his PhD degree in the University of Edinburgh in 1948, and he was back in China in 1950. He served as the director of nuclear testing ground in 1962.

④Wang Daheng was an optical instrument scientist, and he stayed in the UK for ten years. He returned to China in 1948, and he played a foundational role in Chinese optics enterprise.

⑤Chen Fangyun, a Chinese radio electronics scientist, worked in the A.C. Cossor Ltd., a British electronics company during 1945-1948, and participated in the development of commercial shipborne radar in Manchester factory. He was one of the founders of the Institute of Electronics, CAS.

⑥Huang Weilu was a specialist in rocket and missile control technology. He worked in the General Electric Company and Marconi Company in the UK during 1943 to 1945, and then he studied in the Department of Radio at the Imperial College London. He was back in China in 1947.

⑦Yao Tongbin, one of the pioneers in the field of aerospace materials, finished his PhD at the University of Burmingham and Imperial College London successively. He came back to China in 1955.

⑧The Atomic Energy Research Establishment (AERE), also known as Harwell Laboratory, was the main centre for atomic energy research and development in the United Kingdom from 1946 to the 1990s. It was created, owned and funded by the British Government.

the UK to China's nuclear industry. Wang Daheng, a leading Chinese opticist, stayed in the UK from 1938-1948. He first received training in optical design at Imperial College, subsequently pursuing studies in optical glass manufacturing at the University of Sheffield. He subsequently joined Messrs. Chance Brothers, working on the R&D of optical glass. At that time, Chance was the largest supplier of optical glass for military use in the UK. Wang was exposed to the latest British developments of optical engineering, glass manufacturing, and optical industry, thereby amassing a wealth of knowledge and experience that proved instrumental in the establishment of China's optics industry. [19] Wang worked at Changchun Institute of Optics, Fine Mechanics and Physics, CAS (中国科学院长春光学精密机械与物理研究所), dominating the manufacture of high-performance optical glasses supplied to the fundamental research and nuclear industry.

Wang formed a friendship with another Chinese young scientist, Li Xun, during his stay in the UK. The latter achieved the doctoral degree in the Department of Metallurgy, University of Sheffield in 1940, and then worked there as a researcher until he went back to China in 1951. Li Xun's most significant academic achievement in the UK was the study of hydrogen in steel, the primary cause of internal cracking in steel. His research was rapidly implemented in the steel industry, which was experiencing a period of significant expansion during wartime. [20] In 1950, on the advice of Wang, Qian Sanqiang invited Li Xun to return to China with the objective of establishing the Institute of Metals of the Chinese Academy of Sciences (中国科学院金属研究所). Li proceeded to contact a group of metallurgists in the UK, including Zhang Peilin (张沛霖)①, Zhang Zuomei (张作梅)②, Zhuang Yuzhi (庄育智)③ and Ke Jun (柯俊), to join the CAS together. ([20], pp.76-84) They all contributed to the R&D of nuclear materials and fuels back in China.

There was also another group of Chinese students training in the UK in 1940s, including Chen Fangyun and Huang Weilu. Instead of studying at a university to pursue a degree, they worked as apprentices in factories, sponsored by the Federation of British Industry (FBI), and trained as engineers qualified to British standards. The factories where they were working even supported the main wartime production in Britain. [21] For example, Metropolitan-Vickers, which accommodated the most Chinese interns, was one of the biggest and most important heavy engineering facilities for most of the 20th century in Britain and the world, supplying key components, parts and equipment to the Tube Alloys Project.

The most notable characteristic of the Chinese students trained in the UK, in contrast to those who studied there before the 1940s, was their exposure to the British nuclear industry and cutting-edge research projects, a result of the strengthened Sino-British alliance during World War II.

III. For Science: China-UK Institutional Interlinkages

The PRC placed significant emphasis on the scientific value of exchanges with the British scientific community, driven largely by the urgent need to advance its nuclear and defense industries. This section will explore this dynamic by focusing on two interrelated forms of institutional collaboration: informal exchanges between the CAS and the Royal Society, and government-level connections. As China's highest scientific institution, the CAS played a dominant role in fostering scientific contacts with foreign entities, while the Royal Society, due to its high standing in British science, served as an important gateway for China to engage with broader British scientific networks, including universities and research institutes. [22]

In 1960, a high-level delegation from the CAS

① Zhang Peilin, a metal physicist and academician of the CAS, did his doctoral research in Li Xun's laboratory and co-founded the Institute of Metal Physics of the CAS with Li Xun after his return to China.

