Il'ya Mikhaĭlovich Frank (on his eightieth birthday)

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The mark of an outstanding scientist becomes apparent to all once his name becomes inseparably identified with groundbreaking research, with achievements that founded new fields and opened up new directions for other scientists to pursue. The scientific work of Il'ya Mikhaĭlovich Frank certainly satisfies this criterion.

Il'ya Mikhaĭlovich was born on October 23, 1908 (October 10 by the prerevolutionary calendar) in Petersburg. In 1926 he enrolled at Moscow University. After graduating from university in 1930, Il'ya Mikhaĭlovich worked for several years in the laboratory of A. N. Terenin at the State Optical Institute (Leningrad), where he employed optical methods to study photochemical reactions. His work in this field was characterized by elegant and original technique, as well as exhaustive analysis of experimental data. On the basis of this research I. M. Frank was awarded the Doctor of Sciences degree at the age of twenty six.

In 1934 Il'ya Mikhaĭlovich moved to FIAN—the P. N. Lebedev Physics Institute headed by S. I. Vavilov. Realizing the importance of the then nascent field of nuclear physics S. I. Vavilov suggested to a number of young scientists, including Il'ya Mikhaĭlovich, to switch to this new field. Il'ya Mikhaĭlovich, an optics specialist by inclination, training and experience, was difficult to persuade, but in the end he agreed to change his research interests.

At approximately the same time, under the guidance of S. I. Vavilov, P. A. Cherenkov began his famous research into the luminescence of liquids caused by irradiation with radium γ-rays (at the time a gram of radium was about the only major asset of FIAN). As we know P. A. Cherenkov discovered that the passage of γ-rays caused all pure liquids to radiate weak light. A series of independent experiments demonstrated convincingly that this radiation had new and unusual properties. S. I. Vavilov proved that it was emitted by electrons knocked out by γ-rays and hence differed from luminescence. The nature of this phenomenon remained unexplained until 1937, when I. E. Tamm and I. M. Frank published a complete explanation of the "Vavilov-Cherenkov radiation" in a paper destined to become a classic.

At the time, the mechanism proposed by I. E. Tamm and I. M. Frank appeared paradoxical in the extreme. In those days other scientists were hypnotized by two concepts from the theory of relativity usually stated in ubiquitous but imprecise terms: first, an electron cannot propagate faster than light; second, a charge in uniform motion does not radiate. A psychological barrier—difficult to appreciate today—had to be surmounted before one saw that these notions, appropriate to electron motion in vacuum, did not apply to motion in refractive media. Il'ya Mikhaĭlovich closely followed Cherenkov's experiments and correctly understood their significance. Here his characteristic independence of thought, capacity for profound physical analysis, attention to experimental detail, perseverance, and ability to extract the central features of a phenomenon came to the fore.

IL'YA MIKHAĬLOVICH FRANK

The importance of this discovery hardly needs elaboration. It opened a new chapter in physics, which could be labeled the optics or electrodynamics of relativistically moving sources in refractive media. It is not surprising that for this discovery S. I. Vavilov, I. E. Tamm, I. M. Frank, and P. A. Cherenkov were awarded the USSR State Prize in 1946. In 1958, I. E. Tamm, I. M. Frank, and P. A. Cherenkov also received the Nobel Prize in physics for this same discovery (S. I. Vavilov was no longer alive). But even without its high official recognition every physicist realizes the importance of this advance in scientific knowledge.

Il'ya Mikhaĭlovich subsequently embarked on the study of a different phenomenon, which contained a number of interesting problems. Together with V. L. Ginzburg, I. M. Frank analyzed the field of a uniformly moving charge which crosses a flat interface between two media with differ-

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ent refractive indexes. The authors discovered that the charge must emit electromagnetic radiation, which they termed transition radiation. This phenomenon was experimentally observed only in the late 1950s, ten years after it was predicted by Frank and Ginzburg.

