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Personalia

ISAAK KONSTANTINOVICH KIKOIN

(on his sixtieth birthday)

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ONE of the outstanding Soviet physicists, Academician Isaak Konstantinovich Kikoin, celebrates his sixtieth birthday on 28 March 1968.

Kikoin was born in 1908 in the small provincial town Zhgara, the son of a mathematics school teacher. After completing his schooling at the Pskov Agronomy School, he registered in 1925 in the physico-mechanical department of the Leningrad Polytechnic Institute, from which he was graduated in 1930. While still a second-year student, he started to work at the Leningrad Physico-technical Institute, and his first paper was published in 1929 and was devoted to a problem which remained timely to this very day, namely, the role of conduction electrons in ferromagnetism.

It must be said that Kikoin was fortunate. While quite young, he fell into a rare creative atmosphere which prevailed in the staff gathered by A. F. Ioffe, and this was precisely the time of the foundation of quantum mechanics, and particularly its applications to the physics of the condensed state. It is therefore no accident that Kikoin's very first cycle of investigations performed after graduation from the institute has become a classic. We are referring to the measurement of the Hall effect and electric conductivity of liquid metals in a magnetic field (1931–1933). This problem, which seems quite pedestrian to a contemporary physicist, was at that time of prime significance. The quantum theory of the electric conductivity of metals, developed by Sommerfeld shortly before, yielded for the Hall constant a value determined by the conduction-electron density and completely independent of the character of the arrangement of the ions. But this result was in striking contrast with the experimental data of Nernst and Drude, who observed no Hall effect at all in liquid metals. In a series of experiments of great experimental mastery, Kikoin established the existence of the Hall effect in a liquid metal and showed that the magnitude of the effect is close to that in the solid metal. He demonstrated quite clearly, in parallel, that all the preceding measurements of the galvanomagnetic phenomena in liquid metals were in error, owing to the unique convection which appears in a magnetic field. The next step was the measurement of the change in the resistance of liquid metals in a magnetic field—again a demonstration of the relatively weak effect occurring on going through the melting point. These investigations created quite a stir, and are now cited as basic.

In 1933, Kikoin started a cycle of investigations on the analysis of the influence of a magnetic field on ferroelectric effects in semiconductors. These investigations led to the discovery (jointly with M. M. Noskov) of an entirely new phenomenon, the so called photomagnetic effect. The gist of this effect is that an electric field is

reduced in a semiconductor illuminated with light and placed in a magnetic field; the direction of this field is perpendicular both to the direction of the magnetic field and to the direction of the incidence of the light.

This phenomenon is called the Kikoin-Noskov effect. In 1933–1934, Kikoin carried out an exhaustive investigation of this effect in polycrystalline semiconductors and observed a new phenomenon—the appearance, under definite conditions, of an electric field whose sign does not change when variation of the direction of the magnetic field is changed (the so called even photomagnetic effect).

The next step in Kikoin's work is connected with the investigation of the Hall effect in ferromagnets (1936–1940). Using a carefully thought-out experimental procedure, Kikoin established uniquely the existence, besides the ordinary Hall effect, also an anomalous effect, which turns out to be connected not with the magnetic field but with the magnetization of the ferromagnetic metal.

Proceeding further, Kikoin performed a very beautiful experiment with ferromagnetic metals, which enabled him to prove that the anomalous Hall effect exists in this case, too, and is due to the magnetic moment which now appears in the presence of an external magnetic field. Thus, these investigations yielded a fundamental result, according to which the vectors H and M must be regarded as independent in the analysis of kinetic phenomena. It is interesting to note that the development

of the theory of phenomena of this class at the microscopic level entailed great difficulties and was delayed by many years. Real progress was attained only in the most recent years.

All these investigations, which gained Kikoin worldwide fame, were carried out at the Leningrad Physicotechnical Institute.

In this connection, we cannot fail to note the tremendous role played by A. F. Ioffe in the development of Kikoin as a physicist, since Kikoin was one of Ioffe's most brilliant students and co-workers in those days. However, true to his idea of organizing new physics centers in different cities of the country, A. F. Ioffe developed within the Leningrad Physico-technical Institute the budding staffs of future institutes, to which he sent his best students. In 1936, when the Ural Physicotechnical Institute was organized in Sverdlovsk, Kikoin was transferred there together with his laboratory.

Among the prewar investigations carried out in the Urals, special mention should be made of the experimentally very subtle measurement of the gyromagnetic ratio in superconductors (1938–1940). It was conclusively demonstrated in these experiments for the first time that it is precisely the electron current which causes the diamagnetism of superconductors, and not other factors such as the electron spin.

From the first days of the war, Kikoin and his entire laboratory were assigned applied problems. Within a relatively short time he was able to create a new type of dc ammeter capable of measuring tens of thousands of amperes. This instrument is based on an original principle, involving the measurement of the magnetic field of the current. A state prize was awarded to Kikoin and his co-workers for this work.

