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Reconsidering "Eternal Brotherhood": the Transfer of Nuclear Technology from the Former Soviet Union to the People's Republic of China in the 1950s

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Abstract

It has been insisted in an authorized historical record compiled in People's Republic of China that due to incompleteness and insufficiency of the scientific and technological supports from the Soviet Union, the Chinese initial nuclear weapon development had to be conducted by Chinese scientists and engineers through their "single-handed efforts." Such a view was widely accepted today not only in China but also in Japan or other countries. However, as seen in the two letters with the joint signature of Igor' Kurchatov, the top scientist in the Soviet nuclear development, and the top managers of the Soviet nuclear industry to the Soviet political leadership which were included in Volume No.6 of Igor' Kurchatov's *Selected Works* published in the autumn of 2013, those influential key-persons recommended more active exportation of nuclear technology to China. This paper is a trial to reexamine and reevaluate the Soviet aids toward People's China in this field on the basis of those letters, the memoirs of the involved Soviet specialists, such as Evgenii Vorov'yov and the Chinese historiography.

I. Introduction

Soon after the foundation of the People's Republic, China's nuclear weapon development project was launched with the strong will[1] of Mao Zedong and other New China's political leaders.

They were sceptical about the United States' nuclear policy and were afraid of a possible nuclear attack by them because of the potential "racism" in the United States' leadership. This led Mao, like some other political leaders of newly independent Asian countries such as Jawaharlal Nehru in India, to consider this "racism" the reason why the United States used their atomic bombs not on Germany but on Japan and conducted repeated nuclear bomb explosion tests in the Pacific zone. (Any nuclear weapon had never been used upon the white, Caucasoid species!) (Jones) China's "brother" country, the Soviet Union provided scientific and technological assistance to China's nuclear weapon development project. The Chinese scientists and engineers who were involved, however, had to make every effort towards the development of nuclear weapons by themselves after the withdrawal of support and aid from the Soviet Union and the repatriation of the Soviet-dispatched specialists in accordance with the break-out of the Soviet-China conflict. The tremendous, self-reliant efforts of the Chinese scientists and engineers eventually brought about the success of their first atomic bomb explosion test on October 16, 1964, which Zhou Enlai compared to "a farewell firework for Khrushchev (Nikita Khrushchev. 1894-1971)". (Negin et al., 303) The authorised record[2] (Li Jue et al.) on the development of the Chinese nuclear industry claims that the Soviet's aid to China in this field was quite insufficient and imperfect. This view was accepted by several foreign historians such as Shigeo Hiramatsu (Hiramatsu) and Hisako Iidzuka (Iidzuka) from Japan. The records and memories kept in the Soviet Union have been seldom referred.

"Counter arguments" against such a story from the side of the Soviet Union could be rarely seen except for the witness of Evgenii Negin,[3] (Negin et al., 303-315) who worked as the Director of All-Union Institute of Experimental Physics, the core research facility of the so-called Arzamas-16. However, recently, a collection of the scientific works of Igor' Kurchatov (1903–1960), the scientific leader of the Soviet nuclear project, was published (Kurchatov). The sixth volume of this collection, published in the fall of 2013, includes two letters jointly signed by Kurchatov and the Soviet highest officers in charge of the nuclear industry and sent to then Premier, Georgii Malen'kov (1902–1988) or the Central Committee of the Soviet Communist Party, which recommend more active exportation of nuclear technology to China. Thus, the intention and concrete plan for the supply of nuclear technology to China, at least at the draft level, are clarified. In the following parts of this paper, we shall examine those two letters of Kurchatov and the others, reexamine the witnesses of the Soviet engineers dispatched to China for the scientific and techonogical assistance for the Chinese early nuclear development and then compare them with the authorised historical record compiled in the Chinese side. Thus we shall have a new approach to the Soviet aid to the Chinese nuclear project in 1950s beyond the above-mentioned, wide-accepted view.

