Isaak Markovich Khalatnikov (on his seventieth birthday)

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On October 17, 1989, the outstanding Soviet theoretical physicist, Academician Isaak Markovich Khalatnikov, celebrated his seventieth birthday. The scientific activity of I. M. Khalatnikov has been diverse, encompassing many fields of contemporary theoretical physics, from the theory of superfluidity to quantum field theory and general relativity.

Extensive studies of the theory of quantum fluids occupy a special place in the works of I. M. Khalatnikov. Khalatnikov continued studies of superfluidity begun by L. D. Landau, and for many years Khalatnikov was the leading theoretician in this field. He created the theory of relaxation processes in liquid helium, examined various hydrodynamic phenomena in liquid helium (including shock waves), synthesized the hydrodynamics and kinetics of solutions of the isotopes ^{3}He and ^{4}He, and provided a theory for the temperature jump at the boundary between liquid helium and a solid body (the Kapitsa jump). He formulated a general phenomenological theory of mixtures of Fermi- and Bose-liquids. All these works were always conducted in close association with experiment, and undoubtedly had the strongest stimulating effect on the development of worldwide studies of superfluidity.

A great number of I. M. Khalatnikov's works were also devoted to the theory of quantum liquids of another type, Fermi-liquids. He studied the kinetic phenomena in Fermi-liquids, constructed a theory of light scattering in them, and developed a microscopic theory based on the model of solid spheres. Khalatnikov formulated canonical methods (Lagrangian and Hamiltonian) in the hydrodynamics of quantum liquids. The Hamiltonian formalism was found to be a powerful means of studying nonlinear hydrodynamic processes.

Khalatnikov's work (with L. D. Landau) on the theory of sound absorption near the points of second-order phase transition became a foundation for the later development of the dynamic theory of phase transitions.

Khalatnikov, L. D. Landau, and A. A. Abrikosov studied quantum electrodynamics, and were the first to pose and solve the problem of the asymptotic behavior of basic quantities in field theory (the Green's functions of the photon and electron) at high momenta. In this work they also developed an original method of summing an infinite sequence of Feynman diagrams, which later found extensive application in statistical physics, as well as in the theory of elementary particles. They were the first to formulate methods of functional integration for Fermi fields, and these methods have become an everyday tool of theoretical research.

In particular, one should consider I. M. Khalatnikov's studies in cosmology and relativistic astrophysics. Work over many years (begun with E. M. Lifshits) led to the discovery in relativistic cosmological models of a new type of oscillatory behavior in the vicinity of a temporal singularity. It was found that this type of singularity has a very general character, and it formed the basis of a general cosmological solution of the Einstein equations with a temporal singularity. These results found widespread application in astrophysics to understand the behavior of the initial stages of development of the universe. Finally, an exact solution was found to the problem of stochastic properties of the evolution of homogeneous models of the universe (a development of earlier joint work with E. M. Lifshits and I. M. Lifshits). In essence, this is the first case of an exact solution of a stochastic mode problem. This series of publications touches on the development of original qualitative methods of studying the evolution of the universe with dissipative processes being taken into account.

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Without giving a full survey of all the works of I. M. Khalatnikov, we nevertheless mention his series of works in relativistic hydrodynamics (which were later applied to the theory of multiple generation of particles) and his virtuoso work on mathematical methods for three-dimensional quasicrystalline scattering in quantum mechanics.

For a number of years I. M. Khalatnikov participated with great energy and initiative in the solution of the most

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important applied problems in special State assignments. This activity, for which he was awarded the State Prize of the Soviet Union, was for him, among other things, a stimulus to develop new effective methods to solve differential equations numerically. In these studies he was the first to pose and solve the problem of the stability of difference schemes for equations of hydrodynamics and thermal conductivity.

His intense scientific work did not prevent I. M. Khalatnikov from simultaneously pursuing pedagogical and scientific organizational activities. He is a professor of the Moscow Physico-Technical Institute. Of students under his direct supervision, six have defended their doctoral dissertations, and twelve have defended their candidate's dissertation.

I. M. Khalatnikov was the initiator of the creation of the USSR Academy of Science Institute of Theoretical Physics, which was named for L. D. Landau. He headed this institute as its director, and in a relatively short time gathered a strong group of theoreticians and created a center which was fully equipped to play a prominent role in the further development of Soviet theoretical physics.

Isaak Markovich is, as usual, vigorous and full of creative plans. In recent years he and his students have done much work on the hydrodynamics of a ^{3}He superfluid, a theory of dynamic fluctuations, and cosmological problems. However, the scientific interests of I. M. Khalatnikov are not limited to these subjects; he is always fully aware of the latest achievements in theoretical physics, and actively supports work on the leading edge of science.

Translated by C. Gallant