Vadim Evgen'evich Lashkarev (obituary)

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Vadim Evgen'evich Lashkarev, a noted Soviet physicist, scientist, and educator and an Academician of the Ukrainian Academy of Sciences, died at Kiev on December 1, 1974 at the age of 71. The development and emergence of semiconductor physics in the Ukraine and primarily at Kiev are associated with his name.

Lashkarev was born into the family of a lawyer at Kiev on October 7, 1903. He belonged to the generation of Soviet physicists who, on entering the science during the difficult years after the First World War, were immediately attracted to the development of the new divisions of physics that were only then making their first appearance. On graduating in 1924 from the Kiev Institute of Public Instruction that had been formed from the University, he began his scientific work as a graduate fellow in the Scientific Research Physics Department of the Kiev Polytechnic Institute. This department was later to become the nucleus of the Ukrainian Academy of Sciences Institute of Physics, and Lashkarev headed one of its sections in 1929–1930. His first experimental studies were concerned with the diffraction and scattering of x-rays and were done in part under the supervision of V. P. Linnik and later with S. D. Gertsriken, a graduate student. Lashkarev worked as a theoretician during the same period. The titles of his papers of that time—"On the Theory of Gravitation," "On the Theory of Motion of Matter and Light in the Gravitational Field," "Derivation of the Frenkel' Drag Coefficient from the Theory of Quanta of Light"—illustrate the broad range of his interests in the new physics.

Lashkarev's scientific career blossomed with his transfer to the Physico-technical Institute in Leningrad (1930–1935). Here he did the first Soviet work on the diffraction of electrons and wrote our country's first monograph on this problem. These studies composed his doctorate thesis.

In 1939, Lashkarev returned to Kiev at the invitation of the Ukrainian Academy of Sciences and headed the Semiconductors Division of the Academy's Institute of Physics and the Physics Department at the University. In spite of this abrupt change in his scientific direction, his classical paper on thermal-probe investigations of the barrier layer in cuprous-oxide rectifiers appeared shortly thereafter. The p-n junction (the term itself appeared much later) was discovered by this method, although all of its importance for semiconductor physics and engineering became clear only afterward. During the Second World War, Lashkarev worked at Ufa, to which the Ukrainian Academy of Sciences Institutes of Physics had been evacuated. There, together with his work in the Academy, he headed the Branch Scientific Research Institute laboratory that worked on the improvement of semiconductor devices for the war effort.

His return to Kiev in 1944 and his election to the Ukrainian Academy of Sciences in 1945 marked the beginning of the next, longest, and most fruitful phase in Lashkarev's career. After the liberation of Kiev, the Institute of Physics went to work in a wrecked and ruined building. But the laboratory was operating in very short order. A scientific seminar and a scientific conference in which Lashkarev was the most active and frequent speaker began to meet regularly. Within a short time, a series of highly important studies of photoelectromotive forces in cuprous oxide whose importance went far beyond the actual problem of the mechanism by which the photo-emf arises had been completed. Lashkarev elaborated a theory of this phenomenon and showed that the nonrectifier emf (or the so-called Dember effect) is determined by the diffusion of minority carriers, whose motion is leading and causes bipolar diffusion from the illuminated electrode into the sample. The role of the junction, whose properties—blocking or antiblocking (the latter term was coined by Lashkarev)—determine the sign and magnitude of the emf, was clarified. The theory of the capacitor (noncontact) emf was developed, and the importance of the appearance of surface charges in determining the emf was emphasized. Later, a theory of nonstationary photoconductivity was developed, and the possibility of controlling photoconductivity with an external electric field was predicted and realized in an experiment. The concepts of the diffusion mixing lengths stretched and compressed by the field, which are now universally accepted conventions, were introduced here. Studies of bipolar conductivity were a natural development from this. The phenomenon in which, under quasineutrality conditions, the field may either squeeze carriers toward one of the junctions or hold them into the interior of the sample was investigated theoretically. Hence the discovery of the injection mechanism—the extremely important phenomenon on which the operation of semiconductor diodes and transistors is based. Next, we should mention the discovery of the infrared luminescence of cuprous oxide and the development of the constant-illumination variable-signal method in the study of nonlinear photoconductivity. This made it possible to separate nonlinear effects due to variation of the quantum yield and to recombination phenomena. An important step forward was made in the discovery and investigation of so-called superlinear photoconductivity in CdS and the photoactivation of photocurrent yield (a stronger than linear increase in the photocurrent with increasing illumination, and an accompanying increase in the initial response rate of the photocurrent). The idea of the exciton mechanism of photoexcitation that was advanced in this context eventually became firmly entrenched in semiconductor physics. Special note should be taken of a study of the relation between the work function and the subsurface conductivity of the semiconductor, since it laid the foundation for systematic study of the physics of surface phenomena in semiconductors. One of the purely applied studies was the development and production use of a technology for the FÉSS-V silver sulfide photocells that had been discovered in the 1930's by Bernadskiĭ at Kiev. In this context, Lashkarev created a theory of photocells that contained a layer with low conductivity.