II. The Intention and Plan of the Leaders of the Soviet Nuclear Industry

The first letter (Malyshev and Kurchatov) with the joint signature of Kurchatov and Vyacheslav Malyshev (1902–1957), the Minister of Medium-sized Machine Building, dated April 29, 1954, says,

> "Currently, the United States is making their efforts to develop research on nuclear physics and atomic energy in West-European countries in order to take advantages of the fruits obtained by the scientists from these countries for their (military) purposes. We believe it reasonable for us to integrate the efforts of the scientists and engineers in the democratic countries and to support strongly these countries starting up and developing the research of nuclear physics and atomic energy".(Malyshev and Kurchatov, 129)

They consider the supply of nuclear technology to China a countermeasure against the U.S. nuclear diplomacy to their allies. They also proposed a detailed plan to supply equipment to China together with its budget estimation. They made a proposal to supply China with three kinds of equipment: (1) a natural uranium-heavy water modulated-thermal neutron reactor not exceeding 5 MW, (2) 30 MeV class cyclotron and (3) an electrostatic generator for 5 MeV class particle accelerator (20 million rubles for the latter two), along with 7 tons of heavy water (24 million rubles), 3–4 tons of metallic natural uranium (2 million rubles) and others that were estimated 10 million rubles. (Malyshev and Kurchatov, 130) It is noteworthy that the date of this letter preceded the date of the official initiation of the Chinese nuclear weapon development in the meeting with enlarged membership in the Secretariat of the Central Committee of the Chinese Communist Party on January 15, 1955. (Li Jue et al., 3) Malyshev and Kurchatov, however, say,

> "Although (thanks to our supports,) China will exceed France in the level of physical experimental equipment and will be only next to the Soviet Union, the United States, the United Kingdom and Canada, this program will be only the first step; the plutonium which can be obtained for a day, even using the most powerful of the above-mentioned equipment, will not exceed 5 grams". (Malyshev and Kurchatov, 130)

What is characteristic in this letter is its great expectations for scientific exchanges with Chinese scientists. The letter continues, "Nuclear physics in the People's Republic of China currently stays at a low level, but there are several physicists with high quality, having achieved several important and interesting successes". The letter mentions the names of some of the Chinese physicists: "Zhang (maybe, Zhang Wenyu) who discovered that uranium nuclei may be separated

into three elements instead of two by the action of neutrons"; "Khu (maybe, Hu Ning), a (Wolfgang) Pauli's student, a highly qualified expert in the field of quantum electron dynamics and elementary particle theory"; "Peng (Maybe, Peng Huang-wu), a (Max) Born's student"; "Kin-sing Nan (maybe, Jin Xing-nan), an expert on radioactive alpha decay" and "Fei Lyung(?), Tang(?), Wang (maybe, Wang Gan-chang) and other notable Chinese scientists". (Malyshev and Kurchatov, 129-130)

Many Soviet scientists and engineers were dispatched to China to provide their support for China's economic development and the modernisation of the Chinese military armament.[4] In many cases, the Soviet scientists desired contacts with the Chinese scientists more eagerly rather than the unilateral provision of scientific knowledge to China from their own side. For example, one of the Soviet scientists dispatched to China, an outstanding biophysicist, Gleb Frank (1904–1976), admired the capabilities and achievements of some of the Chinese scientists.[5] It seems that the Soviet scientists, who had long suffered from the scientific isolation from the rest of the world since the outbreak of the Cold War, thirsted for the intake of scientific knowledge from Chinese scientists, some of whom learned the newest currents of Western research.

The second letter (Malyshev, Vannikov and Kurchatov) was jointly signed by Malyshev, Kurchatov and Boris Vannikov (1897–1962), the then First Deputy Minister of Medium-sized Machine Building, and was addressed to the Central Committee of the Communist Party of the Soviet Union. This time, the letter recommends extending the targets of their support to Czechoslovakia and Poland, in addition to China, as a countermeasure against the nuclear foreign policy of the United States, which "provides support to Belgium, West Germany, Switzerland, Norway, Japan and other countries in this field". (Malyshev, Vannikov and Kurchatov, 134) They advise supporting these countries for a broader and powerful development of their nuclear research, including fundamental research.

