Scientific session of the Division of General Physics and Astronomy of the Academy of Sciences of the USSR (25 September 1991): Dedicated to the 90th anniversary of the birth of L. V. Shubnikov

Usp. Fiz. Nauk **162**, 181–183 (October 1992)

A scientific session of the Division of General Physics and Astronomy of the Academy of Sciences was held on September 25, 1991 in the P. L. Kapitsa Institute of Physics Problems. The following reports were presented at the session:

1. *N. E. Alekseevskiĭ.* Introduction to "The publications of L. V. Shubnikov."

2. *M. V. Kartsovnik, V. N. Laukhin, and S. I. Pesotskiĭ.* Shubnikov–de Haas oscillations in organic metals.

3. *R. V. Parfen'ev and M. L. Shubnikov.* Shubnikov–de Haas effect in semiconductors. (A brief summary of this report was published in the April issue of Uspekhi of this year—Usp. Fiz. Nauk **162**(4), 153 (1992) [Sov. Phys. Usp. **35**(4), 327 (1992)].

The introduction and the first report are published below.

Introduction:

N. E. Alekseevskiĭ. *The Publications of L. V. Shubnikov.* Today we are celebrating the 90th anniversary of the birth of Lev Vasil'evich Shubnikov. Lev Vasil'evich was born on September 29, 1902 and died tragically on October 10, 1937. During his comparatively short life Lev Vasel'evich carried out very many interesting investigations in low-temperature physics, solid-state physics, and superconductivity. He founded the Low-Temperature Laboratory at the Ukrainian Physicotechnical Institute and the Deep-Cooling Station (DCS) at the same institute. His work in the period from 1932 to 1937 is described in detail in the book "L. V. Shubnikov. Selected Publications. Recollections," published in Kiev in 1990 by Naukova Dumka press and edited by Academician Boris Ieremievich Verkin with the active participation of Lev Vasil'evich's wife and colleague Ol'ga Nikolaevna Trapeznikova. Anyone desiring to learn more about the research and personality of Lev Vasil'evich will find much of interest in this book. I shall discuss only very briefly some aspects of the work he performed at the Low-Temperature Laboratory of the Ukrainian Physicotechnical Institute.

First of all, one must keep in mind the fact that in 1930 there were no cryogenic laboratories in the Soviet Union. There were only three such laboratories in the entire world: at Leiden, organized by Kamerlingh–Onnes; in Toronto, organized by MacLennan; and, in Berlin, organized by Meissner. (The Institute of Physics Problems was organized later, in 1935–1936.) The laboratory in Khar'kov was organized by L. V. Shubnikov in 1934. Work with liquid hydrogen was performed already in 1934 and with liquid helium soon thereafter. In 1935, the year I arrived there, the laboratory already had a machine for liquefying air and nitrogen at a rate of 25 L/h, a machine for liquefying hydrogen at a rate of 12 L/h, and a helium liquefaction machine, purchased in Germany with the assistance of Meissner, with a capacity of 1.2 L/h. After this apparatus was assembled in Khar'kov it was equipped, on the initiative of Lev Vasil'evich, with an apparatus for pouring liquid helium into a Dewar. It should be kept in mind that the production of, for example, liquid nitrogen, which was mainly employed for cooling traps in vacuum setups, was very limited at that time. For example, at the Leningrad Physicotechnical Institute approximately only 2 L/day were supplied to each experimenter. Having arrived in Khar'kov in 1935, I was amazed that liquid nitrogen was poured in a wide stream from a 50 liter Dewar for cooling copper solenoids generating magnetic fields of up to 5 kOe. In addition, the laboratory had magnets, which generated magnetic fields of the order of 25 kOe. A procedure for working with liquid hydrogen was worked out in detail, and experiments with liquid hydrogen were ordinary and did not present any special difficulties (in contrast to the then current situation in working with liquid hydrogen). At the low-temperature laboratory most investigations involving low temperatures were performed in a large hall covered with a light roof equipped with a special hatch which had a relatively large area and could be opened, if necessary, in case of a possible accident when working with liquid hydrogen. As far as I can remember, however, no such accidents occurred. Many investigations were performed in liquid helium, which was obtained directly in the experimental apparatus. To this end, a gas line supplying helium at a pressure of ≈ 200 atmospheres was provided throughout the laboratory. Helium was supplied to the apparatus and cooled to the temperature of liquid hydrogen, and then liquefied after throttling. During those years Lev Vasil'evich initiated many directions in low-temperature physics and technique. For example, fundamental investigations of superconductivity of lead alloys were conducted, the low-temperature properties of water-free chlorides were studied, the phase diagrams of a number of mixtures of liquefied gases were studied, λ transitions were investigated in a wide class of substances, the magnetic properties of liquefied hydrogen were investigated, the magnetic moment of the proton was determined (together with Lazarev), the viscosity of many liquefied gases was measured, the study of the properties of liquid and solid helium was undertaken, and much else was accomplished.

Lev Vasil'evich's name is linked with the so-called Shubnikov-de Haas effect. This effect was first observed in the galvanomagnetic properties of single crystals of pure bismuth. The work was performed in Leiden, where Lev Vasi-

 0038-5670/92/100897-02$03.00

l'evich worked from 1926 to 1930. The superconducting phases arising in superconducting alloys between the magnetic fields H_{c1} and H_{c2} are also named after Lev Vasil'evich. A number of low-temperature experimental methods are also linked with Lev Vasil'evich Shubnikov's name.

L. V. Shubnikov's name is probably more popular abroad than in our country. For example, Shubnikov phases apparently first appeared in a book by Professor Buckle entitled "Superconductivity," published in German in 1977.

According to information which I received from a colleague of B. I. Verkin, a chair at the University of Wisconsin in the USA is named after L. V. Shubnikov. We at the Academy of Sciences are now trying to correct this situation. The presidium of the Academy of Sciences has decided to establish a L. V. Shubnikov prize. The prize will be awarded once every three years for the best experimental work in low-temperature physics. Unfortunately, this question has at the moment been set aside. We hope that it will be resolved in the near future.

At today's session investigations on the application of the Shubnikov–de Haas effect in organic superconductors and semiconductors will be described.

Translated by M. E. Alferieff