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B. A. NIKITIN'S WORK AT RADIUM INSTITUTE, ACADEMY OF SCIENCES USSR

V. M. Vdovenko

Boris Aleksandrovich Nikitin, one of the most outstanding USSR chemists, Corresponding Member of the Academy of Sciences USSR, died on 20 July 1952 at the age of 46. After receiving his early training as a chemist at Khar'kov University, Nikitin was transferred to Leningrad State University, where he completed his course of studies in 1927. Nikitin's degree thesis dealt with the distribution of radium between crystals of barium bromide and solutions of this salt. He carried out work on this thesis under the supervision of V. G. Khlopin.

While still a student at Leningrad University, Nikitin began to work at the Radium Institute, Academy of Sciences USSR. All his future activity was to be connected with this institute. After finishing his studies at the university, Nikitin received an aspirantship at the Radium Institute, where he completed a dissertation under Khlopin's guidance. This dissertation dealt with the application of radioactive tracers in work on the so-called new type of mixed crystals, the existence of which had been discovered a short time previously by Grimm, the well-known crystal chemist. These crystals are not composed of salt pairs which exhibit isomorphism as defined by Mitscherlich, but of pairs having differently charged ions, although the stoichiometric formulas of the two salts forming the pair are identical (for instance, $BaSO_4$ and $KMnO_4$ or $NaNO_3$ and $CaCO_3$). At that time, lively discussions took place on the subject of the existence of crystals of this type.

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In his aspirant's dissertation, which initiated a long series of investigations on problems of isomorphism, Nikitin demonstrated that mixed crystals of the Grimm type are fundamentally different from genuine mixed crystals, i. e., those of the Mitscherlich type. He showed in the dissertation that mixed crystals of the Grimm type cannot form if the concentration of one of the components is too low. This means that mixed crystals of the new (Grimm) type have a lower limit of formation, while in genuine (Mitscherlich) mixed crystals, where replacement proceeds ion by ion, a lower limit of formation has never been observed.

In subsequent work on the subject, Nikitin was able to show that a lower limit of miscibility is characteristic not only for crystals of the Grimm type, but also for anomalous mixed crystals. As distinguished from genuine mixed crystals, both Grimm crystals and anomalous mixed crystals have a coefficient for the distribution of the microcomponent between the solid phase and the liquid phase which depends on the concentration of the microcomponent in the solution. Further work on the subject led Nikitin to the conclusion that both mixed crystals of the Grimm type and anomalous mixed crystals must be regarded as colloidal solid solutions in which the solute is not present in the form of individual ions, as in genuine mixed crystals, but in the form of independent crystalline nuclei.

Nikitin's investigations on the quantitative limits of miscibility of various crystalline structures are closely related to the work outlined above. On the basis of purely geometric concepts, Nikitin calculated the quantitative limits of miscibility applying to 20 different cases. The results of these calculations proved to be in complete accordance with experimental data.

Nikitin's work on the chemistry of noble gases is also of great theoretical and practical significance. He advanced a number of fundamental theoretical postulates pertaining to molecular compounds and held that investigation of the molecular compounds of noble gases may serve as a basis for clarifying relationships which are valid for all molecular compounds. He derived the so-called rule of analogy, which states that when two substances possess similar van der Waals forces and have molecules that are similar in size and shape, these two substances must form analogous molecular compounds which are similar with respect to their stability and are capable of forming mixed crystals. By applying the method of isomorphic coprecipitation of compounds of noble gases with the corresponding compounds of their analogs, Nikitin obtained a number of molecular compounds of noble gases, i.e., hydrates of radon and neon; compounds of radon, argon, krypton, and xenon with phenol; of radon with p-chlorophenol; and of radon with toluene. Making use of the great differences between the dissociation pressures of the molecular compounds of different noble gases, Nikitin developed an original chemical method for the separation of these gases.

Among other investigations carried out by Nikitin, his extensive work on the solubility of radium sulfate in water and in solutions of sodium sulfate of various concentrations must be noted. In the course of this work, Nikitin was able to discover a serious error made by US investigators (Lind and others) in determining the solubility of radium sulfate. Because the American investigators did not take into consideration the adsorption of radium on the filter, they arrived at a solubility which was 100 times smaller than the actual solubility. After developing an experimental technique which permitted elimination of the effects of adsorption, Nikitin determined the actual solubility of radium sulfate and the effect which additions of sodium sulfate have on this solubility. He has demonstrated that, notwithstanding the extremely low concentrations of radium, the law of mass action is strictly applicable in this case, if corrections for the coefficients of activity are made.

The work done by Nikitin in the field of geochemistry is also of great interest. He investigated the distribution of radium in water occurring below the petroleum layers in a number of petroleum fields of the USSR. The fact that this water is enriched with radium has been proven [in the course of Nikitin's own work and in related work]. It has also been established that this enrichment takes place as a result of the leaching out of rocks by water of a definite chemical type. In addition to his work on radium found at petroleum occurrences, Nikitin has investigated the distribution of helium in natural gases of the USSR.

Parallel to his activity in the field of scientific research, Nikitin conducted extensive science organization work at the Radium Institute, where he was chief of the Chemical Division in 1938-1940, Deputy Director in Charge of Scientific Work in 1940-1946, and director of the institute from 1950 until his death. Nikitin also did much work in connection with the training of scientific personnel. During a number of years, he was instructor at the Chemical Faculty of Leningrad State University. Nikitin was elected Corresponding Member of the Academy of Sciences USSR in 1943. He was awarded the Order of Lenin, two Orders of the Labor Red Banner, and two Stalin Prizes (1st and 3d class). Nikitin's death represents a great loss to Soviet radiochemistry.

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