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BIRTHDAYS

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Yulii Borisovich Khariton (on his 90th birthday)

Academician Yulii Borisovich Khariton is an outstanding scientist, a world class physicist, and one of the founders of the first Russian nuclear centre — the All-Russian Institute of Experimental Physics [ARIEP (the Russian abbreviation is VNIIEF)]. Since the date of its creation in 1946 until 1992 Khariton was the principal designer and then the permanent Scientific Head of the Institute. Since the end of 1992 he has been Honorary Head of the Institute.

Khariton was born on 27th February 1904 in St Petersburg to a family of a journalist and an actress. His early passionate interest in mathematics and physics and his excellent education at home (in particular his fluent command of the German language) enabled him to graduate from a nonclassical secondary school ('real'noe uchilishche') already at the age of 15. Only the rule current at the time that the attainment of the age of 16 was required before enrolling at an educational institute [college] prevented him from doing so immediately.

In 1920, after his apprenticeship as a mechanic at the telegraph workshop of one of the Petrograd railways, he became a student at the Electromechanical Faculty of the Polytechnic Institute.

The deep impression made by the lectures of Professor Abram Fedorovich Ioffe led the young student to the conclusion that physics was more interesting than electrical engineering and at the beginning of 1921 Khariton transferred to the Faculty of Physics and Mechanics organised by Ioffe in 1918 at the same Polytechnic Institute. In the summer of 1921, N N Semenov, who conducted the practical exercises in physics, invited Khariton and two other students, A F Val'ter and V P Kondrat'ev (who subsequently became members of the Academy of Sciences), to work in his laboratory at the Physicotechnical Institute. The invitation was gladly accepted.

In 1925, Khariton graduated from the Polytechnic Institute and his collaboration with Semenov continued until 1945. His first most important piece of research on "the oxidation of phosphorus vapour at low pressures", carried out and published in 1926 by him with Z F Val'ta, was devoted to the mechanism of gas-phase reactions.

In the study of the glow generated during the oxidation of phosphorus vapour by oxygen, they observed that there is a definite critical oxygen pressure below which the reaction does not occur.

Max Bodenstein of the Institute of Physical Chemistry of the Berlin University, the most outstanding expert in the field of chemical kinetics at the time, published a critical comment stating that the phenomenon of the inflammation limit is impossible in principle and is a consequence of certain experimental errors. Upset by this and unable to continue research himself on the controversial subject whilst on a visit to England as a postgraduate, Khariton wrote to Semenov about it. The latter, together with his coworkers at the Leningrad Physicotechnical Institute, reproduced and continued Khariton and Val'ta's experiments. As a result, Semenov achieved the first theoretical interpretation of the mechanism of the phenomena which became the basis for the creation of a theory of the branching in chain reactions. Later Bodenstein admitted that his criticism was unjustified, while Semenov gave a copy of his book *Chain Reactions* to Khariton as a present with the inscription "To Dear Yulii Borisovich, who was the first to direct my thoughts into the field of chain reactions". Indeed, Khariton and Val'ta pointed out in their study that the oxidation of phosphorus is to some extent analogous to an electric discharge in gases with a characteristic sharp transition from a silent discharge to a spark discharge.

Yulii Borisovich Khariton

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In 1926–1928, Khariton worked at the Cavendish Laboratory in Cambridge under the supervision of Rutherford and Chadwick. For his study on "the counting of scintillations generated by alpha-particles" he was awarded the Degree of Doctor of Philosophy in 1928. After returning from England in 1928, Khariton turned to research on explosives: kinetics and detonation. In 1931, Semenov became Director of the Institute of Chemical Physics in Leningrad, which he founded with A F Ioffe's support, and Khariton became Head of the Explosives Laboratory, which he organised at this Institute. Here Khariton founded the Soviet School of the Physics of Explosion of which he is in fact the recognised leader.

Among the most important results of this research, we may point to 'Khariton's principle' which determines the possibility of detonation of explosives. He discovered and explained the existence of a critical diameter for the detonation of a charge.

In 1939–1941, Khariton and Ya B Zel'dovich published the results of their analysis of the mechanism of the fission of uranium as a branched chain reaction. They examined the problem of the stability of a nuclear reactor and discovered the factors determining it; in particular they pointed out the role of moderating neutrons for the regulation of a chain reaction and, on the other hand, elucidated the conditions the fulfilment of which would ensure the occurrence of a nuclear explosion (the latter study was carried out with the participation of I I Gurevich).

At the beginning of 1942, Khariton was sent to the Research Institute No. 6 of the National Committee for Armaments (Narkomat Boepripasov — an equivalent of the Ministry of Armaments) in Moscow, where he worked throughout the war years on problems vital to the front line forces and participated in studies designed to create cumulative charges and certain new types of anti-tank weapons.

In 1943, Laboratory No. 2 of the USSR Academy of Sciences was created with I V Kurchatov at its Head. Kurchatov suggested to Khariton that he should head studies designed to create nuclear weapons. Khariton recalls that "we became members of this Laboratory where I had a staff of several persons. Regular discussions on questions concerning the creation of nuclear weapons were initiated. It became clear that it would be necessary to be able to carry out detonations of a large mass of explosives, that such work could not be developed in Moscow, and that another place would have to be sought".

