

*Chronicle*

## The last accomplishment of B. I. Verkin

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The paper describes the decisive role of B. I. Verkin in the return from oblivion the name of L. V. Shubnikov and the restoration of the place worthy of his contribution to the low temperature physics and its applications. We begin with a brief survey of Shubnikov's works, several of them are of the Nobel prize level. Then we briefly describe the foundation by B. I. Verkin of the Institute for Low Temperature Physics and Engineering. Finally, we outline the history of writing the book about Shubnikov and the outstanding efforts by B. I. Verkin in the realization of this last, according to him, achievement of his life.

Keywords: B. I. Verkin, L. V. Shubnikov.



B. I. Verkin (August 8, 1919–June 12, 1990)

## 1. Introduction

The past year 2020 was marked by two anniversaries. May 12, 2020 was the 60th anniversary of the B. I. Verkin Institute for Low Temperature Physics and Engineering (ILTPE, Russian abbreviation FTINT), and in January of the same year, we celebrated the 45th anniversary of the journal “Low Temperature Physics” (LTP, Russian abbreviation FNT). These events, as well as 30 years since June 12, 1990, when Boris Ieremievich Verkin, the founder and first director of the institute, as well as the founder and the first editor-in-chief of the journal, passed away, allows us to return once again to the scientific and scientific-organizational legacy of this remarkable scholar, brilliant organizer and outstanding person. One more important motivation for this is the approaching 120th birthday of Lev Vasilyevich Shubnikov (September 29, 1901–November 10, 1937). The reason to mention together these four anniversaries becomes especially clear in the light of an episode that took place in the spring of 1990 shortly before the death of Boris Ieremiyevich (BI, as everyone called him). We met in his office to prepare the presentation of the book about L. V. Shubnikov [1] just published by the publisher “Naukova Dumka” of the Academy of Sciences of Ukraine. BI looked quite unwell. Suddenly, he said that in his life he had done three main things: founded the institute, launched the journal, and returned fame and good name to Lev Vasilyevich Shubnikov. Although at first glance the scale of these achievements seems rather different, nothing was surprising for us in such an assessment: the creation of a book about Shubnikov was indeed his great human and scientific activities, both in general and, of course, for BI himself.

The history of creation of the book on Shubnikov [1] was already described in details in our reminiscences about B. I. Verkin [2]. However, such a detailed description led in a sense to the shifting of accents and did not permit to emphasize the grandeur of Shubnikov’s personality and the significance of his contribution to low temperature physics as well as the crucial and leading role of BI in the creation of the book [1].

After the publication of book [1] and, we believe, under its influence, several more works on Shubnikov appeared. These are the books by French authors (1994) [3], by the KITP (Kharkiv Institute of Physics and Technology) team (1998) [4], the collection of interviews [5], and the book by Reinders (2017) [6]. However, the two books [4, 6], while presenting a fairly complete description of Shubnikov’s work and the life in the Soviet Union, Kharkiv in particular, in the 1930s, essentially use the material of our book but, unfortunately, do not mention Verkin at all. Moreover, the second of them [6] attributes the creation of our book to the KIPT team instead of the team of the ILTPE. As a result, books [4, 6] lack the description of the decisive role by B. I. Verkin in bringing from oblivion the name of Shubnikov and in the restoration of the place that Shub-

nikov deserved due to his contribution into the low temperatures physics.