In 1943, work began in the Soviet Union on the development of atomic science and technology. Kikoin was among the first few physicists with whom I. V. Kurchatov began the analysis and development of the entire group of problems. He took active part in the creation of a laboratory which subsequently was reorganized into the Atomic Energy Institute, where Kikoin has remained the last 25 years. He became the scientific director of one of the leading divisions. He demonstrated during that time the rare combination of talents of a physicist, engineer, and a director of a large staff. He took a decisive part in the physical research and performed simultaneously very effectively the scientific guidance at three levels—the laboratory, the design office, and the industry. The result was an extremely successful solution of the problem.

At present Kikoin has the opportunity of focusing an appreciable part of his attention on "academic" problems. Naturally, he has again returned to problems in solid-state physics. He has started a broad investigation of the photomagnetic effect in germanium and silicon single crystals (1956–1965). He observed the anisotropy of the even photomagnetic effect, and after some time also of the odd effect in semiconductors having cubic symmetry. This interesting phenomenon turned out to be connected with the anisotropic character of the carrier dispersion law.

Kikoin has investigated this phenomenon thoroughly, observing many far from trivial relations. In 1966 he observed for the first time the quantum oscillations of the photomagnetic effect at low temperatures.

Related to this cycle of investigations is the photopiezoelectric effect observed by him (1964), wherein an electromotive force is produced when an illuminated semiconductor is deformed.

He is continuing research on galvanomagnetic phenomena in ferromagnets. Notice should be taken of two important results of a group of his published papers (1959–1964). The first is observation of an anomalously large Hall effect in a ferromagnetic chromium-tellurium alloy consisting of nonferromagnetic components. The second is a distinct separation of the main mechanism of the interaction in the case of the anomalous Hall effect in ferromagnets. This mechanism turned out to be the interaction between the conduction electrons and excitations of the spin system.

In connection with the development of work on plasma, Kikoin proposed and realized experimentally (1963) the measurement of the local density of a deuterium plasma with the aid of a beam of tritium ions. The method is based on measuring the intensity of the neutrons produced as a result of the nuclear reaction of deuterium with tritium.

A few years ago Kikoin started to investigate a problem of importance to many-particle physics, namely the electric conductivity of an irregular system in which the average distance between atoms varies. To this end, he undertook very interesting experiments on the measurement of the electric conductivity and on the establishment of the equation of state of metallic mercury vapor in the transcritical region of temperatures and pressures. The published results (1965–1967) demonstrated the existence of a density interval in which the conductivity has a metallic character, and then, at low densities, a radical change of the very mechanism of the electron transport in such a system. Research of this class of phenomena is continuing to this day.

Almost from the first days of his independent scientific activity, Kikoin paid much attention to the training of young physicists. He began his pedagogical activity already at the physical-mechanical department of LTI and then took charge of the physics department of the Ural Polytechnic Institute for eight years. After moving to Moscow, he lectured at the recently organized Moscow Engineering-physics Institute, and is now lecturing at the Moscow State University. During all these years he taught a full course of general physics and sometimes a course of atomic physics. All know how important a good course of general physics is for the development of physical thought. Many physicists of the younger and middle generation can regard it as their very good fortune that the principles of their physical philosophy were shaped by Kikoin's lectures.

He wrote two books during those years, a monograph "Physics of Metals" (1936) jointly with Ya. G. Dorfman, which served as a textbook for several generations of physicists, and a textbook on molecular physics jointly with his brother A. K. Kikoin (1965).

I. K. Kikoin devotes much time finding ways of early training of experimental physicists, during their undergraduate years. In this connection, he completely reorganized the curriculum of the students at the Moscow State University, forcing them to do independent work in the laboratory in the very first year. Further, under-

standing perfectly well that a future scientist must develop while still on the school bench, he has been voting many efforts in recent years to the improvement of the teaching of physics in schools. Kikoin is the chairman of the commission of school programs in physics; he has organized together with A. N. Kolmogorov a physical-mathematical boarding school for elder students (not residents of Moscow) who are particularly apt in the exact sciences, and has found for many years time to deliver lectures to them. But perhaps the most important fact is that he is writing a school textbook on physics. It is very difficult to write a school text, and one can only wonder how, on entering his sixties, he finds time and strength for it.

The question of time and strength is a special one, and if we already write an article on Kikoin, we cannot fail to say a few words on how he works. Every day at 8:30, sick or healthy, Kikoin is in the laboratory. And every day at nine o'clock in the evening he is still at the institute. He still experiments daily himself.

It remains to note some formal landmarks in his biography. In 1943 he was chosen a corresponding member of the USSR Academy of Sciences, of which he became a full member in 1953. He was awarded the title of Hero of Socialist Labor, Laureate of the Lenin and State prizes, and he received five Lenin orders.

Kikoin enters his sixtieth birthday full of ideas and efforts. We wish him health and successful completion of all his creative plans.

Translated by J. G. Adashko