The KB-11 Design Bureau (subsequently All-Russian Institute of Experimental Physics) was created in 1946 on the basis of one of the factories of the National Committee for Armaments in Sarov (subsequently Arzamas-16). Khariton was appointed the principal designer and Deputy Head of KB-11. The first atomic charge was tested in August 1949 and the first specimens of hydrogen bombs were tested in 1953 and 1955.

However, this was only the beginning. The improvement of nuclear weapons continued for many years. Khariton was responsible for the scientific supervision of the development of various types of atomic and thermonuclear weapons which served and still serve nowadays as part of the existing ordnance. He was supported in this work by the enormous intellectual potential of outstanding scientists such as Ya V Zel'dovich and A D Sakharov as well as many other members of Theoretical Divisions who served in essence as a kind of 'brains trust' of the ARIEP. For a long time, Khariton was Chairman of the Scientific-Technical Council No. 2 of the Ministry of Medium Machine Construction (at the present time the Ministry of Atomic Energy of the Russian Federation), which was concerned with problems of nuclear weapons. During recent years, when nuclear tests have not been carried out, he devoted much attention to problems of the safety of nuclear weapons in active service and during storage and also to problems of the maintenance of their effectiveness. Almost 50 years have already elapsed since the creation of KB-11. A small design bureau was converted into a large research centre in our country. At the present time 3 Academicians of the Russian Academy of Sciences, 60 Doctors, and 520 Candidates are working as part of a team comprising many thousands of members. Among the members of the Institute, there are 250 Laureates of the Lenin and State prizes.

The ARIEP is engaged in research and development in the following principal fields of study: the physics of ultrahigh pressures and temperatures, the physics of explosion and shock waves, reactor physics, the physics of thermonuclear synthesis, the physics of lasers, studies and tests in the field of the mechanics and reliability of constructions, the development of methods and apparatus for the recording of fast processes, and many others. All these studies are combined in virtually one principal applied task: the creation of devices for the generation of nuclear and thermonuclear energy for both defence and economic purposes. The successful fulfilment of these investigations is in many respects due to the utmost support offered by Khariton and his invariable goodwill towards and care for people.

We may note here one remarkable feature of the attitude adopted by Khariton in his work — he prefers to discuss problems directly with the person involved in the given scientific research without paying attention to questions of hierarchy. His ability to listen with interest, to understand the essential features of the subject, to ask crucial questions, and to penetrate into all the details of the problem lead his interlocutor to work with the maximum devotion of which he is capable, making full use of his creative possibilities.

Khariton does not suffer falsehood and a formal approach to the matter in hand. Studies on certain scientific topics which were begun on Khariton's initiative are being continued with his direct participation. Thus experimental studies designed to investigate the effect of radiation from a nuclear explosion on the viability of weapons and of military technique were begun on his initiative.

Khariton's considerable and constant interest in this topic made it possible to create a powerful experimental base not only at the ARIEP but also in other organisations and thus promoted the development of nuclear rocket weapons resistant to various types of influences.

A field of physics new to the Institute — the physics of lasers — began to develop at the ARIEP in 1965 under the supervision and with direct creative participation by Khariton. A novel feature was the use for the pumping of lasers of light quanta generated at the front of a shock wave or a high-temperature plasma supplied by magnetic-cumulative generators. Khariton has devoted much attention to studies on laser thermonuclear synthesis. Powerful 'Iskra-4' and 'Iskra–5' laser devices were created at the Institute.

Khariton initiated the creation and development of the Mathematical Division of the ARIEP. He has always been concerned with mathematical matters and his personal participation helped on many occasions to solve seemingly insoluble problems. At the present time, the ARIEP has a powerful computer centre equipped with a set of unique programs for the solution of problems in modern experimental physics and engineering.

The scientists at the ARIEP honourably represent Academician Khariton's school both in our country and abroad. Their achievements in various branches of physics are widely known through numerous open publications and also through the results of experiments carried out jointly with American scientists during recent years.

The Academy of Sciences frequently recognised Khariton's outstanding achievements. Since 1945 he has been Corresponding Member and since 1953 a Full Member of the Academy of Sciences. In 1974, he was awarded the Kurchatov medal and in 1982 the Lomonosov medal. His enormous output has been recognised by numerous state prizes. He was awarded three times the title of Hero of Socialist Labour and he is a Laureate of the Lenin and State prizes (three such prizes). Khariton is an Honorary Citizen of the city of Arzamas-16.

We, his colleagues and students, convey to dear Yulii Borisovich our heartfelt greetings on the occasion of his glorious jubilee and wish him many years of life, health, and joy of creation.

E N Avrorin, A V Belugin, V S Bosamykin, R I Il'kaev, G A Kirillov, V N Mikhailov, E A Negin, Yu S Osipov, Yu A Romanov, A N Skrinskii, I D Sofronov, L M Timonin, Yu A Trutnev