Boris Tov'evich Geĭlikman (obituary)

V. G. Vaks, V. K. Voĭtovetskiĭ, V. M. Galitskiĭ, V. L. Ginzburg, I. I. Gurevich, V. Z. Kresin, A. B. Migdal, I. L. Fabelinskiĭ, and N. A. Chernoplekov

Usp. Fiz. Nauk. 123, 711–713 (December 1977)

PACS numbers: 01.60.+q

Professor Boris Tov'evich Geilikman, doctor of physical-mathematical sciences, and a prominent Soviet theoretical physicist died suddenly on May 23, 1977. We have lost a remarkable individual and a prominent scientist whose work in different fields of physics is well known both in the USSR and abroad. Many of his papers are fundamental seminal investigations and they have made an important contribution to the development of physical science.

B. T. Geĭlikman was born in 1914 in Moscow. His father was a well known historian, in later years a professor of the history of the peoples of the USSR; his mother was a teacher of Russian literature. The exceptionally richly endowed spiritual nature of Boris Tov'evich which greatly attracted people to him throughout his whole life was formed already in childhood.

On completing seven years of school and on graduating from the Electrotechnical Technicum Boris Tov'evich worked as a technician in a factory, and in 1932 he entered the Physics faculty of the Moscow State University. On graduating from the University and after defending in 1940 his candidate's thesis he worked in the pedagogical institutes in Ĭoshkar-Ola and Saratov. In 1944 Boris Tov'evich was accepted as a candidate for the doctorate at the P. N. Lebedev Institute of the Academy of Sciences, and from 1946 and until the last days of his life he worked at the I. V. Kurchatov Atomic Energy Institute.

Having joined the A.E.I. already as an experienced physicist, Boris Tov'evich took an active part in developing atomic science and technology of his fatherland. He made essential contributions to the solution of a number of pressing problems of nuclear physics and technology. This work of Boris Tov'evich Geĭlikman was recognized by government awards. B. T. Geĭlikman's scientific interests were quite varied. The breadth of his physical horizon, his erudition and the clarity of his thought enabled him to enter rapidly into different, often quite distant from each other, fields of physics and to obtain significant results in each of them. Here we shall note only the most important of his papers.

Theory of superconductivity. In 1958–59 Boris Tov'evich, on the basis of the microscopic theory of superconductivity then being formulated, developed a theory of kinetic phenomena in superconductors. He formulated a theory of electron and lattice heat conductivity and a theory of sound damping. In so doing he succeeded in explaining the whole set of corresponding experimental data and in describing the principal laws that distinguish transport processes in superconductors from the case of normal metals. These papers have been incorporated into monographs on the basic principles of the theory of superconductivity.

BORIS TOV'EVICH GEĬLIKMAN
(1914–1977)

In 1965–75 Boris Tov'evich with collaborators developed a theory of so-called anomalous superconductors—superconductors with a strong electron-phonon coupling. The usual theory of superconductivity due to Bardeen-Cooper-Schrieffer (BCS) developed in the approximation of weak electron-phonon interaction was unable to explain the properties of superconductors. Thus, for example, the magnitude of the discontinuity in the heat conductivity at the transition point exceeds by a factor of almost two the value obtained from the BCS theory. It also was not possible to explain the magnitude and the temperature dependence of the energy gap and the electromagnetic, kinetic and other properties. Boris Tov'evich and his collaborators developed a method of making calculations in the case of an appreciable interaction of the electrons with the lattice, and this enabled them to describe completely all the properties of the anomalous superconductors and thereby to eliminate one of the important contradictions of the microscopic theory of superconductivity.

One of the most important problems in the physics of superconductivity is, as is well known, the problem of the increase in the transition temperature. In 1965–67 B. T. Geĭlikman proposed and investigated in detail a new so-called electron mechanism of superconductivity in three-dimensional systems, the realization of which could significantly increase the critical temperature. The special features of the manifestation of this mechanism in metallic alloys and semimetals with overlapping

 0038-5670/77/2012-1035$01.10

bands, in multivalley semiconductors, in systems with impurities, etc., were investigated in detail. In each case factors were indicated responsible for the manifestation of the aforementioned mechanism of superconductivity.

The theory of superfluidity of He^4 and He^3. Here one should note first of all the well known paper published in 1959 on the shape of vortexes and on the critical velocities for the flow of He II along capillaries in which the results due to Onsager and Feynman were generalized to the important case of flow in long capillaries. In 1968 B. T. Geĭlikman showed that near the transition point T_c the critical velocity of flow of He II along capillaries falls off as a definite power of the difference $T_c - T$. This enabled him to explain a number of experimental results which appeared to be unexpected.

Finally, in recent years in connection with the discovery of superfluidity of He^3 Boris Tov'evich and his collaborators carried out important investigations of the kinetic properties of this new quantum fluid which involved both an explanation of a number observed regularities, and also interesting predictions.