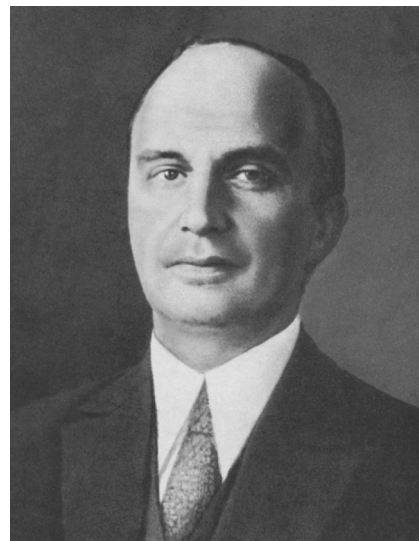
In this paper, we come back to the story about Shubnikov’s book and present it not as a simple history of its creation but as a natural chain of events and actions with L. V. Shubnikov and B. I. Verkin as the main acting persons. We start with a brief survey of the main scientific and organizational Shubnikov’s achievements (Sec. 2). In Sec. 3, a short history of ILTPE foundation and development is presented. A special attention is paid to the usage and creative development by BI of the Shubnikov’s ideas on the aims and structure of the modern scientific and engineering cluster. Section 4 of the paper is devoted to the BI efforts to create the book [1] and to restore a good name of Shubnikov.

## 2. Shubnikov

BI dreamed of working in Shubnikov’s laboratory at the Kharkiv Institute of Physics and Technology (KIPT, Russian abbreviation UFTI) being still a first-year student (1936), but got there a year later, when the head of the laboratory was already B. G. Lazarev since in August 1937 the thirty-six-year-old Shubnikov was arrested and shot in November of the same year.

BI knew perfectly the remarkable scientific heritage of Shubnikov, which contains a number of fundamental results included in the golden fund of experimental physics of the twentieth century. Here are some of the most remarkable of the results.

The first is the effect of low-temperature oscillations of magnetoresistance, discovered in the Leiden laboratory by L. V. Shubnikov and V. de Haas [7] in bismuth. As it turned out later and largely due to the work of BI and co-authors, the Shubnikov–de Haas effect, like the oscillatory de Haas–van Alphen effect discovered somewhat later, are inherent not only to bismuth but is a general metal property. These



L. V. Shubnikov (September 29, 1901–November 10, 1937)

effects originated a new fundamental direction of research in solid state physics, now known as magnetic spectroscopy of the Fermi surface of metals (fermiology).

This was followed by the avalanche of outstanding results of the Kharkiv period.

Experimental discovery of antiferromagnetism: the observation of the temperature anomaly in the specific heat of ferric chloride [8] (and later also of other metal chlorides). This was followed by the observation of a similar anomaly of the magnetic susceptibility at the same temperature, which proved the magnetic nature of anomalies associated with a phase transition to an antiferromagnetic state [9, 10], a new state of magnetic substances having no spontaneous magnetization.

Fundamental series of works on superconductivity. (1) The discovery of ideal diamagnetism of superconductors [11], made independently and actually earlier than Meissner. Unlike Meissner, Shubnikov discovered this effect by measuring directly the magnetization. (2) Thorough study of the calorimetric and magnetic properties of superconducting alloys, which led to the discovery of the type II superconductors, the discovery of two critical fields  $H_{c1}$  and  $H_{c2}$  in these superconductors, and the observation of their mixed state in the intermediate range of fields between  $H_{c1}$  and  $H_{c2}$ , now called the Shubnikov phase [12]. As it turned out later, the type II superconductors constitute the most extensive class of superconducting substances. In particular, this class includes all high-temperature superconductors, which are one of the most important and promising research objects of recent decades. (3) Investigation of the destruction of superconductivity by current and the confirmation of the Silsby rule according to which a critical current in a thin wire creates a critical magnetic field on its surface [13–15]. (4) Direct observation of an intermediate state of type I superconductors [16, 17] in a single-crystal tin ball.

The first in the USSR study of the properties of liquid helium [18], carried out before the classical works of P. L. Kapitza! We emphasize that this is not the only example of constructive competition between Shubnikov and Kapitza, and, later, between the Institute of Physical Problems (directed by P. L. Kapitza) and Shubnikov's laboratory at the KIPT. And more than once the winner in this competition proved to be Shubnikov (see, for example, the history of the discovery of the Shubnikov–de Haas effect [19]).

