

SIBERIAN ACADEMICIAN ALEXEY REBROV: WAY TO SCIENTIFIC HEIGHTS

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On July 30, 2018, Alexey Kuzmich Rebrov, academician of the Russian Academy of Sciences, celebrated his 85th birthday. The Russian scientist is known for the outstanding results in the field of rarefied gas dynamics and thermophysics. This paper analyzes the social conditions and scientific and educational environment that influenced the vital activity of Alexey Rebrov and determined his creative development.

KEY WORDS: *Siberian Branch of the Russian Academy of Sciences (RAS), Kutateladze Institute of Thermophysics, Academician A.K. Rebrov*

In 2018, the scientific community celebrated the birthday of the Russian scientist and Academician Alexey Kuzmich Rebrov. The scientist is known for his outstanding work and achievements in the fields of physical gas dynamics, dynamics of rarefied gases, and thermophysics. At 85 years old, Alexey Rebrov is still full of creative plans and new scientific ideas (Fig. 1).

The biography of Alexey Rebrov includes many events: wartime childhood, education at Kharkov University, postgraduate studies in Kazan, and scientific and educational activities at Research Institutes and Universities in Novosibirsk. Without exaggeration, we can say that the Siberian period has become the mainstream of his life. For almost six decades (since 1961), Alexey Rebrov has lived in the Novosibirsk Akademgorodok and worked at the Institute of Thermophysics of the Siberian Branch of the Russian Academy of Sciences.

Alexey Rebrov was born in 1933 in the Ukrainian village Verkhne-Bogdanovka, Voroshilovgrad Region, in a family of collective farmers. He grew up during wartime, and his childhood years were filled with destitute conditions and hardships. In 1942, his father, Kuzma Filippovich Rebrov, perished at the frontlines. His mother, Sofya Evseevna, did everything possible to ensure that her three children received an education. According to the memoirs of Alexey Rebrov, he changed several schools in different settlements and he graduated from the 10th grade in the village of Petrovka. In these schools, there were many teachers dedicated to their work. Vasily Vasilyevich Zemtsev was a particular teacher who instilled in his students a love for the Russian language and literature.

During a short study in Lugansk Stanitsa, Alexey Rebrov met Petr Balabuev (later the Chief Designer of the Design Office “Antonov” in Kiev), who was a class older. Petr told Alexey about his intention to enter the Kharkov Aviation Institute (KhAI), now called the National Aerospace University of Ukraine named after N.E. Zhukovsky. Since 1930, this Institute has trained specialists in the field of the development and production of aviation and space equipment.

In 1949, Alexey Rebrov also entered KhAI (Fig. 2). He studied at the faculty of aircraft engines and in 1955 graduated from the University cum laude. Alexey Rebrov gratefully recalls his mentors: Professor I.P. Goldaev, Head of the Chair of the Aircraft Engines Theory; Professor and Mathematician A.D. Myshkis; and Teacher and Engineer A.E. Potapenko. At KhAI, under the guidance of Professor I.P. Goldaev, Alexey Rebrov, as an assistant to the Chair of the Aircraft Engines Theory, was engaged in the development of apparatus for thermal drilling of rocks. However, according to the scientist’s admission, another area attracted his mind: the launch of rocket engines. His interest was strengthened after leading the practice of KhAI students in the Voronezh Rocket Design Office.



FIG. 1: Academician Alexey K. Rebrov



FIG. 2: Students of Kharkov Aviation Institute; Alexey Rebrov is on the left (1950)

In 1957, in the hope of taking up this topic, Alexey Rebrov entered the post graduate school at Kazan Aviation Institute (KAI), now called the Kazan State Technical University of the Tatarstan Republic Named after A.N. Tupolev. However, the supervisor, Professor A.V. Bolgarskiy, an outstanding scientist and heat engineer, suggested Alexey Rebrov switch to the problem of rarefied gases and thereby determined his future vector of scientific research. As a graduate student, Rebrov expanded his theoretical knowledge by listening to lectures at Kazan State University (Fig. 3).