General and specific problems in solid state theory. A classical investigation in the general theory of metals is the series of papers by Boris Tov'evich published in 1970–1975 on the foundation and subsequent formulation of the adiabatic approximation in metals. These problems are associated with questions of the stability of the crystal lattice and of the maximum possible value of the constant describing the electron-phonon interaction. The well-known Fröhlich-Bloch model successfully utilized in the theory of conductivity led to certain contradictions in the investigations of the nature and the magnitude of the electron-phonon interaction. The analysis carried out by Boris Tov'evich enabled him to introduce clarity into these problems and to develop for their investigation a consistent perturbation theory in the form of a special diagram technique. This method also enabled him to obtain a number of specific results. For example, he predicted and quantitatively described a new phenomenon, the Raman scattering of sound in metals.

Among many specific problems in solid state physics considered by B. T. Geĭlikman it is necessary to note the extensive series of papers on the low temperature kinetics of metals which led to the understanding of a whole series of unusual relationships observed experimentally. We also note the series of investigations carried out in recent years on the properties of quantum crystals which includes a discussion of the possibility of obtaining superfluid hydrogen, and also the superfluidity of impuritons.

Nuclear physics. The papers on nuclear physics constitute a notable part of the creative heritage of Boris Tov'evich. He made an important contribution to the theory of direct nuclear reactions. In 1955 Boris Tov'evich formulated the problem of direct elastic and inelastic scattering of fast particles by nuclei accompanied by the excitation of collective nuclear levels and he introduced an elegant method of solving this problem within the framework of the adiabatic approximation. These ideas were then developed in a series of papers. At present these methods are widely used in making calculations of direct nuclear reactions.

Various complex problems of the physics of nuclear fission attracted considerable attention on the part of Boris Tov'evich. Already in the fifties it became clear to Boris Tov'evich that the classical picture of the fission of a charged drop cannot explain the basic peculiarities and characteristics of this process. Therefore he devoted a considerable fraction of his investigations to making estimates of different quantum and shell effects in fission utilizing different modes. As a result of these papers, and also of the investigations of other authors, concepts concerning the mechanism of fission were developed which are now accepted. The basic characteristics of the process of fission (distribution of the masses of the fragments, of their kinetic energies, their excitation energies etc.) find their explanation within the framework of a single model which takes into account the shell and the quantum effects. Papers of Boris Tov'evich were devoted to the development and investigation of this model right up to the last days of his life.

Moreover, Boris Tov'evich successfully investigated a number of specific problems of nuclear fission. Thus, in 1964 he developed a quasiclassical theory of ternary fission which gave a good explanation of the angular and energy distributions of α-particles emerging in this process. In the early sixties he predicted a sharp increase in the neutron yield in the case of symmetric fission which was then discovered in experiments initiated as a result of this prediction.

His tremendous efficiency, the breadth of his interests, his enthusiasm in his work marked Boris Tov'evich until the very end of his life. Thus, during the last five years he published approximately thirty scientific articles on the subjects of low temperature physics and of nuclear physics, and of general problems of the theory of metals. We shall many times in future turn to much in his scientific heritage.

Boris Tov'evich combined an intense research activity with scientific activity on topics of public interest. He was an active member of the commission on superconductivity appointed by the Praesidium of Academy of Sciences of the USSR, and he conducted a number of scientific seminars. From 1946 until 1960 Boris Tov'evich was engaged in pedagogic work associated with the chair of theoretical physics in the Moscow Oblast' Pedagogical Institute, and from 1960 and until the end of his life in the Moscow Physico-technical Institute. He supervised the education of tens of pupils, doctors and candidates of science, many of whom have themselves become well-known scientists. The monographs of Boris Tov'evich entitled "Statistical Theory of Phase Transformations" (1954) and "Kinetic and Nonstationary Phenomena in Superconductors" (1972) have become widely known and have been translated abroad.

Boris Tov'evich was a man of an exceptionally high level of general culture. His deep and multifaceted knowledge in the domains of literature and art frequently astonished professional critics and art specialists. Interaction with him was both useful and interesting for persons of the most varied fields of specialization.

The spiritual beauty of this man was remarkable. One rarely meets individuals combining to such a high degree the best human qualities—unusual benevolence and sensitivity, selflessness and modesty, the highest degree of culture and at the same time fortitude, firmness and adherence to principle in important matters. People were always drawn to him, he had very many friends.

The pure image of Boris Tov'evich Geĭlikman will be forever preserved in the memory of those who knew him.

Translated by G. Volkoff

ERRATA

Erratum: Possible experiments with very high energy cosmic neutrinos: the Dumand Project [Sov. Phys. Usp. 20, 361 (May 1977)]

V. S. Berezinskiĭ and G. T. Zatsepin

Institute of Nuclear Studies, USSR Academy of Sciences

PACS numbers: 13.15.+g, 12.30.Ez, 94.40.Te

On p. 361, right-hand column, 15th line from the bottom. The sentence "The possibility of neutrino generation...... important astronomical information". should read: "The existence of high-energy neutrinos of extraterrestrial origin was first noted by M. A. Markov (Proc. of 1960 Annual Internat. Conf. on High Energy Physics, Rochester, 578, 1960) and by K. Greisen (Proc. Internat. Conf. on Instrumentation for High Energy Physics, Vol. 1, 210, 1960) back in 1960. In 1963, V. L. Ginzburg and S. I. Syrovatskii,[4] in a discussion of neutrino generation by cosmic rays, pointed out that underground neutrino experiments could yield important astronomical information."