

DOI: 10.1070/PU2002v045n02ABEH001030

**Remarks on the paper****by G A Goncharov and L D Ryabev****“The development of the first Soviet atomic bomb”**

The review paper by G A Goncharov and L D Ryabev [1], indicated in the title of this note, assembled together and discussed the documents covering the period from 1939 to 1949 that throw light on the grandiose effort of building the atomic bomb in the USSR. Analyzing the state of research in the USSR on the problem of using nuclear energy in the pre-war period, the authors of Ref. [1] point to the achievements in nuclear physics and also throw a glance at the research that was relevant to the possible development of the atomic bomb. This review quotes my and V A Maslov's classified invention application “The use of uranium as an explosive and toxic substance” filed in October 1940 to the Inventions Bureau of the USSR People's Commissariat of Defense. G A Goncharov's and L D Ryabev's comments about this invention application are in need of substantial corrections. That was the time when serious doubts were expressed concerning the feasibility of triggering a nuclear explosion in a mass of uranium composed of the uranium-235 isotope or of a mixture of isotopes enriched in uranium-235. The doubts appeared because the conclusion that a nuclear explosion of the critical mass of uranium was possible had been made without taking into consideration how the critical mass could be created. In the actual conditions it would be necessary to transfer the uranium mass in some manner from the subcritical state with respect to the chain decay to the critical area (for instance, by bringing together two uranium masses). Ya B Zel'dovich and Yu B Khariton [2] showed that this transition was of crucial importance and that it should be implemented at a rate comparable to the enormous rate of the exponential rise of neutron concentration; their opinion was that this was hardly feasible.

On the other hand, no method was available at the time to separate uranium isotopes in the amounts required for creating an actual nuclear explosive [3, pp. 187, 211]. Even though this aspect was given much attention by the Academy of Sciences of the USSR and by a number of laboratories, most Soviet physicists were very sceptical regarding the feasibility of solving this problem. Therefore, the task of creating the atomic bomb centered not so much and not only on how to finalize its design but much more on solving the

problem of separating the isotopes in the large amounts required. The authors of the review fail even to mention this key problem and treat our proposal as an independent application not connected to the invention application “A method of preparing a mixture enriched in uranium with mass number 235. Multichamber centrifuge” simultaneously submitted by F F Lange, V A Maslov and V S Shpinel' and the application “Thermal-circulation centrifuge” submitted slightly later by F F Lange and V A Maslov. This approach to our idea regarding a specific design of an atomic bomb and to other designs discussed in the review (when the problem of the creation of nuclear explosive was considered infeasible) leads to the bewildered question: Why were the designs devised and even submitted as invention applications if they were practically unusable? However, our applications were submitted and scrutinized, in today's terms, as a package. They greatly changed the situation and opened up ways for experimentally testing the feasibility of creating atomic bombs of various designs. This is the gist of the matter that we raise here.

We had received no response to our applications at that time, and only on the 7th December 1946 the Inventions Department of the USSR Ministry of Defense decided to issue author's certificates on all three inspected applications. G A Goncharov and L D Ryabev, considering only the V A Maslov and V S Shpinel' application, comment on this decision in the following words: “*Although obviously irrelevant, the application by Maslov and Shpinel' is interesting insofar as it is the first pretension to the invention of an atomic bomb design made in the USSR. This is probably the reason why the Inventions Department at the USSR Ministry of Defense decided on December 7, 1946 to issue an author's certificate to Maslov and Shpinel' despite the negative reviews of their application that were made as early as 1941* [1, pp. 195–196]”.

This quote requires a number of comments. The suspicion formulated in it of our *pretension* to inventing the design of an atomic bomb is quite unsubstantiated because our application suggested only the idea of a design, which could pretend to be an invention only after successful experimental testing. The hypothesis that this pretense of invention could have been sufficient for the Inventions Department of the Ministry of Defense to decide to give us the author's certificates in 1946 appears unrealistic and cannot explain why this decision was not made on the same basis in 1941 when we had been refused the invention certificates — refused on all three applications. To understand the reasons which caused the change in the decision made in 1941 on our applications, one has to take into account a number of remarks regarding the character of the principal negative responses of the referees to our applications. The inference made at the Chemistry Research Institute of the USSR People's Commissariat of Defense expressed grave doubts in the feasibility of a nuclear explosion as such, while the conclusion of the chief referee V G Khlopin, the Chairman of the Uranium Commission and Full Member of the USSR Academy of Sciences, contained a number of counter arguments of general nature which

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Received 19 July 2001, revised 18 September 2001  
*Uspekhi Fizicheskikh Nauk* 172 (2) 235–236 (2002)  
Translated by V I Kisin; edited by A Radzig

appeared quite inconclusive [3, p. 187]. However, once the American atomic bomb had been exploded in 1945, all these doubts were blown away and the Inventions Department, recalling our applications, decided to issue the certificates.