After his post graduate studies in 1960, A.K. Rebrov worked as an assistant teacher at the Department of Theoretical Foundations of Thermal Engineering at KAI and published his first scientific works. During the Kazan period, there was a significant event in the life of a young man: meeting a girl named Asfira, who was a mathematician. Asfira became the life partner of Alexey, and, as the wife of a Decembrist, she followed her beloved husband to Siberia.

According to the memoirs of Alexey Rebrov, his correspondence acquaintance with S.S. Kutateladze, one of the eminent scientists in the field of thermophysics, happened back in Kazan, when Alexey was preparing to take the candidate exam in this specialty field and read a book by S.S. Kutateladze. The personal acquaintance took place in Leningrad: the result of an interview with Samson Kutateladze, one of the organizers of the Institute of Thermophysics of the Siberian Branch of the USSR Academy of Sciences (Kupershtokh and Bykovskaya, 2018), resulting in the assignment of Alexey Rebrov to work in Novosibirsk in the laboratory of outstanding scientist Alexander Ivanovich Leontiev.

The Rebrov family arrived in Novosibirsk Akademgorodok in 1961. At the Institute of Thermophysics, Alexey Rebrov worked his way up, which is typical of a Soviet scientist: he worked as a junior, and then as a senior researcher, followed by head of a laboratory, and then as the head of the rarefied gas department. He defended his PhD thesis, and then his habilitation thesis. He was elected a Corresponding Member of the Academy of Sciences of the USSR in 1990 and Academician of the Russian Academy of Sciences in 2000. From 2017 to the present, he has been the chief researcher at the Institute of Thermophysics, and since 2003 he has been an Adviser of the Russian Academy of Sciences (Fomin, 2007).

In the 1960s, the extensive cycles of research on thermohydrodynamic processes during fluid boiling and turbulent transfer in gas-dynamic boundary layers were started at the Institute of Thermophysics under the guidance of S.S. Kutateladze with the participation of A.I. Leontiev. In 1962, 29-year-old Alexey Rebrov became the head of the group studying rarefied gas flows in the thermal gas-dynamics laboratory of the future academician, A.I. Leontiev. Colleagues of Alexey Rebrov note that one of his most amazing qualities is his ability to assess the prospects of an emerging scientific field and find his place in it.



FIG. 3: Professor A.V. Bolgarskiy; Alexey Rebrov is on the far right (Kazan, 1959)

With the advent of the space age, interest in rarefied gas flows was widespread. A.K. Rebrov chose supersonic jets as the main object of research, focusing on experimental studies with diagnostics at the molecular level. In the early 1960s, this choice was uncommon. Only some scientists foresaw that the study of supersonic jets was relevant to the problems of space subjects and would find applications in many physical processes.

In 1962, Alexey Rebrov defended his PhD thesis on “Heat transfer at free convection in a rarefied space.” The thesis was the result of an experimental investigation of the problem started by Alexey Rebrov under the guidance of Professor A.V. Bolgarskiy. Therefore, the defense took place in Kazan.

In 1966, after a year of successful work as the Scientific Secretary of the Institute of Thermophysics, a rarefied gases laboratory was organized at the Institute of Thermophysics, which was based on the potential of a research group headed by A.K. Rebrov. A.K. Rebrov was elected the head of laboratory (and then the department). The dynamics of rarefied gases is a section of gas mechanics and physical kinetics, which studies phenomena requiring consideration of molecular structure and using ideas and methods of the kinetic theory of gases (Fig. 4). The development of vacuum technology and cosmonautics was the impetus for the rapid growth of research in this area and the formation of an independent discipline—the dynamics of rarefied gases—at the junction of gas dynamics and the kinetic theory of gases (Predtechensky et al., 2013).