> "As a first step, for these countries, we should build up small experimental nuclear reactors with a thermal power of 1,000 to 5,000 kW and particle accelerators, provide small amounts of nuclear fissionable materials for experimental research and assist in the training of nuclear engineers". (Malyshev, Vannikov and Kurchatov, 135)

And then, they estimate the total costs for such measures:

> "For the construction of one experimental reactor using 40-50 kg. of uranium enriched to contain less than 10% of uranium-235 will require 3.5 million rubles, the whole equipment will require 10 million rubles, and then, the cost of its construction and installation work will require 5 million rubles. ... One cyclotron will cost approximately 10-12 million rubles together with the cost of its construction. One electrostatic accelerator will cost 1.5-2 million rubles, and

with the construction cost – nearly 3 million rubles". (Malyshev, Vannikov and Kurchatov, 135-136)

Here, it is noteworthy that the purpose of such support to their allies was not limited to non-military, peaceful one, as seen also in the first letter. The letter assumes that the Soviet Union can obtain the reinforced nuclear war potential for the "Socialist Bloc" as a whole through such a large scale of aid, saying, "Taking into consideration the presence of uranium resources in China, Poland and Czechoslovakia, it will be of great political significance to make these countries join to the atomic superpowers by building up nuclear reactors in them". (Malyshev, Vannikov and Kurchatov, 136)[6] The measures proposed here to strengthen the scientific and technological support which should be given to the allies soon became a real policy; cooperative agreements on nuclear research and its peaceful use between the Soviet Union, China and their allies in Eastern Europe were concluded one after another from April to May of 1955. In the following 10–15 years, a total of 12 research and training centres on nuclear reactors, 16 particle accelerators and 5 radiochemical and isotope research facilities were established in East-European Soviet allies with assistance from the Soviet Union to these countries. (Petros'yants et al., 991-992) The large-scale nuclear research centre in Eastern European countries called the Joint Nuclear Research Institute, which was one of the direct objectives of these agreements, was established on March 26, 1956. (Dzhelepov, 290)

III. The Witness of the Soviets Concerned in the Chinese Nuclear Project

On April 27, 1955, in Moscow, a Soviet-China agreement regarding the supply of a nuclear reactor and some nuclear fissionable materials from the Soviet Union was signed. (Li Jue et al., 22) In addition, on May 15, 1957, the Soviet government signed a secret agreement to provide China with a model of an atomic bomb and technological documents concerning the supply of the nuclear reactor. (Kulik, 372) Therefore, it is possible to say that the proposals in the above-mentioned two letters had been adopted by the Soviet political power, at least, to some extent.

Prior to the introduction of the two letters, practically only one valuable record about the Soviet aid to China in the field of nuclear science and technology in the 1950s was the review written by Evgenii Negin and Yu. N. Smirnov (His biographical record – unknown). According to them, an engineer, Evgenii Vorov'yov (1920–1994. Fig.1)[7] played a crucial role in the coordination of the Soviet's support to China. Although he himself had left no records or memories of this coordination, Negin and Smirnov heard him verbally and summarised the outline.

In May 1957, Vorov'yov was dispatched to China under the order of the Chief of the Defence Section of the Party's Central Committee, Ivan Serbin (1910–1981), and stayed in Beijing until

Fig.1. Evgenii Vorov'yov at the right side (The left side – Yurii Oganesyan)
(http://www.imyanauki.ru/rus/scientists/3996/facts.phtml)

November 1959, working there as the Scientific Advisor of Beijing Nuclear Research Centre. In addition to him, A.A. Zadikyan (in charge of industrialisation. His biographical record – unknown), S.A. Zakolupin (in charge of chemistry and radiation chemistry. His biographical record – unknown) and others were also dispatched. (Negin et al., 306)