It must be emphasized that our main purpose was not to receive inventor's certificates which, to be honest, were of no great importance at the time, but to put forward forceful arguments for starting the work which appeared to be of critical importance for the country. This is why we decided to address the USSR People's Commissar of Defense marshal S K Timoshenko at the beginning of 1941, and why V A Maslov sent him a letter arguing the need to organize work on using atomic energy for military purposes [3, pp. 224, 225]; among other things the letter said that "...it appears extremely important to create as soon as possible, in one of the special-purpose research institutes, a laboratory specializing in uranium research, as this would make it possible for us to conduct research work in permanent contact with the most skilled technicians, chemists, physicists and military experts of our country". Alas, no governmental decisions were made concerning this problem. Responding to my remarks, G A Goncharov and L D Ryabev explain in their subsequent text that the principle suggested by V A Maslov and myself for triggering a nuclear explosion, which consisted in placing uranium masses in partitioned chambers separated by neutron-impermeable walls which would be removed by an ordinary chemical explosion, could not work "...because no materials exist that could serve to build sufficiently compact separating walls completely impervious to neutrons...". Indeed, such materials do not exist. However, there is no need to have these walls completely impervious to neutrons, and we do recognize that the application used an imprecise formulation. The answer to the question of whether it was possible to ensure sufficient absorption of neutrons in the separating walls depends on the value of the volume occupied by the partition design. At that time the volume of interest could not be given because it depends on the critical mass which had not yet been established. Therefore, any judgement on the correctness or incorrectness of the principle formulated in our applications could only be made after the relevant experiments were completed.

The above arguments make it possible to conclude that if our proposals were accepted in due time, work on elucidation of the feasibility of using uranium energy for military purposes could be started in the USSR independently of the corresponding research work abroad, even before the Great Patriotic War of 1941–1945 — that is, two years before the State Defense Committee ordered the organization of the uranium research work.

V S Shpinel'

## References

1. Goncharov G A, Ryabev L D "O sozdanii pervoi otechestvennoi atomnoi bomby" ("The development of the first Soviet atomic bomb") *Usp. Fiz. Nauk* **171** 79 (2001) [*Phys. Usp.* **44** 71 (2001)]
2. Zel'dovich Ya B, Khariton Yu B "Kinetika raspada urana" ("Kinetics of uranium decay") *Zh. Eksp. Teor. Fiz.* **10** (5) 477 (1940)
3. *Atomnyi Proekt SSSR: Dokumenty i Materialy* (The USSR Atomic Project: Documents and Materials) Vol. 1 1938–1945 Pt. 1 (Editor-in-Chief L D Ryabev; Exec. comp. L I Kudinova) (Moscow: Nauka – Fizmatlit, 1998)

DOI: 10.1070/PU2002v045n02ABEH001067

## About V S Shpinel's remarks on the review "The development of the first Soviet atomic bomb"

The authors of the review "The development of the first Soviet atomic bomb" [1] made a conscious decision to restrict the subject-matter of the paper to the topic formulated in the abstract: "*Based on documentary materials covering the period from 1939 to 1949, this paper traces the origin and evolution of the physical ideas behind the first Soviet atomic bomb and discusses the most important events associated with the project*". The review article reached a size very near the limit allowed for publications in the *Physics – Uspekhi*, and therefore the history of the work on manufacturing the active fissile materials, and especially the work on separation of uranium-235 which was not used in the design of the first Soviet atomic bomb, could not be described in detail and to a large extent was left outside of the aspects discussed in the review.

Therefore, commenting on the invention application which was directly relevant to the topic of paper [1], namely, that of V A Maslov and V S Shpinel' "The use of uranium as an explosive and toxic substance" of 17 October 1940 [2, pp. 193–196] which was submitted to the Inventions Bureau of the USSR People's Commissariat of Defense, the authors of Ref. [1] failed to mention the invention application by F F Lange, V A Maslov and V S Shpinel' "A method of preparing a mixture enriched in uranium with mass number 235. Multichamber centrifuge" [2, pp. 196–198], also accepted at the end of 1940 by the Inventions Bureau as a follow-up to the former application.

Nevertheless, paper [1] discussed the problem of separation of uranium isotopes, whose solution, in the opinion of a number of Soviet scientists before the Great Patriotic War, was inseparable from the very feasibility of implementing the nuclear chain reaction. The paper quoted part of a record made in V I Vernadsky's diary on June 1, 1941: "*We now face the problem of uranium as a source of energy — real, technical energy, and the problem may reform the entire technical capacity of mankind... Still, we have ongoing arguments: physicists focus on the nuclear theory, not on the particular goal set before physical chemists and geochemists, i.e. extracting the 235-isotope of uranium. Here we have to follow the theory, testing it at once by experience...*". Quoting this citation, the authors of article [1] expressed their agreement with Vernadsky's opinion on the importance of solving the problem of the separation of uranium isotopes — this was a straightforward problem standing in the path of achieving the release of atomic energy.

Even though the authors of Ref. [1], not aiming to outline the history of work on the separation of uranium isotopes,

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Received 28 November 2001

*Uspekhi Fizicheskikh Nauk* **172** (2) 236–238 (2002)

Translated by V I Kisin; edited by A Radzig