② Zhang Zuomei, a metal physicist and academician of the CAS, achieved his PhD degree from the School of Engineering, University of Sheffield, and co-founded the Institute of Metals of the CAS together with Li Xun and others, and then transferred to the Institute of Mechanical and Electrical Engineering in 1957, where he served as deputy director.

③ Zhuang Yuzhi, Ph.D. in Metallurgy, University of Liverpool, 1951.

was invited to the Royal Society's tricentenary celebrations, followed by a scientific tour of Britain in 1961. The latter delegation, led by the Vice-President of CAS, Zhu Kezhen (竺可桢), included prominent scientists, Zhang Peilin, Wang Shouwu (王守武), and Bei Shizhang (贝时璋), all of whom were key figures in China's "Two Bombs, One Satellite" project. This marked the first time that CAS representatives visited leading research sites in Britain, including those in Cambridge, Oxford, Edinburgh, London, and the nuclear power station at Harwell. [23] These visits provided the CAS delegation with valuable insights into British research in critical fields such as nuclear physics, metallurgy, semiconductors, and biophysics. As one of their reports mentioned, the CAS's visits to Britain also made China aware that in the UK "it is easy to keep abreast of new trends in the development of science and technology in every capitalist country, especially … the U.S". [24]

In September 1962, the first ever delegation of the Royal Society led by Sir George Lindor Brown went to the PRC. Some ideas were exchanged during this trip about ways of encouraging visits by senior, middle and junior research workers and it was agreed that this matter might be explored further. The CAS was particularly enthusiastic about short-term visits to the UK by senior scientists, as Zhu Kezhen said, who could "accurately investigate the strengths of foreign bodies and collect the scientific and technological information they need." [25] The Royal society was more interested in exchanges for junior researchers. Brown told Zhu that having researchers "work in the other party's laboratories" would be "even more useful" than exchanging short-term delegations ①.

As a result of an informal agreement, two Chinese senior scientists, Huang Weiyuan (黄维垣) and Feng Depei (冯德培), first visited Britain in October 1963, followed by Huang Wuhan (黄武汉), Deng Ximing (邓锡铭) and Gan Fuxi (干福熹) in January, 1964, for about one month. [26] They were all undertaking important defense research related to the nuclear industry. Huang was the deputy director of the Organic Chemistry Institute of CAS (中国科学院有机化学研究所), leading the research on fluorine oils, which was a lubricating material in the device for separating uranium isotopes. He visited Birmingham, Oxford, Manchester and Imperial Chemical Industries, with the task of investigating organofluorine chemistry in Britain and its applications in the nuclear industry. Similarly, Huang, Deng and Gan, the founding figures of China's laser research, went to the UK in the urgent need to study the latest developments in lasers, as well as laser physics, laser materials and the applications of laser technology.

At the same time, the junior research workers programme was launched. Thirty-three Chinese researchers arrived in Britain from 1964 to 1966, staying for two years, and they researched in UK laboratories under British supervisors, moving between institutions every few months. The CAS wanted to place these workers in institutions as much as possible, because "they could sound out more top technology in institutions than in universities". [27] These workers mostly studied physics of electronics, semi-conductors, radio, electronic digital computers, autonomics, high-energy physics, gas chemistry, physical metallurgy, and ship diesel, which were the key supporting disciplines of the "Two Bombs, One Satellite" project. Most workers were arranged at the National Physical Laboratory②, Imperial College, the Post Office Engineering Section, and the University of Cambridge. The Royal Society found that the study of these junior workers was strongly propose-driven. For example, supervisor of Xu Zhenjia (许振嘉)③, Professor E. W. J. Mitchell commented that:

> Mr Hsu has not settled easily into the laboratory. When he first came, I tried to interest him in another problem on gallium arsenide, which I think might have produced some very valuable results, but he felt that the technique

①This view can also be seen in the record "Discussion Record of Zhu Kezhen, Wu Youxun, Du Runsheng and the delegation of the Royal Society on the exchange of research workers".

②The National Physical Laboratory (NPL), founded in 1900, is the national measurement standards laboratory of the United Kingdom. It sets and maintains physical standards for British industry. And is one of the oldest metrology institutes in the world.

③After returning to China, he worked at the Institute of Semiconductors, CAS.

involved in that proposal would not be one that he would be able to use on returning to China. [28]

The Royal Society viewed its exchanges with the CAS as an opportunity to exert influence on the British government and enhance the Society's reputation within British civil science. Central to this collaboration was the scheme for exchanging junior research workers, which was considered "the most important" aspect of the relationship between the Royal Society and the CAS. [29] In contrast, the CAS placed more emphasis on the practical benefits of these exchanges. For the PRC, at a time of isolation, the primary objective was to gain access to the latest scientific and technological advancements from capitalist countries.