The work of B. G. Lazarev and L. V. Shubnikov where the magnetic moment of the proton was measured with an error of less than 10% [20]. This result, later called the triumph of a physical experiment [21] and one of the most remarkable experiments in physics [22], made it possible, in particular, to correct by 13 (!) orders of magnitude the erroneous estimate of the relaxation time of the magnetization of solid hydrogen at helium temperatures given by V. Heitler, G. Willis, and E. Teller [23].

A wide and detailed study of the properties of simple cryogenic liquids [24, 25], which made it possible to obtain

rich quantitative information about their thermodynamic and kinetic properties. Pioneering studies of phase transitions in methane at high pressures [26], which laid the foundations for the physics of cryocrystals and physics of high pressures.

These remarkable achievements, including several results of the Nobel prize level, were obtained in Kharkiv at the KIPT in a quite short period from the beginning of 1931 to the middle of 1937.

During these incomplete six years, and largely thanks to L. D. Landau and L. V. Shubnikov, KIPT became one of the internationally known centers of physics. Many famous physicists visited regularly the institute for discussion and scientific work (N. Bohr, W. Weisskopf, P. A. M. Dirac, V.-F. Meissner, R. Peierls, B. Ya. Podolsky, P. Ehrenfest, etc.).

More generally, this period can be spoken of as the era of “storm and onslaught” in the physical and mathematical sciences of Kharkiv in the 30s of the XX century, associated with the names of N. I. Akhiezer, S. N. Bernshtein, L. D. Landau, B. G. Lazarev, A. S. Leipunsky, I. V. Obreimov, L. V. Shubnikov. This is evidenced, among other things, by the fact that it was in Kharkiv and during this period that the three most significant physics and mathematics meetings of the country were held. This is the first All-Union Congress of Mathematicians (1930), which was attended by leading mathematicians of the USSR, by a number of leading foreign scientists (J. Hadamard, A. Denjoy, E. Cartan, S. Mandelbrot, P. Montel — all France — and others) and physicists Ya. I. Frenkel and V. A. Fock. Next, this is the first All-Union conference on theoretical physics (1934) with the participation of N. Bohr (Denmark), I. Waller (Sweden), I. Williams (Great Britain), M. Plesset (USA), L. Rosenfeld (Belgium), J. Salomon (France). Finally, this is a session of the Academy of Sciences of the USSR (1935), at which S. I. Vavilov, one of the leaders of physical science in the USSR at the time, later a Nobel Prize winner, said that a quarter of all physics in the USSR is done in Kharkiv.

In addition to the spectacular purely scientific achievements listed above, Shubnikov was extremely successful in organizational activities. He not only created the first in the country (before P. L. Kapitza!) Laboratory of Low Temperature Physics (1932). Understanding quite well the strong need for an extensive applied physics work, cryogenics in particular, and the importance of bringing its results to an industrial level, he founded a Pilot Deep Cooling Station (Russian abbreviation OSGO).

After the arrest and execution of Shubnikov in 1937, all mentions of him and his brilliant and extensive work vanished completely. His name was deleted from the list of authors of his joint works with his students and colleagues [10, 14, 15, 17, 26, 27] and, it would seem, from the history of physics in general.

The name first appeared in print again only in 1950, i.e., when even the mention of the name of the repressed researcher in a scientific article was still an act of consider-

able civic courage. This was done in the article [28] by B. I. Verkin, B. G. Lazarev, and N. S. Rudenko on the de Haas–Van Alphen effect in a number of metals (cadmium, beryllium, magnesium, tin, indium). The authors explicitly referred to the works of L. V. Shubnikov and V. de Haas and for the first time introduced the term “Shubnikov–de Haas effect”.

