Lev Al'bertovich Vaĭnshteĭn (on his sixtieth birthday)

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Corresponding Member of the USSR Academy of Sciences Lev Al'bertovich Vaĭnshteĭn, a noted Soviet theoretical physicist and specialist in mathematical physics, celebrated his sixtieth birthday on December 6, 1980.

Vaĭnshteĭn has more than 100 titles of major scientific and practical works to his credit in the electrodynamics of ultrahigh frequencies and electronics. Many of them have become classics and won worldwide recognition. Foremost among them is a series of studies made between 1947 and 1950 and devoted to exact solution of a fundamental problem of diffraction theory—the diffraction at the open end of a waveguide. This problem, which had been formulated by Lord Rayleigh, is the key to a whole range of mathematical-physics problems. Its solution proved to be especially important in the context of the rapid development of ultrahigh-frequency radioengineering during the 1940s. In the first paper of this series (1947), Vaĭnshteĭn reduced the problem of wave diffraction at the open waveguide end to an integral equation for the current flowing on the waveguide wall and then wrote an explicit solution of this equation in quadratures, using a factorization technique. Later, he used this procedure for systems of integral and functional equations. It became possible as a result to obtain rigorous solutions for a broad class of waveguide and antenna problems that had previously been investigated for the most part by approximate methods, with the accuracy of the results not always being obvious. The theory developed by Vaĭnshteĭn made it possible to answer a multitude of questions of great importance for the general theory of diffraction, e.g., radiation from large openings, the limits of validity of the Huygens principle, etc. Many of these results have been published in two monographs: "Difraktsiya élektromagnitnykh voln na otkrytom kontse volnovoda" (Diffraction of Electromagnetic Waves at the Open End of a Waveguide), 1953, and "Teoriya difraktsii i metod faktorizatsii" (Diffraction Theory and Factorization Methods), 1966. The importance of these works and of the solution methods developed remains undiminished today. The factorization method came to be the most important method for investigation of many mathematical-physics problems; it is the foundation of later methods for analysis of diffraction problems, such as the boundary-wave method, the method of geometric diffraction theory, etc.

Another series of Vaĭnshteĭn's fundamental studies was devoted to the theory of open cavities (1962–1965). Among other things, such cavities are used as the basis for lasers and millimeter- and submillimeter generators; therefore the practical importance of these studies

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can hardly be overstated. Working from a simple and lucid representation of the open cavity as a waveguide segment, Vaĭnshteĭn succeeded in deriving asymptotic formulas for the characteristics of the oscillations that occur in such systems. It is interesting to note that, as it turned out, this theory was related in many respects to the theory of wave diffraction at the open waveguide end. For example, Vaĭnshteĭn showed that Q oscillations in cavities with plane mirrors are formed as a result of reflection from the edges of the mirrors and that in the first approximation the reflection takes place in the same way as diffraction of a wave at the open end of a waveguide. For analysis of open cavities, Vaĭnshteĭn developed a whole series of interesting methods that subsequently came into widespread use in investigation of quasioptical systems. Examples of these methods are the parabolic-equation method, the method of approximate factorization, geometrical-optics methods of analysis, spectral decomposition in terms of the waves of the continuous spectrum, etc. In essence, a complete theory of two-mirror open cavities was derived in these studies. Their principal results were set forth in the 1966 monograph "Otkrytye rezonatory i

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otkrytye volnovody" (Open Cavities and Open Waveguides).

In addition to these works, which are bound together by their community of subject matter, Vaĭnshteĭn authored several single investigations each of which spawned entire approaches to analytic and numerical problem-solving for diffraction. These include, for example, the double variational method, the double-reduction method, and others. They have recently acquired special importance with the rapid development of computers, which has made it possible to solve problems of high complexity. Vaĭnshteĭn is also credited with several interesting studies in the theory of wave diffraction by metal gratings and the theory of thin vibrators (here some of the papers were written jointly with P. L. Kapitza and V. A. Fok). Several of Vaĭnshteĭn's papers were devoted to problems of radio propagation in near-earth space (in collaboration with V. A. Fok, G. D. Malyuzhinets, and M. G. Belkina).

Vaĭnshteĭn is active in various areas of modern radiophysics. Theoretical-electronics research is an important object of his creativity. Vaĭnshteĭn derived a nonlinear theory of the traveling-wave tube and obtained serveral interesting results pertaining to the stability of oscillations in high-power magnetron devices. The nonlinear theory of the traveling-wave tube (1956–1957) was the first rigorous effort in the field; it had a strong influence on the development of this chapter in the theory of electronic devices.

Vaĭnshteĭn has a very broad range of scientific interests, and it is difficult to do them justice in limited space. We might mention, for example, the research on separation of signals from random-noise backgrounds (which was reflected in a 1960 monograph written jointly with V. D. Zubakov). Among his more recent studies, we note the series on solution of inverse (poorly conditioned) problems, the theory of signal transmission along lines with dispersion and absorption, and the theory of microwave plasma diagnostics.

Along with his extensive and productive research activity, Vaĭnshteĭn gives a great deal of attention to teaching and the preparation of numerous students. For a number of years, he lectured on microwave electrodynamics at the Moscow Physicotechnical Institute. This course formed the basis for his book "Elektromagnityne volny" (Electromagnetic Waves) (1957), which is to this day a valuable aid to specialists in high-frequency electrodynamics. Vaĭnshteĭn has also lectured at all the diffraction workshops held in the USSR, as well as at microwave-electronics workshops. Some of these lectures have been published in the monograph "Lektsii po sverkhvysokochastotnoĭ élektronike" (Lectures on Ultrahigh-Frequency Electronics), which he coauthored with V. A. Solntsev). Vaĭnshteĭn participates actively in the All-Moscow Seminar on Wave Diffraction, which has a strong influence on research in microwave electrodynamics. He gives much time to scientific-organizational activity.

Vaĭnshteĭn's writings are distinguished by clarity of exposition. He demands the same from his colleagues and students, and his friendly constructive criticism significantly improves papers that are discussed with him.

Vaĭnshteĭn's research has had a strong influence on the development of modern radiophysics. Most of the books that he has published in the USSR have also been published abroad and won wide recognition.

The friends, colleagues, and students of Lev Al'bertovich Vaĭnshteĭn wish him health, vigor, and further triumphs in his creative scientific work from the bottom of their hearts.

Translated by R. W. Bowers