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Personalia

ÉLEVTER LUARSABOVICH ANDRONIKASHVILI

(On his Sixtieth Birthday)

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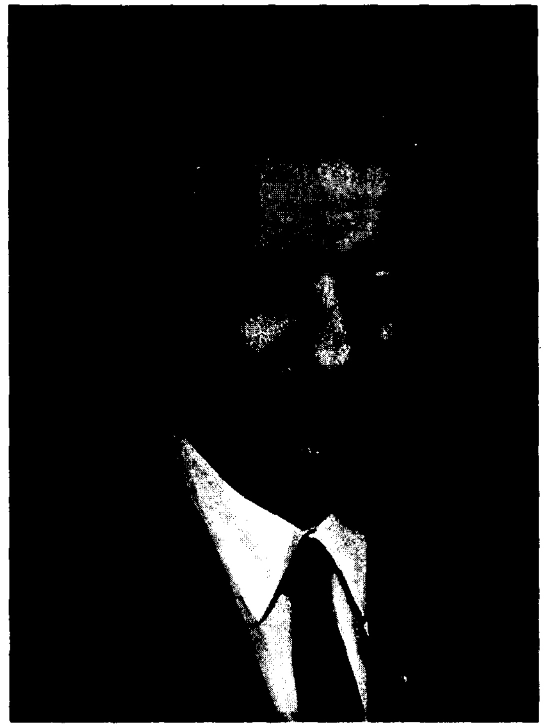
DECEMBER 25, 1970 marked the 60th birthday of the Academician of the Georgian Academy of Science, the distinguished Soviet physicist Élevter Luarsabovich Andronikashvili.



Andronikashvili was graduated from the Leningrad Polytechnic Institute, where the close relations between pupils and teachers brought him into contact with Ya. I. Frenkel, M. P. Bronshteĭn, V. K. Frederiks, L. D. Landau, and others. Already in his student years Andronikashvili took part in the research work which had begun with the study of solid-state physics in 1930 in the Leningrad Physico-technical Institute in the Laboratory of Academician A. F. Ioffe.

Upon his graduation from the Leningrad Polytechnic Institute in 1932, Andronikashvili was assigned to work in the Central Aerohydrodynamics Institute (TsAGI), from which he transferred in 1933 to the All-union Institute of Aviation Materials (VIAM) which was split-off from TsAGI. The studies which Andronikashvili carried out during this period dealt with the theory of phase transitions in condensed systems. His candidate's dissertation, which he defended in 1935 when he was already a lecturer in the Physico-mathematical department of Tbilisi State University, dealt with these questions. Until 1940 Andronikashvili was occupied with the organization of the educational process and with teaching in this department.

In January 1940 Andronikashvili began to work in the Institute of Physics Problems of the U.S.S.R. Academy of Science where, under the influence of the scientific ideas under development at that time by Academician P. L. Kapitza, he linked his scientific work with research in the area of the low-temperature physics.

In 1945 Andronikashvili studied for his doctor's degree in the Institute of Physics Problems and began a series of experiments on the superfluidity of liquid helium. This research was a continuation, on the one hand, of the renowned research of P. L. Kapitza, but on the other initiated research in the field of quantum hydrodynamics. Together with the discovery of second sound by V. P. Peshkov, these tests were the first experimental confirmations of the theory of superfluidity originated by Academician L. D. Landau.

Andronikashvili's research in this field received wide recognition from the world's scientific community. In it he demonstrated his talent and skill as an experimenter and established an ingenious and refined method which has found a firm place in science under the name of the "Andronikashvili experiment."

The results Andronikashvili achieved seemed paradoxical from the standpoint of classical thermodynamics and hydrodynamics when he proved that beginning with 2.17°K (and lower) liquid helium can be static and in motion simultaneously. This method was used by Andronikashvili as a basis for his investigations and was repeatedly applied in many laboratories of the world. The "Andronikashvili stack" was used for research on critical phenomena during oscillations of solid in helium II (in Cambridge (England) and in Tbilisi), for the measurement of the density of normal components in solutions (in Pasadena (USA) and in Khar'kov), for the detection and investigation of a persistent stream of superfluid liquid in an immobile vessel (in England and in the USA), for research on rotating helium (in Khar'kov, Tbilisi, and Cambridge), and also in many other experiments conducted in the low-temperature centers of the world. The methods and results of this research have become classic and have been included in all the textbooks and monographs on the physics of low temperatures.

