

Émanuil Aïzиковich Kaner (Obituary)

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Soviet science has suffered a great loss. Émanuil Aïzиковich Kaner, a prominent theoretical physicist, a corresponding member of the Academy of Sciences of the UkrSSR died on 25 July 1986 at 54 years of age after a brief illness. A wonderful man and a prominent scientist passed away at the peak of his creative powers. The multifaceted scientific activity of É. A. Kaner was distinguished by its high degree of activity and its large scale.

É. A. Kaner was born on 19 November 1931 in Khar'kov. In 1954 he graduated from the physico-mathematical faculty of the A. M. Gor'kiĭ State University in Khar'kov specializing in two fields—"experimental physics" and "theoretical physics." Already during his student years Kaner published his first scientific papers. They were devoted to research on the interference of light in thin silver films and to the theory of the anomalous skin-effect in metals. The field of Kaner's principal interests—electron properties of metals—has been determined since that time. Here he was fortunate in finding an excellent teacher in the person of academician I. M. Lifshitz.

Already in Kaner's early papers his brilliant ability as a theoretician became evident. His name entered science after the discovery in 1956 of cyclotron resonance in metals. The prediction of this phenomenon initiated a new field of research—radio physics of the solid state. The theory of cyclotron resonance which was Kaner's candidate dissertation turned out to be so complete that up till the present it retains its significance for the explanation of new experimental data. In subsequent years Kaner developed a general kinetic theory of cyclotron resonance with arbitrary reflection of electrons from the surface and the theory of the delay effect in weak magnetic fields. In 1958 he predicted the effect of "cut-off of cyclotron resonances"—the first effect in a series of high-frequency dimensional phenomena later found experimentally. The work was highly thought of by L. D. Landau who submitted it for publication. Cyclotron resonance has long ago turned from being an object of research into one of the most powerful methods of investigating effective masses, mean free paths and Fermi surfaces of conduction electrons. It has been observed in more than forty metals, hundreds of articles on this topic have been published, the phenomenon is presented in many textbooks, monographs and reviews. The discovery of cyclotron resonance is significant for general physics, and has been included in the USSR State registry of discoveries.

Another widely known series of Kaner's papers is devoted to the problem of propagation of electromagnetic waves in metals. These papers were included in his doctoral dissertation (1964). Prior to the early 1960s it appeared that



ÉMANUIL AÏZIKOVICH
KANER
(1931–1986)

there was no doubt that radio waves cannot penetrate into the bulk of conductors and are damped out within the skin-layer. The papers of É. A. Kaner (together with V. G. Skobov) led to a revision of the commonly accepted concepts. Kaner predicted a number of new types of radio waves capable of penetrating deeply within a metal. A new collisionless mechanism for the damping of electromagnetic oscillations in metals in a magnetic field was observed for the first time. This phenomenon was given the name of "magnetic Landau damping." The conclusion concerning the existence of magnetic Landau damping is of fundamental significance. The whole series of papers on waves in metals served as the beginning of broad studies of plasma effects in solids and at present forms the theoretical foundation of an entire field—radio spectroscopy of metals and semiconductors. Some results of these investigations were summarized in the monograph

"Electromagnetic waves in metals in a magnetic field" published in two editions in England (1969, 1971). This monograph has received universal acclaim.

Kaner's papers devoted to ballistic mechanisms of anomalous penetration of radio waves into metals have become classics. Here he is the author of the theoretical prediction and study of the fundamental effects of single particle (trajectory) type also leading to transparency of metals. In scientific literature they are called "Gantmakher-Kaner modes" (V. F. Gantmakher observed them experimentally). Results on the anomalous penetration of radio waves have led to yet another inventor's certificate.

Kaner's research on the magnetic acoustics of metals is of fundamental significance. He predicted: acoustic cyclotron resonance, resonance on open orbits and helicon-phonon resonance. All these effects have been experimentally confirmed, and the helicon-phonon resonance, that has become popular, stimulated the search for other similar phenomena of coupling acoustic and electromagnetic waves. Kaner also developed the foundations of magnetic acoustoelectronics of metals based on surface (Rayleigh) waves. To this same series also belong Kaner's pioneering results on strong nonadiabatic effects in electron-phonon interaction in metals. In 1980 Kaner was awarded the State Prize of the UkrSSR for his series of papers on the magnetoacoustic spectroscopy of metals.