As stated in the initial plan, a nuclear reactor, a cyclotron and other equipment were successfully delivered from the Soviet Union to China. In addition to these, "tail-styled" machines (Fig.2) for the enrichment of uranium, i.e., the gas-diffusion apparatus and the electromagnetic separation apparatus equipped with 250 tons of electromagnets were provided to China. The latter was dismantled from the Atomic Energy Institute (later, Kurchatov Institute) in Moscow and delivered to China. Furthermore, in the summer of 1958, under the direction of Kurchatov, Vorov'yov gave a lecture at the Chinese Academy of Sciences on the thermonuclear fusion reaction. In 1958, when the Chinese nuclear weapon development went in full scale, the Soviet Union dispatched a total of 111 nuclear engineering experts and 43 geological experts to China. In the same year, the Soviets provided Harbin Institute of Military Technology with the protection program against nuclear weapons. In addition, on June 18, Arzamas-16, the Soviet nuclear warhead design and development centre, dispatched some nuclear warhead specialists, such

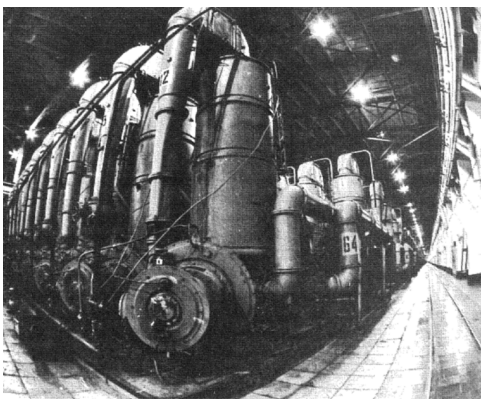

Fig.2. The Soviet-made gus-diffusion apparatus, OK (Velikhov, 164)

as Negin, who taught Chinese specialists about the detonating methods, its devices and how to assemble atomic bombs and left China on August 2. (Negin et al., 312-314)

Here, we will examine these support measures in light of China's official records. *Today's Chinese Nuclear Industry* refers to the reactor and the cyclotron as described in the first letter of Kurchatov and Malyshev:

"According to the China-Soviet Agreement, the Soviet side took responsibility for the design of the reactor and the cyclotron at the first stage of their construction and the Chinese side was responsible for providing the data for the investigation and the general sketch of the plane diagram for that purpose, (We) took part in the examination of the first stage design and drew up the design plan and the charts for construction". (Li Jue et al., 25)

The nuclear reactor (Fig.3) which was thus built up reached the critical state on June 13, 1958, and the delivery ceremony was held on September 27. (Li Jue et al., 25)

No explicit description can be found in *Today's Chinese Nuclear Industry* on the "tail-styled" machines and the electromagnetic separators for uranium enrichment, such as described in the review by Negin and Smirnov. However, the following description and the photographs placed in this book seem to certify the truth of the testimony of Negin and Smirnov:

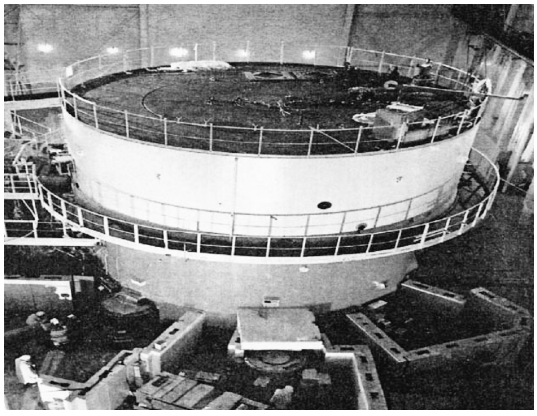

Fig.3. The Chinese first research (heavy-water) reactor after "Revision"
(Li Jue et al., Photo. No.74)

"When the Soviet Union cancelled the agreement with China and stopped to provide support, the main frame of the uranium fuel production, i.e., the Lanzhou Uranium Enrichment Plant, was already basically completed and the other equipment was relatively well completed. As for the plutonium production facilities, the construction of their main part, i.e., the producing reactor, was at the stage where the ground excavation for founding the reactor and the work

to pour concrete into that basis had been just finished. And then, the construction of the reprocessing plant of nuclear fuel was still awaiting the decision." (Li Jue et al., 42)