During the time he was working in the Institute of Physics Problems, Andronikashvili conducted outstanding experiments; he determined the temperature dependence of the viscosity of the normal components of liquid helium II, studied the relative motion of the normal and superfluid components in capillaries on the basis of Landau's theory, and conducted experiments on the rotation of superfluid helium at high speeds where, incidentally, a considerable divergence was found between experiment and Landau's theory, subsequently explained by the Onsager-Feynman quantized-vortices hypothesis.

While engaged in these studies, Andronikashvili became close friends with Landau, and their joint work was very fruitful. It played and continues to play an important role in the development of Andronikashvili's research and in that of his students.

Only $3^1/_2$ years were needed to complete the series of these important experiments, and in 1948 Andronikashvili defended his doctor's dissertation "Research on the Hydrodynamics of Superfluidity." Later in 1952 he was honored with the U.S.S.R. State Prize for his experiments on liquid helium.

Helium is the sole liquid that does not freeze even at absolute zero. It is the only liquid whose properties are explained on the basis of the laws of quantum mechanics. The significance of the Soviet theoretical and experimental studies of superfluidity cannot be overestimated. The success in the field of superfluidity served as a powerful stimulus for the development in many areas of solid-state physics and above all in the theory of superconductivity. This is why the work done some 25 years ago by Andronikashvili and other scientists within the framework of Landau's theory continues to be relevant at present.

In the fall of 1948 Andronikashvili was charged with establishing a laboratory base for the recently organized physico-technical department of the Tbilisi State University and with establishing a base for research in the field of cosmic-ray physics in Georgia. On his initiative, a physics institute was transferred in 1950 to the Georgian Academy of Sciences from the then-existing Institute of Physics and Geophysics. During this period a laboratory was constructed under Andronikashvili's direction, with the aid of Georgian physicists, for the study of cosmic rays on the slopes of Mt. El'brus at an altitude of 4000 meters above sea level. A series of important experiments on the physics of elementary particles was conducted in this laboratory. Simultaneously, underground laboratories were established in Tbilisi for the study of the penetrating component of extensive air showers. Studies were made of the theory of the interaction of elementary particles, and new methods were designed for research on the interaction of high-energy particles with matter. The research in this area led in subsequent years to outstanding success, foremost among which were streamer spark chambers, which possess unique characteristics and are widely used in all outstanding scientific centers of the world where research is conducted on elementary-particle physics. The work done by Andronikashvili's pupils received recognition in 1970 with the Lenin prize.

Under Andronikashvili's guidance, Georgian physicists invented the widely known calorimeter which is used in the study of the muonic component of extensive air showers and in the study of the interaction of high-energy particles. In addition, they created discharging-condensation chambers, which considerably extended the capabilities of experiments in physics, etc.

Among Andronikashvili's studies in this area, mention should be made of his research on the spatial distribution of the penetrating component of extensive air showers, which he carried out in conjunction with his pupils and which received wide recognition. The fundamental importance of the work consists in the fact that it demonstrated for the first time the small value of the transverse momentum of particles which carry enormous energy.

The work of the Georgian physicists on cosmic rays progressed further in a high-mountain station whose construction was begun in 1957 on the Tskhra-Tskaro pass. Under the direction of Andronikashvili and his pupils, this station was equipped with unique equipment which made it one of the most powerful stations in the world, making it possible to study the interaction of particles of energy exceeding by one order of magnitude that of the particles obtained from the most powerful accelerators.

Beginning in 1956 Andronikashvili put a great deal of effort into the creation of a department of physical cybernetics, which was split-off in 1960 from the Institute of Physics to become the independent Institute of Cybernetics of the Georgian Academy of Sciences.

In 1957 on Andronikashvili's initiative the construction was begun in Tbilisi of a research atomic reactor which was put into action in 1959. Upon completion of this large scientific object, Georgian physics acquired a base for further development.

A team of physicists lead by Andronikashvili succeeded in organizing research on the reactor almost from the first day of its operation. Important experiments were carried out in the field of the radiation of physics of solids, the chemistry of hot atoms, and the physical principles of powerful gamma-radiation sources.

This area of work by Andronikashvili and his pupils is of unquestionable practical interest. The new type of powerful gamma-radiation source became known under the name of indium-gallium radiation loop. The first setup of this type in the world was set up in 1960 under the leadership of Andronikashvili by the crew of the Tbilisi reactor.