Despite the absence of formal diplomatic relations between the PRC and the UK, scientific exchanges continued through both official and semi-official channels. The Chinese Chargé in London and the Ministry of Foreign Trade were the key institutions facilitating these interactions. As the PRC's only official establishment in Britain at the time, the Chargé's office played a crucial role in coordinating scientific exchanges with the UK and other Western nations. It provided practical advice to the CAS and other related institutions on both scientific and diplomatic matters, ensuring that the PRC could focus on its priority research areas while minimizing political conflicts. [30]

Additionally, the PRC's Cultural and Scientific Attaché maintained relationships with various British professional associations, universities, and research institutes. These networks helped recommend Chinese scientists for participation in international academic conferences in the UK and invited prominent British scientists to visit China to share their latest research. Between 1961 and 1965, under the guidance of the Chargé's office, Chinese scientists from the CAS attended several professional conferences, covering topics such as cryogenics, lasers, radio communication, space optics, and electronics. A notable example of this cooperation was the International Cryogenics Engineering Conference in 1961.

The British physicist, Kurt Mendelssohn ①, one of the founding figures in the field of cryogenics, sent the invitation to the Chinese Chargé's office in London for the 3rd International Cryogenics Engineering Conference held in London. After investigating the organizers, the participating countries and the main content of the conference, the Chargé d'affaires thought it was of great value for domestic defense industry production, especially for the nuclear industry, suggesting the Institute of Physics, CAS (中国科学院物理研究所), send several scientists to this conference:

> This conference mainly focused on large-scale production, storage, transport and use of cryogenic liquids, the most important issue in currently cryogenic engineering, including the liquid hydrogen, widely applied to production of heavy water in nuclear industry. By this chance, the trade office (affiliate the Chinese Chargé d'affaires) would contact some relevant factories for visit, and participants could exchange ideas with foreign scholars beyond the conference. [31]

After further discussion, the physicist Hong Chaosheng (洪 朝 生) of the Institute of Physics was nominated. He had served as Mendelssohn's translator during his previous visit, and had rich experience in small-scale liquefaction equipment. The other two participants were Wu Zilu (吴子炉, Director of Nitrogen Fertiliser Plant, Dalian, Ministry of Chemical Industry) and Chen Daci (陈 大 慈, Deputy Director of Oxygen Plant Research Institute, Hangzhou, First Ministry of Machine Building), who were working on the production of liquid hydrogen and oxygen.

In addition to purely academic connections, "the combination of technology and trade" was an important exchange pattern for China against scientific isolation. [32]

In 1957, Britain unilaterally removed the "China Differential" policy of the Coordinating Committee for Export Control to Communist Area (COCOM),

①In 1957, Mendelssohn was appointed as a consultant at the Atomic Energy Research Establishment in Harwell, England. There, he led a research team dedicated to studying the properties of radioactive actinides, with a particular focus on the transuranic elements plutonium and neptunium at low temperatures.

showing its strong intention to improve the trade relations with the PRC. In the same year, at the invitation of Sino-British Trade Council, a Chinese Economic and Technical Mission, initiated by the State Technological Commission（国家技术委员会）and the Ministry of Foreign Trade（对外贸易部）, visited to the UK in the name of trade, making a thorough investigation of British industry, especially the nuclear industry for the first time.

According to a report from the Sino-British Trade Council, the Mission's visits to the Calder Hall nuclear power station and the UK Atomic Energy Authority were particularly significant. [33] At the request of the State Technological Commission, Deng Zhaoming（邓照明）, Deputy Director of the Science and Technology Bureau in the Second Ministry of Machine Building（第二机械工业部）, which oversaw the nuclear industry, led a small delegation to visit various academic, technical, research, and professional institutions, to gain an overview of Britain's scientific and technological progress in atomic energy.

After returning to China, Deng compiled a report titled 'An Overview of the Atomic Energy Industry in the UK', published in March 1958, which addressed key technological aspects of the atomic energy sector. These included nuclear reactor components, the application of rare metals, instruments and apparatus, nuclear reaction development, the nuclear fuel cycle, and economic assessments. Of particular importance, Deng's report analyzed Britain's international relations and foreign trade, with a specific focus on nuclear issues. He noted a divergence between the UK and the U.S. regarding nuclear monopoly over socialist countries. While the U.S. was opposed to sharing nuclear technology with socialist states, Britain was more willing to sell nuclear energy products and even provide complete equipment for large-scale reactors and nuclear power stations. [34]

Deng concluded that Britain could serve as a unique channel for acquiring advanced nuclear technology and knowledge. [34] The visit underscored the potential for improving Sino-British trade relations and facilitating technological exchanges, which, in turn, could help mitigate Britain's concerns about the potential proliferation of sensitive nuclear technology.