Simultaneously, the creation of the vacuum gas-dynamic complex, the largest in the USSR, equipped with modern diagnostic tools was started at the Institute of Thermophysics under the leadership of A.K. Rebrov. This allowed priority studies on non-equilibrium supersonic jet flows to be conducted, which took into account translational, rotational, and vibrational relaxation; spontaneous condensation; and radiation. Modern equipment also allowed applying the research on gas dynamics of spacecrafts and the development of resource-saving vacuum diffusion pumps. The vacuum gas-dynamic complex at the Institute of Thermophysics, without exaggeration, can be called one of the best in the world.

In 1966, the Head of the International Department of the USSR Academy of Sciences visited the Institute of Thermophysics. He was greatly impressed by the experimental base created under the guidance of the young scientist, Alexey Rebrov. There was a proposal to work at the Space Research Institute in Canada. The business trip of A.K. Rebrov in 1967 laid the foundation for cooperation with foreign researchers in the field of rarefied gas flows. The collaboration resulted in modeling the “Soyuz” and “Apollo” spacecraft docking (Kolesova, 2017).

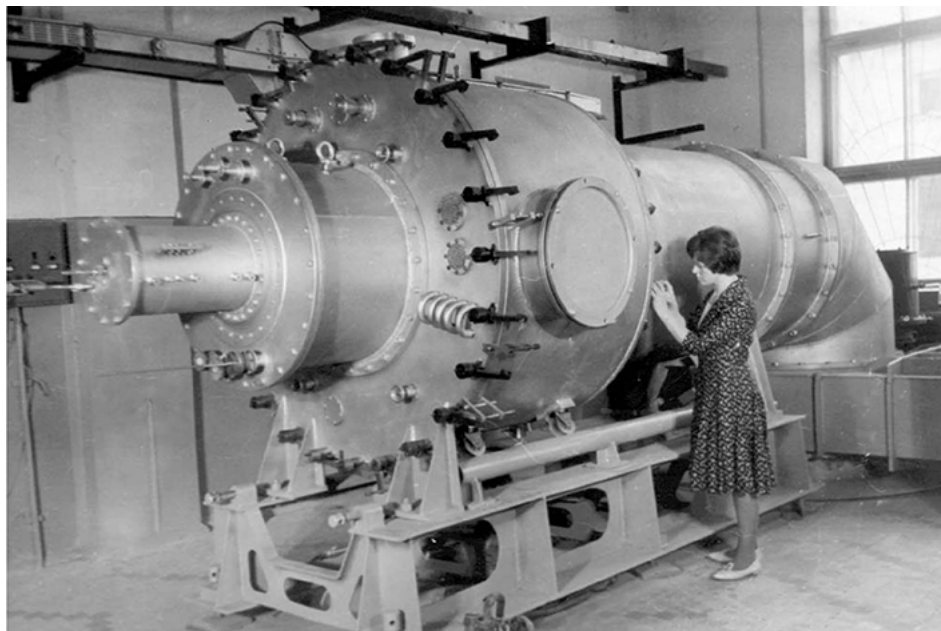


FIG. 4: Experimental setup “VS-2” (Novosibirsk, 1969)

Starting from 1970, the Siberian scientist A.K. Rebrov participated in international conferences on the dynamics of rarefied gases. In 1972, he was elected to the International Advisory Committee of Symposia on the dynamics of rarefied gases, and he remained a member of this committee for 26 years. On the initiative of A.K. Rebrov, Novosibirsk was chosen as the venue for this conference in 1982. It was attended by well-known experts from 17 countries, including D. Fenn, the Nobel laureate (Fig. 5). Cooperation on the problem of rarefied gas dynamics helped to construct sustainable options for cooperation between the Institute of Thermophysics and scientific centers in other countries.