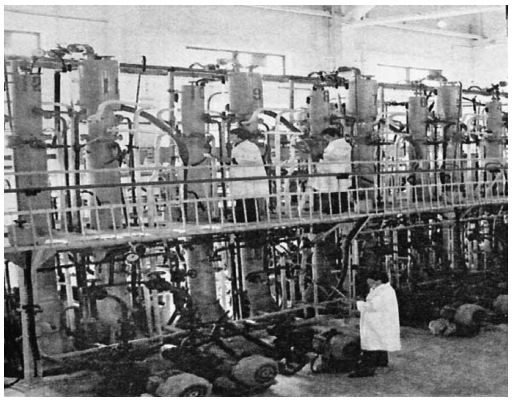

Fig.4. The Chinese isotope separating apparatus (Li Jue et al., Photo. No.55)

At the same time, it is supposed that this statement explains, to some extent, why the development of highly enriched uranium bombs was prioritised in China's early nuclear weapon development. In addition, the photograph of the "isotope separation apparatus" placed in the official record is similar to the Soviet gas diffusion apparatus called "OK" apparatus. This resemblance can be observed from the comparison of Fig.4 quoted from *Today's Chinese Nuclear Industry* (photo. No.55) and Fig.2 quoted from the Proceedings of the Symposium held at Dubna in 1996. (Velikhov, 164)

IV. Concluding Remark

The two letters examined here tell us that at least for the intention of those planners, who were influential in the policy-making related to the nuclear development project, a large-scale transfer of nuclear technology to China was considered rather desirable. These two letters may lead us to the counterevidence against the conventional understanding that due to the limitedness and insufficiency of the Soviet supports, China's nuclear weapons project was accomplished due to China's own "self-reliant" efforts.

They drew up the plan to aggressively support People's Republic of China and the other allied countries as a countermeasure against the United States' aid to their allied countries in nuclear science and technology as a sort of "enclosure" of the scientific research activities in the Western Bloc. The Soviet Union provided extensive support by providing a nuclear reactor, particle accelerators and others to China. It is noteworthy that the purpose of the Soviet Union behind providing this support was not limited to the peaceful use of atomic energy, but it had a vital

interest in securing the uranium resources that existed in the territories of their allies.

It seems that the Soviet scientists, who had suffered the isolation from the rest of the world for a long time, had become so eager that they wanted to exchange with the Chinese scientists. They were in close relationship with current European and American scientists only a few years ago, until their return to their own country in response to the invitation from the leaderships of newly founded People's Republic.

China's first atomic bomb explosion test was conducted on October 16, 1964. A few days ago, before the test, the then Soviet political leader, Khrushchev, said to the Japanese foreign minister, Fujiyama, Aiichiro:

> "Chinese people will be able to cause nuclear explosion. While we were in a close, brotherhood relation, the Chinese scientists gained so much access to our secret operation and witnessed our way to work. ... We provided them with the equipment for producing nuclear fuel. ... They received very many things and came to know how to do with the matter." (Negin et al., 304)

Negin and Smirnov also stated that "by this time (of their return from China) the mission had done almost everything."[8] However, they also mention, "mysteries remained yet [for the Chinese side.]"

