Isaak Mikhailovich Tsidil'kovskiĭ (on his seventieth birthday)

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On 21 May 1993 corresponding member of the Russian Academy of Sciences Isaak Mikhaĭlovich Tsidil'kovskiĭ, a prominent physicist, Head of the Semiconductor Laboratory of the Institute of Metal Physics of the Ural Branch of the Russian Academy of Sciences celebrated his seventieth birthday.

I. M. Tsidil'kovskiĭ belongs to the generation of people who bore on their shoulders all the difficulties of the Patriotic War of 1941–1945. In July of 1941 he volunteered to go to the front and went through the war as an infantryman, radio operator, and scout from the Dnepr to the Volga, and later from the Volga to the Spree. He was shell-shocked and wounded several times. After demobilization he entered in 1946 the Physics Faculty of Kiev University. It is just at that time that a rapid development of semiconductor physics began. The brilliant lectures and seminars of Professors V. E. Lashkarev and S. I. Pekar determined his choice of scientific direction.

From the very first independent steps in science made in 1953 at the Dagistan Branch of the Academy of Sciences of the USSR I. M. Tsidil'kovskiĭ found his own path. On the advice of the patriarch of Soviet physics Academician A. F. Ioffe and Professor V. P. Zhuze he began the study of thermomagnetic phenomena in semiconductors. In the course of five years he succeeded in investigating a remarkably broad class of materials. Already then Tsidil'kovskiĭ demonstrated the ability of fruitfully to combine the art of the experimenter with a deep theoretical analysis of the results of measurements.

The investigations carried out by him in the 1950's on the physics of thermomagnetic phenomena became pioneering ones and convincingly demonstrated all the advantages of these effects as a subtle method for the investigation of the mechanism of scattering of charge carriers in solids. To a great extent due to Tsidil'kovskiĭ's work this new field of the kinetics of solids was created. In those years he predicted and experimentally observed planar thermogalvanomagnetic effects which in a number of cases are a more convenient tools for research than the Hall and the Nernst–Ettingshausen effects. The monograph "Thermomagnetic phenomena in semiconductors" (1959), the first in world literature on this topic, was at once translated into English, and even today has not lost its scientific value.

Having moved in 1957 on the invitation of S. V. Vonsovskiĭ to Sverdlovsk, Tsidil'kovskiĭ organized at the Institute for the Physics of Metals of the Academy of Sciences of the USSR a laboratory which soon became the center of semiconductor research in the Urals. In the laboratory a large cycle of researches was started on quantum transport phenomena in strong magnetic fields, under conditions of high pressure, and also on optical, magneto-optical, and microwave properties of semiconductors. A particularly subtle experimental mastery was required for investigating thermomagnetic effects in strong pulsed fields with a short pulse duration. In the course of carrying out this program a magnetophonon resonance (predicted by V. L. Gurevich and Yu. A. Firsov) was discovered and thoroughly studied, and phenomena of spin-magnetophonon and combined magnetophonon Shubnikov–de Haas resonances were predicted and investigated.

Since the early 1970's I. M. Tsidil'kovskiĭ together with his students actively investigated the electron metal-dielectric transitions induced by magnetic fields, by a high pressure (up to 400 kbar), and by doping. The principal objects of the investigations were moderately doped semiconductors near the critical Mott concentration and gapless semiconductors. The long-standing problem of the negative temperature coefficient of resistance in the case of doped semiconductors was solved. With unflagging interest Tsidil'kovskiĭ worked for many years on the analysis of the situation of strong scattering of electrons when their mean free path is comparable with the interimpurity (or interatomic) distance and the standard approach of the Boltzmann equation is unsuitable. In a number of cases he succeeded in finding ways for a qualitative interpretation of the complex picture of the experimental data.

One of the most important results of Tsidil'kovskiĭ's scientific activity were the investigations that initiated a new direction in solid state physics—the physics of gapless semiconductors. Investigating in 1954–1955 the properties of mercury telluride he showed that the gap between the valence band and the conduction band is close to zero and that the edges of these bands are situated at the center of the Brillouin zone. He with collaborators discovered and studied various phase transitions in gapless semiconductors induced by pressure, magnetic field, and change in composition. Tsidil'kovskiĭ's big contribution to the investigation of gapless semiconductors was marked by the award to him and a group of other scientists of a State Prize of the USSR for 1982.

The investigations of the last decade are devoted to the problems of the Wigner crystallization of impurities in gapless semiconductors, to the anomalies of the electron properties of semimagnetic semiconductors and HTSC. He succeeded in showing that the sharp increase in the mobility of the electrons in mercury telluride doped with manganese as the temperature is lowered below 10 K is due to the formation of donor-acceptor dipoles. A theory was developed which enabled one to explain quantitatively the

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anomalous change in the mobility of the electrons in mercury selenide doped with iron or chromium, depending on the temperature and the content of the impurity. The observed anomalies of the kinetic properties, as has been established, are associated with the ordering of the ions of the transition elements due to the Coulomb interaction between them. Investigating the properties of the HTSC Tsidil'kovskiĭ showed that a number of the special features of the temperature dependences of the kinetic coefficients are associated with the presence of a narrow band near the Fermi level.

An important part of Tsidil'kovskiĭ's creative output are the books and reviews written by him: 8 monographs and 11 reviews in leading journals of our country and abroad. The monograph "Electrons and Holes in Semiconductors" (1972) which is rightly acknowledged as an encyclopedia of modern band theory was awarded the A. F. Ioffe Prize. In 1982 Pergamon Press published the monograph "Band Structure of Semiconductors." In 1991 the monograph "Electron Spectrum of Gapless Semiconductors" was published which is currently being translated into English by Springer publishers. All his monographs are widely known in the world scientific community. I. M. Tsidil'kovskiĭ has been repeatedly invited by foreign colleagues to visit abroad where he lectured on problems of semiconductor physics and HTSC. In 1988 he was honored by being named the Max Planck professor of the Humboldt University in Berlin.

Tsidil'kovskiĭ as a scientist is characterized by a clear physics intuition, a striving for a complete unbiased interpretation of intricate phenomena or those complicated by secondary details. A good example is the exhaustive interpretation given by him (Usp. Fiz. Nauk, 1975) of the classical experiments of Barnett and Tolman.

The fruitful scientific activity of I. M. Tsidil'kovskiĭ is coupled with extensive scientific-organizational work. He is the chairman of the Problem Council on electron physics of the Institute of Metal Physics, and a member of the board of editors of the journal "Physica Status Solidi." He is continually concerned about the growth of the new generation of scientific workers. Among his pupils there are 3 doctors and more than 25 candidates of science.

On his jubilee I. M. Tsidil'kovskiĭ is full of new creative ideas. From the bottom of our hearts we congratulate Isaak Mikhaĭlovich and wish him good health, a joyful life, indefatigability and activity, and new scientific ideas and achievements.

Translated by G. Volkoff