É. A. Kaner made an important contribution to the development of the problem of instability and propagation of waves in semiconducting and gas-discharge plasma—he predicted the helicoidal instability of coupled acoustic and spiral electromagnetic waves, he developed the theory of cyclotron parametric instability of a new type in semiconductors.

Kaner's ideas and results in the statistical theory of propagation of radio waves in a turbulent atmosphere, in the scattering of radio waves by hydrometeors, radio ranging and other fields of modern radio physics have turned out to be fruitful. He developed the theory of "fluctuational flares" which are important in designing lines of distant radio communication. Testimony to the breadth of Kaner's scientific interest is also provided by the fact that he (together with A. Ya. Usikov *et al.*) put forward the idea independently of A. Schawlow and proposed an effective method for isotope separation with the aid of laser radiation.

A characteristic trait of all of Kaner's work is its novelty of ideas and originality. Being an excellent master of mathematical apparatus Kaner first of all valued the beauty of a physical idea and the nonstandard approach to solutions. His papers always stimulated experimental and theoretical investigations. The constant creative tension and the tremendous energy impelled Kaner to tackle the solution of the most difficult problems. In his last years Kaner occupied himself with investigating acoustic properties of disordered systems of small size, of nonlinear electrodynamics of metals and semiconductors. He solved the complicated problem of the electron-phonon interaction and spatial dispersion of conductivity in one-dimensional disordered conductors,

which had remained unsolved for many years.

This brief list far from exhausts the content of the scientific activity of É. A. Kaner. His latest articles and review papers have not yet been published, many of the planned investigations have not been finished, scientific programs planned by him have not been completed.

Kaner's entire professional activity is associated with the Institute of Radio Physics and Electronics of the Academy of Sciences of the UkrSSR. Kaner exerted a tremendous influence on the formation and the successful execution of the scientific plan of the Institute. He founded and for over 20 years was the Director of the Division of Solid State Theory that at present exists within the Institute of Radio Physics and Electronics of the Academy of Sciences of the UkrSSR. For almost two decades Kaner carried on extensive pedagogical work being a professor of Khar'kov University. Kaner was an excellent lecturer. His vivid content-filled lectures were always very popular among students and scientific youth. Within the Institute of Radio Physics and Electronics of the Academy of Sciences of the UkrSSR, within the Department of Theoretical Physics of Khar'kov University, within the Physico-Technical Institute of Low Temperatures of the Academy of Sciences of the UkrSSR, within the Donetsk Physicotechnical Institute of the Academy of Sciences of the UkrSSR many young and talented theoretical physicists are working who were formed in his school. Kaner combined scientific and pedagogic activity with considerable work in the scientific organization field. He was one of the editors of the International journal "Solid State Communications," a member of the editorial board of the journals "Low Temperature Physics" and "Ukrainian Physics Journal," he was a member of many scientific councils of the Academies of Science of the USSR and the UkrSSR devoted to particular problems.

É. A. Kaner possessed the highest human qualities. Kaner always tried to transmit to his pupils and collaborators his remarkable qualities: love of science, passion in work, devotion to principles and boldness. Benevolence and at the same time rigorous criticality, a clear mind and the broadest erudition—these traits particularly attracted to him scientists of different generations. Many frequently turned to Kaner for scientific advice and aid, and he responded immediately with great generosity. Discussion with him brought invaluable aid and frequently led to new solutions. A cheerful and temperamental man, Kaner was never indifferent to anyone or to anything. His sympathies and antipathies were definite and stable.

Kaner had always worked hard, and worked passionately until his last days.

The bright image of Émanuil Aïzикович Kaner—of this handsome, wise and kind man will be forever preserved in our memory. And his name will remain inscribed in the history of science.

Translated by G. M. Volkoff