Andronikashvili's scientific activity in this area was contiguous to the problems of the physics and techniques of atomic reactors. He proposed the basic design of the first radiation loop and the principles of construction of its specific units. His research and that of his pupils on the creation of this radiation loop played a large role in the further development of radiation-loop design in the U.S.S.R.

Andronikashvili contributed greatly to the technique of experimentation on nuclear reactors in yet another way: he created the first low-temperature loop in the U.S.S.R., with a fully original design which permits refrigerant to be introduced into the active zone of the reactor and in this way to irradiate various substances at low temperatures.

Andronikashvili's pupils subsequently developed this research trend and created a large number of unique remotely-controlled internal reactor devices, which allowed them to perform mechanical tests and physico-chemical measurements directly under irradiation in the active zone of the reactor at low temperatures.

These studies made the Tbilisi reactor unique and established its well-deserved reputation both here and abroad.

The atomic reactor created the necessary premises for research on radiation physics of solids.

Assuming a diffusion character for the formation of dislocation by "condensation" of point defects produced by irradiation, Andronikashvili set up a series of physical and computer experiments with his co-workers, which fully confirmed the validity of such a concept.

Subsequently Andronikashvili and his co-workers devoted a great deal of attention to the study of the dislocation structure in crystals, to the collective movement of dislocations (linear violations of the regular arrangement of the atoms), to the oscillations of line defects with point defects, to pinning linear defects on boundaries and on volume defects. These experiments had important practical consequences—the simultaneous action of low temperature and of radiation on a prestressed crystal leads in some cases to simultaneous increase, by 2—3 times, of both the strength and the plastic characteristics of a substance.

The same questions were fundamental in the study of the motion of liquid helium. The Onsager-Feynman vortices, with the motion of the helium around their axes subject to the Bohr quantum postulate (the spatial quantization scales increase in this case by 10^7—10^{10} times), are nothing but linear disturbances of the density of the superfluid component.

After he had organized the third low-temperature physics laboratory in the Soviet Union at the Tbilisi State University in 1956 (in 1960 a laboratory of the same type was organized in the Institute of Physics of the Georgian Academy of Sciences, and in 1962-one affiliated with the atomic reactor), Andronikashvili resumed his studies of quantum hydrodynamics, and in conjunction with his pupils created a model of wave motion of rotating helium pierced by linear vortices that are parallel to the axis of rotation. He showed that owing to such vortices superfluid helium possesses a torsion modulus and the characteristics of the wave and dissipation processes which take place in it depend on the direction in which they are studied. In his research with his co-workers, Andronikashvili uncovered processes of formation and the disintegration of vortices in rotating helium. Collective vortical motions were studied as well as the fluctuation of vortex lattices and the pinning of vortices to surfaces. At the present time many of these ideas are beginning to penetrate even into astrophysics.

Andronikashvili managed to apply many of the laws discovered in these experiments to the collective characteristics of Abrikosov fluxoids in type II superconductors in the mixed state. It should be noted that the Abrikosov fluxoids are also linear disturbances (in this case—of the magnetic flux density), and alongside the Onsager-Feynman vortices they serve as one example of the macroscopic manifestation of the laws of quantum mechanics. In the case of superconductors, Andronikashvili studied in detail the fluctuation of fluxoid lattices, the pinning of fluxoids on dislocations, and the effect of reactor irradiation on the pinning power.

In recent years Andronikashvili has been the head of a large group of scientists working in the field of the physics of macromolecules and cryobiophysics. Under his direction, his pupils created a series of unique scanning differential microcalorimeters of the adiabatic type, with the help of which they succeeded in measuring for the first time the innermolecular melting heats of such bioactive matter as DNA, RNA, and fibrillar and globular proteins. The method developed by the Georgian physicists received wide recognition in the USSR as well as abroad.

Andronikashvili is the author of more than 120 scientific works. He trained a large group of highly skilled scientists, many of whom are widely known to the world scientific community through their own distinguished work.

In 1950 Andronikashvili was chosen as a Corresponding Member and in 1956 as a full member of the Georgian Academy of Sciences. In 1960 he was awarded the title of Honored Man of Science of the Georgian SSR. His work was recognized with the orders and medals of the Soviet Union.

Alongside his scientific and teaching work, Andronikashvili actively participates in the civic life of the country. He was elected a deputy of the Supreme Soviet of the Georgian SSR for 2 sessions and has repeatedly been elected a deputy of the Tbilisi town council.

Translated by A. Barker