IV. International Dimension: China's Involvement in International Nuclear-related Activities

Even before the outbreak of World War II, British scientists had recognized their social responsibility and sought ways to apply scientific knowledge to solve societal problems. Faced with the post-war nuclear arms race going into overdrive, scientists worldwide initiated a series of organizations and events to reflect on the development and function of science. These efforts led to the establishment of several international anti-nuclear scientific organizations and conferences, which aimed to promote the international control of atomic energy, nuclear disarmament, the peaceful use of atomic energy, and the global circulation of nuclear knowledge. [35] British scientists, including Cecil Powell, Joseph Rotblat, Joseph Needham, P.M.S. Blackett, and Dorothy Hodgkin, played pivotal roles in founding and leading these initiatives.

In 1955, when the PRC decided to develop its nuclear industry, it also recognized the necessity of engaging in multilateral dialogues on nuclear affairs. This engagement was crucial not only to counter the nuclear threat posed by the U.S., but also to garner international support for the PRC's nuclear industry and access vital nuclear technology information. [36] The urgent need to develop a nuclear industry became a driving force behind the PRC's participation in international scientific events. Despite being largely excluded from many international scientific organizations due to the political influence of the United States, the PRC found alternative avenues.

One such avenue was the World Federation of Scientific Workers (WFSW), which was founded in 1946. The WFSW provided a platform through which the PRC could pursue international scientific exchanges and diplomatic opportunities. [37] The organization's ideological alignment, shaped by British left-wing scientists such as J.D. Bernal, P.M.S. Blackett, Cecil Powell, and J.G. Crowther, along with support from the Soviet Union, made the WFSW a suitable forum for the PRC's early diplomatic strategies. Prominent Chinese scientists, including Li Siguang, Zhou Peiyuan, and Tu Changwang, held

leadership positions within the WFSW. Cecil Powell, a British nuclear physicist, became the chair of the WFSW in 1956, succeeding Jean Frédéric Joliot-Curie. Powell regarded China as an important base for the WFSW, [38] and under his leadership, the WFSW played a prominent role in preparing the Pugwash Conferences on Science and World Affairs (PCSWA), enabling the PRC's involvement in these conferences during the 1950s①.

V. Conclusion

The significant assistance provided by the Soviet Union to China in the 1950s, within the context of a Cold War geopolitical alliance, partially obscured the transnational hybridcharacter of China's early nuclear industry development. While Soviet aid was crucial, it is important to highlight that a large portion of China's scientific and engineering workforce was trained in the United States and the United Kingdom, with particular emphasis on the latter in this study. Compared to their American counterparts, British-trained scientists maintained closer relationships with China, with many returning after their studies to take on leadership roles in various fields, such as nuclear physics, applied optics, metallurgy, and nuclear chemical engineering.

Following the Sino-Soviet split, China emphasized self-reliance (自力更生) in science, yet nuclear science remained a priority and was largely insulated from political upheaval. The Chinese government and scientific community continued their efforts to overcome technological blockades, particularly in nuclear research and weapons development. The PRC identified the UK as a valuable partner for scientific exchanges with capitalist countries, thanks to positive diplomatic and economic relations. Consequently, nuclear research and technology were prioritized in these exchanges, with pragmatism guiding China's scientific interactions with the UK before the Cultural Revolution. Thus, despite the substantial Soviet aid in the 1950s and the intense focus on self-reliance in Chinese science during the 1960s, British influence was profound and lasting in the early development of China's nuclear program.

This study provides a preliminary exploration of Sino-British scientific relations in the mid-20th century, specifically in the realm of nuclear science. While nuclear weaponry marked the end of World War II, it also set the stage for the Cold War, with profound implications for global geopolitical dynamics. Nuclear science became closely intertwined with Cold War politics, anxieties, and aspirations, shaping the transnational exchange of scientific knowledge. The geopolitical rivalry, diplomatic agendas of China and the UK, and the ideological perspectives of the scientists involved—particularly their views on the governance of science and their personal interests—played a crucial role in Sino-British scientific interactions. Further historical research is needed to fully understand the complexities of these exchanges.

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①In 1956, Powell visited China as Chairman of the Executive Council of the WFSW, calling for an international conference of scientists to oppose nuclear weapons and to advocate the peaceful use of atomic energy, and soliciting concrete Chinese support for the convening of the Pugwash Conference.

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