The development of bipolar diffusion conceptions formed the basis for successful work done in 1951—1956 on the development of germanium diodes and transistors. The Semiconductors Division of the Ukrainian Academy of Sciences Institute of Physics developed a technology for the crystalization, purification, and doping of Ge samples and methods for study of their volume and surface properties. Here Lashkarev theoretically predicted the bulk photo-emf in germanium and observed it in experiments. Simultaneously, he was acting as head and coordinator of the entire range of studies of germanium, involving himself in all details of the various study projects, and instructing junior staff members in the design and workup of experiments and teaching them how to check their work and make certain that the measurement was yielding the necessary information.

The successful completion of this major group of projects revealed the growing strength and expertise of the team headed by Lashkarev and naturally raised the question of making it a separate Institute of Semiconductors of the Ukrainian Academy of Sciences. This institute was founded in 1960 at Kiev. It also absorbed the theoretical division, headed by Academician of the Ukrainian Academy of Sciences S. I. Pekar, from the Ukrainian Academy's Institute of Physics. The institute also acquired new personnel, including students of the Kiev State University Semiconductors Department, which had been created by Lashkarev and which he had headed for some time. The subject-matter range of the institute was expanded substantially. For example, interest in $A^{II}B^{VI}$ compounds and photoelectric phenomena was revived. Under Lashkarev's supervision and with his participation, the institute developed a phenomenological theory of photoconductivity in semiconductors containing several types of recombination and trapping centers, developed new stationary and especially kinetic methods for study of such objects, and used them to obtain a great deal of new information on photoconductivity and luminescence mechanisms in $A^{II}B^{VI}$ and other types of semiconductors. For about 10 years, Lashkarev headed the Ukrainian Academy of Sciences Institute of Semiconductors while simultaneously serving as Editor-in-Chief of the "Ukrainskiĭ Fizicheskiĭ Zhurnal" (Ukrainian Physics Journal), which was founded on his initiative in 1956. However, his health failed, necessitating his gradual withdrawal from active scientific work.

Ultimately, his grave and long illness forced Lashkarev to give up supervision of the Institute and editing of the physics journal. However, he continued to take part in studies of photoelectric phenomena and remained in his job as consultant professor to the day of his death, which came during one of a series of recurring crises brought on by cardiac insufficiency.

Everyone who was fortunate enough to know this unusual man intimately was strongly affected by his personality, by his subtle understanding of physics and his devotion to it, perhaps to an even greater degree than by his direct scientific recommendations and direct aid rendered in work. The personal impression left by conversations with Lashkarev was so strong that it might appear that this exceptionally talented man had accomplished less than he might have in the area of concrete results. But the seeds that he sowed flourished in the work of his colleagues, students, and other physicists, and others did that which he had not time to do himself.

We shall retain glowing memories of Vadim Evgen'evich Lashkarev for a long time. He will be remembered for his pioneering work, much of which has become classical; he will forever remain in the hearts of the many students and colleagues who loved him; the Semiconductors Institute of the Ukrainian Academy of Sciences and the Semiconductors Department of Kiev State University, which Lashkarev created and then headed for many years, will remain as monuments to him.

Translated by R. W. Bowers