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Notes

1. The political leaderships of New China were hungry for their homeland's nuclear armament under the pressure of the United States' "enclosing" policy against the newly founded socialist China by means of confrontation in the Korean War, the conclusions of a series of the security treaties with Japan, South Korea and the Philippines and the organization of ANZAS and SEATO (Kulik, 373).
2. According to the editors of this historical record, the purpose of this book consists in "try(ing) to disclose the historical process of the construction and development of the Chinese nuclear industry and its major achievements as systematically and comprehensively as possible, to summarize the historical experience of the nuclear industrial development as accurately as possible and to gain some disciplined recognition along the lessons of Marxism-Leninism and Mao Zedong thought". And then, they expected to dedicate this book to "the founders and the builders who succeeded in the construction and development of Chinese nuclear industry through a succession of their great efforts for them and their brave struggle with their own blood and sweat and with a song of magnificent triumph and the wide range of readers, homeland and abroad, who are interested in the Chinese nuclear industry." (Li Jue et al., Preface, 2)
3. By the way, the title of this paper is associated with the phrase of a song, which was popular among the Soviet specialists dispatched to China in those days. (Negin et al., 303)
4. With regard to scientific and technological assistance from the Soviet Union to China in the 1950s as a whole, a large scale of joint historical research has been conducted by China-Russia joint research team since 2000 (Zhang Baichung et al.).
5. Gleb Frank was first surprised with the flourishing of radiation physics research in Beijing. Also, Frank was interested in the research activities of Wang Ying-lai, the Director of the Institute for Physiology of Chinese Academy of Sciences, Professor Gchao (maybe, Cao Tian-qin), "who engaged in the study of protein in muscle in Cambridge for several years", the Academy's Institute for Biochemistry "which is producing outstanding achievements", and the Academy's Institute for Experimental Biology "which is engaging in some problems so interesting from the view of biology as a whole". (Arkhiv Rossiiskoi Akademii Fond, 1885, Opis', 1 No.128, sheets, 5–9, 15–19.) We must here take into consideration that even in those days the Soviet biology could not get rid of the dominance of Lysenko doctrine.
6. The Soviet Union conducted a large scale geological survey for uranium resources and, at the same time, eagerly demanded the supply of uranium ores from their "Allies" newly established in Eastern Europe since December of 1949. Thus, the manegement of an East German uranium mining enterprise, "Wismut," was transferred to the Main Directorate of Overseas Assets of the Soviet government at the date of July 10, 1950 (Ryabev, 35). The additional laborers were recruited for that enterprise to increase the annual output of uranium ores to 1,250 tons. (Ryabev,

288-291) Also in the territory of Poland, a large scale search for "lead mines" (the codename standing for uranium mines) was planned in those days. (Ryabev, 443-444) In Czechoslovakia, it was planned to increase the output of "lead mines" on the basis of the additional fund amounting to 10 million rubles which was allotted to the Second Main Directorate affiliated to the Council of Ministers in charge of the nuclear fuel supply. (Ryabev, 469) Such a heated enthusiasm, however, became calm after the discovery of some prosperous uranium resources in Kazafstan and other Central Asian regions since 1956. (Petros'yants et al., 72-74)

7. Vorov'yov participated in the Soviet atomic project from its early days, even while he studied at Moscow Machanical-engineering Institute. In 1952, on the recommendation of Kurchatov, the scientific leader of the Soviet nuclear development, he was appointed the scientific leader of the Enterprise No. 1590 at "Cher'yabinsk-40," the nuclear weapon production centre. After his return from Beijing, he served as the Deputy Director of the Institute for Nuclear Reactor Science at Dimitrovgrad and since 1966 he worked at the Joint Nuclear Research Institute at Dubna. (http://www.imyanauki.ru/rus/scientists/ 3996/facts.phtml)
8. How can we explain the reason why the completion of the first Chinese nuclear bomb was so delayed until in 1964? For the first place, we should take into consideration the following circumstance: "Uranium hexafluoride was to be provided by the Soviet Union. Nebertheless, (it had to be) self-produced. It must have been done (Li Jue et al., 43)." The first nuclear bomb in China was a highly enriched uranium bomb equipped with an implosion detonator, which was developed in the Manhattan Project exclusively for plutonium bombs and not necessary for highly enriched uranium bombs. This choice of the detonating method might be rooted in the preference of the Chinese scientists and engineers involved in the project and it might be rooted partly in inequality of the knowledge level the Chinese scientists and engineers obtained through the Soviet aids. *Today's Chinese Nuclear Industry* refers: "We obtained relatively systematic understanding about the performance and efficiency we can get by using enriched uranium as fissionable material for atomic bomb with the implosion method for their detonation through a tremendous number of theoretical calculation and analysis in 1962. As for the experimental works, we grasped basically the important apparatus, major laws and experimental techniques for the implosion method. We gained the technique producing the nuclear explosive, the technique refining and molding the nuclear material and completed the whole system of automatic control." (Li Jue et al. 1987, 45).

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