In 1972, at the age of 39, A.K. Rebrov defended his habilitation thesis, “Gas Expansion into Low-Density Environment,” for the degree of Doctor of Physical and Mathematical Sciences at the Institute of Thermophysics of the Siberian Branch of the USSR Academy of Sciences (Fig. 6). For a long period of time, A.K. Rebrov was a Professor at Novosibirsk State University (NSU), a member of the Scientific Council of the Faculty of Physics, and head of the Department of Physics of Nonequilibrium Processes at NSU (Aleksandrov, 2014). For several years he was the



FIG. 5: Opening of the International Symposium on Rarefied Gas Dynamics; from left to right: Nobel Laureate D. Fenn, A.K. Rebrov, S.S. Kutateladze, and N.N. Yanenko (Novosibirsk, 1982)

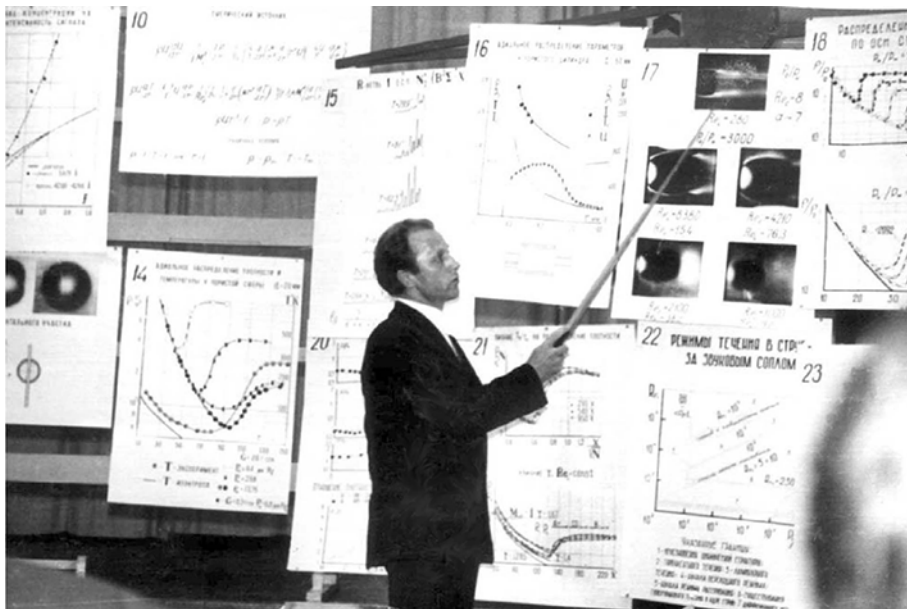


FIG. 6: Defense of habilitation thesis (Novosibirsk, 1972)

Chairman of the State Certification Commission for the Defense of Graduation Projects at NSU and Novosibirsk State Technical University.

At the present time, the scientific school of Academician Rebrov on non-equilibrium processes in rarefied gas flows, plasma, and nanostructures is known for its results in Russia and abroad. An Academician of the Russian Academy of Sciences, dozens of doctors and professors of science, as well as scientists from other countries, are among the students of Alexey Rebrov. While maintaining certain traditions, the subject of research at the scientific school is constantly expanding into new areas, for example, in the direction of jet deposition of nanostructured coatings, and in particular the gas-dynamic synthesis of diamonds. According to Academician Rebrov, “My students are my teachers simultaneously. We started new scientific topics, we studied together. . .” (Fig. 7).

The activity of Academician Rebrov is inextricably connected to the history of the development of the thermophysics and dynamics of rarefied gases. In 2018, the XXXIV Siberian Thermophysical Seminar (held at the Institute of Thermophysics since 1960) was dedicated to the 85th birthday of Alexey Kuzmich Rebrov (Institute of Thermophysics, 2018). At this seminar, Academician Rebrov gave a detailed report about his teachers and events that influenced his life choice. Some interesting facts from his report are included in this paper.

Academician Rebrov celebrated his 85th birthday not as the grand total of a creative biography, but as an ordinary event. Just like at the beginning of his scientific career, Alexey Kuzmich Rebrov, the founder of a scientific school and member of prestigious Russian and international councils and committees, is still busy solving specific problems with a belief in scientific success and the bottom line.



FIG. 7: Academician A.K. Rebrov with colleagues and students (Novosibirsk, 1998)

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