In the following years this phenomenon attracted ever greater interest. When its numerous manifestations were analyzed its importance became altogether comparable to the Vavilov-Cherenkov effect. It turned out that transition radiation could serve as an effective means of determining the optical properties of inhomogeneous media and their surfaces, as well as the parameters of radiating particles, for example the energy of a moving charge.

Our understanding of the main properties of radiation in inhomogeneous media, in particular layered media, owes much to I. M. Frank, whose publications provided many simple and general explanations.

All the above papers cannot be truly identified with nuclear physics, although in that period Il'ya Mikhaĭlovich also pursued some nuclear research. I. M. Frank turned his attention to nuclear physics proper during the war and, from 1946 onward, he became head of the newly founded Laboratory of Atomic Nuclei at the FIAN. In those years the scientific questions associated with the atomic problem were of overriding importance. One of the crucial questions in the field, addressed by Il'ya Mikhaĭlovich and his co-workers, concerned the precise determination of the parameters of uranium-graphite lattices and of the physical details of neutron transport therein. A new idea, due to Il'ya Mikhailovich, proposed the use of pulsed neutron sources. The experiments carried out at FIAN in 1954 demonstrated the great effectiveness of this method and led to the discovery of a number of interesting features.

Another research program focused on the experimental study of neutron-emitting reactions in light nuclei, the interaction of fast neutrons with tritium, lithium and uranium atoms, and fission.

The above experiments required the development of a number of new and subtle experimental methods. The achievements of the research effort headed by Il'ya Mikhaĭlovich were characterized by great precision, thoroughness and completeness. He also succeeded in imparting this style to his students, who went on to develop further the concepts laid down by I. M. Frank.

When the Joint Institute for Nuclear Research (JINR) was founded in Dubna in 1956, it was decided to create a Neutron Physics Laboratory (NPL) and construct a pulsed fast-neutron reactor (IBR). Il'ya Mikhaĭlovich was placed in charge of this laboratory and thenceforth, for over thirty years without interruption, he has served as the head of a large international collective, currently numbering over six hundred researchers. Much research into pulsed neutron sources took place at the NPL over the years. For this research I. M. Frank and his collective were awarded the USSR State Prize.

In recent years a new and qualitatively different pulsed reactor IBR-2 was designed and built in Dubna. This reactor produces a record flux of pulsed neutrons and has become today one of the most productive and universal machines in the world for study of condensed matter using neutrons.

Over the past thirty years the Neutron Physics Laboratory has become one of the greatest centers of neutron research in the world. The scope of the research at the NPL is extremely broad, encompassing nuclear physics, elementary particle research, condensed matter, and applied research. A major advance was the discovery and investigation of ultracold neutrons, which opened up a new direction in neutron physics. The worldwide scientific community greeted with great interest the discovery of the nonconservation of spatial parity in neutron p-resonances, wherein the difference in the cross-sections of neutrons of opposite helicity reaches 15%—a very large weak interaction effect in nuclear physics.

Il'ya Mikhaĭlovich kept abreast of all these research projects. He personally participated in some; others benefited from his discussions, where Il'ya Mikhaĭlovich again demonstrated his knack for discerning new aspects and tendencies in seemingly familiar subjects.

Il'ya Mikhaĭlovich also devoted much effort to scientific-organizational activity. Even before the war he served as the scientific secretary of the Committee on Atomic Nuclei at the USSR Academy of Sciences. Currently he is the chairman of the Scientific Council of the USSR Academy of Sciences on the Physics of Atomic Nuclei.

Over the years the pedagogic activity of Il'ya Mikhailovich has been connected with Moscow University, where he served as head of department and lectured at the faculty of physics. Il'ya Mikhaĭlovich is also the permanent organizer and leader of the deservedly famous International Schools of Neutron Physics, held at JINR every four years.

The scientific accomplishments of Il'ya Mikhaĭlovich have earned him the abiding and deep respect far beyond the circle of his numerous students and friends. The authors of this article would like to add their enthusiastic best wishes to the multitude of sincere and heartfelt congratulations Il'ya Mikhaĭlovich will receive on his jubilee.

Translated by Alexander Zaslavsky