BORIS VLADIMIROVICH DERJAGUIN
(1902–1994)

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IN MEMORIAM

Boris Vladimirovich Derjaguin (1902–1994)

Professor Boris Vladimirovich Derjaguin died on May 16, 1994, at age 92. A great physical chemist and a world-renowned scientist, he laid the foundations of the modern science of colloids and surfaces. An epoch in the development of the physical chemistry of surface phenomena and of colloid chemistry is associated with his name.

Educated in the family of the well-known Russian physicist Professor P. N. Lebedev, Boris Vladimirovich Derjaguin became his successor in the great tradition of Russian science. After graduating in physics from Moscow State University in 1922, Derjaguin began his scientific career at the Institute of Biophysics, where he worked under the supervision of Professor P. P. Lazarev on problems in acoustics and the physics of eyesight. However, the main research of Derjaguin, which made him known worldwide, was performed in the fields of physical chemistry, molecular physics, and colloidal and surface phenomena. Starting in 1932, Derjaguin studied thin interlayers of liquids for the first time at the Institute of Applied Mineralogy. In 1935, he began work at the USSR Academy of Sciences by organizing the Laboratory of Thin Films at the Institute of Colloid and Electrochemistry, now called the Institute of Physical Chemistry. In 1966, his laboratory was expanded to form a Department of Surface Phenomena. Derjaguin remained there until the last days of his life.

Derjaguin was appointed Professor in Physics in 1935 and awarded his doctoral degree in chemistry in 1936 without having to defend his thesis, a singular honor. In 1946, he was elected a corresponding member of the USSR Academy of Sciences, and in 1992 a full member of this Academy.

B. V. Derjaguin became known worldwide in scientific circles owing to his classical work on the theory of stability of colloids and thin liquid films. This theory, known in international science as DLVO theory, was so called after the initial letters of its authors—Derjaguin, Landau, Verway, and Overbeek; it is included in all the textbooks on colloid chemistry and has been widely applied.

The notion of disjoining pressure of thin interlayers and its various components, introduced by Derjaguin, made it possible to pass from two-dimensional Gibbs thermodynamics to the three-dimensional thermodynamics of multiphase systems, taking into account finite thicknesses, special properties of interphase layers, and the long-range action of surface forces. He introduced the notion of the structural component of disjoining pressure resulting from the overlapping of the boundary layers of liquids with a modified structure compared with the bulk structure. He also was the first to suggest the possible formation of boundary phases sharply separated from the bulk phase, which has been substantiated experimentally. Boundary phases possessing a structure analogous to that of liquid crystals have been detected in a wide class of liquids. He theoretically substantiated and applied an original blow-off method of investigating the boundary viscosity of liquids.

The theory of the interaction of curved surfaces occupies a special place in colloid and surface science. Starting in 1934, this theory has been widely used as a way for passing from a well-developed theory of interaction of flat surfaces to the interaction of particles of arbitrary shape. This made it possible to utilize macroscopic bodies of various shapes for direct measurement of surface forces. In pursuing this last research direction, Derjaguin developed a sensitive method for simultaneously measuring interaction forces and for presetting small shifts of thin crossed filaments, which first made possible direct measurement of the forces of molecular attraction of opaque solids (metals) as a function of the distance between them.

In recent years, Derjaguin suggested a new approach to the thermodynamics of thin layers, providing a new possibility for the experimental determination of their thermodynamic thicknesses. Unfortunately, he did not live to see the realization of that method.

Studying the process of sticking of solids, Derjaguin found that fresh surfaces coated with dense layers of opposite sign arose when adhesive bonds were broken. This leads to the appearance of an electronic component of adhesion. A theory of the formation of a double layer on the contact of solids was developed, and the great role of donor–acceptor interactions was demonstrated. In connection with this direction of Derjaguin's research, the theory of the adhesion of particles on their collision with solid substrates, taking into account pulse contact polarization, becomes of great practical significance. The emission of rapid electrons and X-rays on the breaking of adhesive contact in a vacuum has been detected. Derjaguin also detected the emission of neutrons on the breaking of the cohesion of deuterium-containing solids, as a consequence of nuclear processes taking place at room temperature.

A large series of experiments in the physics of aerosol particles were carried out under the direction of Derjaguin. A

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theory of motion of aerosol particles under the effect of temperature and concentration gradients applicable to the problem of capturing particles was developed and experimentally substantiated. A theory of the inertialess capture of aerosol particles from their flow resulting from the streamlining of an obstacle was developed and was verified by the jet method. A method for preventing the formation of radiation fogs through pulverization of high-molecular-weight alcohols was checked under laboratory and then under field conditions.

As early as 1950, Derjaguin supervised studies of the synthesis of diamond under low pressures. The development of experimental methods and theoretical concepts on the influence of atomic hydrogen during the gasification of nondiamond forms of carbon allowed synthesis of diamond from the gas phase on various substrates. Monocrystalline and polycrystalline diamond films were thus prepared.

In the fundamental research of Derjaguin, thoroughness of theoretical development based on physical concepts and originality of approach to the analysis of complex phenomena are combined with the fineness and elegance of experimental technique and the choice of the simplest and most convincing ways of elucidating the mechanism and nature of the phenomena being studied.

Boris Vladimirovich Derjaguin left a large scientific inheritance. He published more than one thousand printed works, including monographs published both in Russia and abroad. Quite recently, Pergamon Press, acknowledging his great scientific merits, has published three volumes of his *Selected Works* in the series *Progress of the Science of Surfaces*. He was the author of numerous inventions and discoveries. Many generations of scientists will benefit from his work.

The scientific achievements of Derjaguin were widely acknowledged. He was awarded the Lomonosov (1958) and Mendeleev (1984) Prizes of the USSR Academy of Sciences for his fundamental research. In 1990, he was awarded a USSR State Prize for the development of the theory of stability of colloids and thin films. He was also decorated with many USSR orders and medals.

In 1965, Clarkson College (Potsdam) conferred an honorary doctorate upon him. He was a member of the Faraday Society, and served for several years as the Vice-President of the International Association of Colloid and Interface Scientists (IACIS). In addition to the Russian Academy of Sciences, he was a full member of the International Academy of Natural Sciences "Leopoldina," the New York Academy of Sciences, the International Academy of Creative Arts, and the Russian Academy of Natural Sciences. The name of B. V. Derjaguin has been put on the Desk of Glory at the Technological Institute in Haifa, Israel, along with the names of Mendeleev, Pauling, Debye, Bernal, and other outstanding scientists.

The rare talent of Boris Vladimirovich attracted many scientists, who became his pupils and successors. For several generations of scientists he was not only a teacher, but also a friend. His memory will remain in the hearts of numerous persons, both those who merely acknowledged his talent and those who had the privilege of working with him. The further development of the Derjaguin school of ideas and the expansion of the field of their practical application will constitute the best memorial to this outstanding scientist.

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