

III INTERNATIONAL CONFERENCE
“CATALYSIS: FUNDAMENTALS AND APPLICATIONS”

Georgii Konstantinovich Boreskov
On the Occasion of the 100th Anniversary of His Birth

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April 20, 2007, was the centenary of the birth of Academician Georgii Konstantinovich Boreskov, an organizer and the first editor-in-chief of *Kinetika i Kataliz*, eminent scientist and engineer, outstanding science manager of the 1950s–1970s, and founder and the first director of the Institute of Catalysis (Siberian Branch, Russian Academy of Sciences).

Boreskov was born in the town of Omsk into the family of a Russian Army officer. He graduated from the Odessa Institute of Chemistry. From 1932 until his tragic death in 1984, his scientific interests were inseparably connected with the theory and practice of catalysis.

Boreskov as a scientist developed in the best traditions of Russian classics of chemistry, namely, D.I. Mendeleev, V.I. Ipat'ev, A.E. Favorskii, and N.D. Zelinskii, who always combined in-depth fundamental research with solving challenging practical problems.

Boreskov systematically developed the concept of catalysis as an essentially chemical phenomenon in which the crucial role is played by intermediate chemical interactions of the reactants with the catalyst, and this field of his research was of paramount significance to catalysis science and practice. Based on this concept, Boreskov laid the scientific foundations for the present-day understanding of the mechanisms of catalytic reactions and the nature of catalytic action. For example, he demonstrated that catalytic reactions can proceed via two types of mechanisms, namely, stepwise and one-step mechanisms. The ranges of conditions under which these mechanisms take place were determined, and the rate of the catalytic reaction was correlated with the properties of the catalyst. In particular, it was found that the activity of a catalyst in total oxidation reactions is governed by the energy of the bonding between oxygen and the surface of the active component, while the catalytic activity in selective oxidation is determined by the energy and character of the bond between the substrate and the surface.

By general analysis of the energy profiles of catalytic and noncatalytic reactions, Boreskov demonstrated that the acceleration of any type of catalytic reaction (homogeneous, heterogeneous, or enzymatic) by a catalyst is due to the fact that the intermediate chemical interactions of the reactants with the catalyst enhance the compensation for the energy of bond dis-

sociation in the reactants from bond formation in the reaction products.

Boreskov's concept that the catalyst is affected by the reaction medium is of principal importance for the theory of catalysis, catalytic technologies, and preparation of solid catalysts (“contacts”). A practical implication of this concept is the Boreskov rule, according to which the specific catalytic activities of substances with the same chemical composition are nearly equal, irrespective of the way these substances were prepared. This concept has made it possible to describe the kinetics of many reactions important to practice. At present, it serves as the basis for the developing kinetic theory of catalytic processes that takes into consideration the changes in the properties of the catalyst under the action of the reaction medium and rests upon the formalism of nonequilibrium thermodynamics.

Boreskov's works on the kinetics of reversible reactions are also of fundamental importance. He established a general relationship between the activation energies of the forward and reverse reactions, introduced the concept of the apparent molecularity of a complex chemical reaction, and suggested ways of determining this quantity. The above-mentioned relationship is now called the Horiuti–Boreskov relationship.

A distinctive feature of Boreskov's scientific activity was the aspiration to cover all stages of catalytic process design, from suggesting a fundamental idea pertaining to catalysis theory to developing a catalyst preparation technology, designing a contact apparatus, and commercializing the catalytic process. By investigating mass transfer in heterogeneous catalytic reactions, Boreskov laid the scientific foundations of the preparation of catalysts with an optimum porous structure. Solving engineering problems involved in the optimization of catalytic reactors, he devised new methods of contact apparatus design. These methods made up the foundation of mathematical simulation of catalytic processes, a new field of science, which was then successfully advanced by Boreskov in collaboration with M.G. Slin'ko over many years. A glowing example of putting ideas into practice is the development of a vanadium catalyst for sulfur dioxide oxidation by Boreskov as early as the 1920s. This catalyst was employed in all of the USSR's contact apparatuses producing sulfuric acid. The monograph *Kataliz v*

proizvodstve sernoi kisloty (Catalysis in the Manufacturing of Sulfuric Acid) by Boreskov is an exemplary, enduring guide to the design and commercialization of catalytic processes and to solving relevant engineering problems.

Comprehensive covering of all aspects of catalysis, from the theoretical foundations of prediction of catalytic activity and catalyst preparation to the design of contact apparatuses and commercialization of catalytic processes—this is the principle by which Boreskov was guided when organizing the Institute of Catalysis in Akademgorodok, Novosibirsk oblast. This institution has become the world's largest research center in the field of catalysis and has gained great prestige both in Russia and abroad. Along with advancing the basic theory of catalysis and designing new catalysts and catalytic processes, the Institute of Catalysis successfully addresses the following challenging topics in science and technology: unsteady-state catalytic processes, which provide an opportunity to substantially intensify the production of important chemical products and the processing of lean raw materials without extra energy input; catalytic heat generators, which make it possible to greatly enhance the apparatus duty per unit volume and hold great promise for various applications ranging from autonomous energy supply systems to agriculture; new methods of synthesis of high-quality liquid fuels and aromatic compounds from light hydrocarbons, which are still being utilized to an insufficient extent; new catalysts for obtaining modern polymers; novel petrochemical and oil processing processes; etc.

An active researcher and brilliant pedagogue utilizing his rich creative experience, Boreskov educated tens of doctors and candidates of sciences and founded his own scientific school, which is still working actively. Boreskov always paid great attention to education. Over many years, he lectured at leading chemical education institutions of the Soviet Union. He was Head of Department at the Moscow Institute of Chemical Technology (now the Mendeleev University of Chemical Technology of Russia) and founded the Department of Catalysis and Adsorption at Novosibirsk State University.

Boreskov was a prominent science manager. He had the ability to appreciate, and to provide timely support

for, all new and promising areas and to focus the efforts of large groups of researchers on the key areas of catalysis science. As an active initial organizer of the Siberian Branch of the USSR Academy of Sciences (SB USSR AS) and Chairman of the Joint Council for Chemical Sciences at the SB USSR AS, Boreskov made a large contribution to the development of chemistry in Siberia.

As Chairman of the Council on Catalysis at the State Science and Technology Committee of the USSR Council of Ministers and Head of the Catalysis Section of the Presidium of the USSR AS, Boreskov put great effort into coordination of catalytic studies in the Soviet Union and into practical application of their results.

Boreskov did a large amount of important work towards the establishment of contacts between Soviet researchers and their foreign colleagues. He organized USSR–Japanese and USSR–French workshops on catalysis and executed scientific exchanges with researchers from the United States, West Germany, Italy, Belgium, and other countries.

Boreskov's scientific achievements gained worldwide recognition: he was elected President of the International Congress on Catalysis, Honorary Member of the New York Academy of Sciences and of the East German Academy of Sciences, and Honorary Doctor of Wrocław Polytechnic Institute and of the University of Poitiers. Boreskov was a member of the editorial boards of the most respectable international journals on catalysis. He established the journal *Kinetika i Kataliz* and the international journal *Reaction Kinetics & Catalysis Letters* and was the first editor-in-chief of these journals.

Boreskov's research and managerial activities were highly appreciated by the government. The scientist was given the title of Hero of Socialist Labor and was awarded USSR orders, medals, and state prizes.

The 100th anniversary of Boreskov's birth was commemorated by holding the International Conference on the Theory and Practice of Catalysis and the Russian–German Symposium on Catalysis in Novosibirsk Akademgorodok in early July 2007.

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