Thereby, the ice was broken. Seven years later, in 1957, A. A. Abrikosov, in his pioneering article on superconducting vortices [29] (Nobel Prize in Physics 2003), mentioned the work of Shubnikov and co-authors on the magnetic properties of superconducting alloys. In nine more years (1966) the leading physics journal of the USSR “Soviet Physics Uspekhi” (SPU, Russian abbreviation UFN), an analog of the USA *Reviews of Modern Physics*, published an article by O. I. Balabekyan [30] dedicated to the 65th anniversary of L. V. Shubnikov. 12 years later, in 1978, two articles by B. G. Lazarev [31], in which it was noted that Shubnikov “brought to the institute the problems of superconductivity, magnetism, thermodynamic properties of matter, properties of helium, etc. In addition, Lev Vasilyevich created at the KIPT a style of critical, thorough, precise work.” Special attention was paid to the already classical results obtained by Shubnikov and his group in superconductivity.

In three more years (1981), a joint meeting of the Scientific Councils of Kharkiv research institutes — ILTPE, KIPT and the Institute of Radiophysics and Electronics (IRE) — was held dedicated to the 80th anniversary of L. V. Shubnikov, and the SPU journal dedicated a whole its section *Personalia* [32] to Shubnikov. The section included a biographical article, written by his former student N. E. Alekseevsky, and two scientific articles — by Yu. N. Ovchinnikov on Shubnikov’s work in superconductivity and by N. B. Brandt and S. M. Chudinov on the Shubnikov–de Haas effect.

Four years later, in 1985, a collection of scientific papers was published [33] dedicated to the 25th anniversary of ILTPE. Formally, this was a report of the institute, but, according to BI’s plan, the collection also demonstrated the fact, specially mentioned in the preface, that the origins of most of the institute’s scientific directions date back to L. V. Shubnikov, the head of the first school of low temperature physics in the USSR.

Thus, the wall of silence that surrounded Shubnikov’s name from 1937 to the early 1950s gradually collapsed. Nevertheless, as can be seen from the given above chronology of publications, the process of restoring the good name of Shubnikov and his role in the development of low-temperature physics was quite slow and difficult. As became clear from our conversations with many well-known and actively working physicists, even at the end of the 1980s, the true scale of Shubnikov’s personality, his outstanding scientific results and his role in the creation and development of low-temperature physics in the country were not known to the general physical community in coun-

try and beyond. So the more efficient steps were needed. The first of these steps has been actually made in 1960 and was related to foundation by B. I. Verkin of the Institute for Low Temperature Physics and Engineering (ILTPE).

### 3. Verkin: Institute and Journal

BI fully shared Shubnikov’s ideas on the structure of a physical research center, containing a scientific division, a design bureau, a pilot production facility, and a plant producing the cryogenic equipment. The ILTPE, created in 1960 by BI and directed by him for about thirty years, was the brilliant creatively updated implementation of these ideas. BI, like Shubnikov, has been strongly oriented on the development of the most important areas of low-temperature physics. Therefore, the scientific directions of ILTPE not only naturally continued and developed the directions founded by Shubnikov — superconductivity, low-temperature magnetism, spectroscopy of metals, helium, cryogenic liquids — but also added to them the optical and elastic properties of solids, the physics of real crystals, the transport properties of conducting systems, and later enriched them with such new modern directions as microcontact spectroscopy, molecular biophysics, high-temperature superconductivity, physics of mesoscopic systems and nanostructures.

The Special Design Bureau [34] was another updated implementation of Shubnikov’s ideas. A lot of devices and apparatus were designed and produced by Bureau from 1960 to 1990. The short list of them includes various superconducting electronic devices (bolometers, quantum magnetometers, generators), low-temperature thermometers, mass spectrometer, laboratory and special cryostates, widely used in cosmic investigations, geophysics, and technics. Small series of these products released first by the Pilot Production facility at the ILTPE and later by the Pilot Plant in Valky town (50 km from Kharkiv) provided their production of the marketable scales. Another direction of the Bureau dealt with such mundane problems as transportation and conservation of the food products, design of underwater respiratory apparatus and cryogenic shredding of the various substances. And completely new and pioneer direction established and developed in the Bureau was the design of wide spectrum of medical cryoinstruments. This direction was so timely and successful that its development led to the foundation in Kharkiv of the new research Institute of Cryobiology and Cryomedicine.

One more important step made by BI was launching of the international journal “Low temperature physics” (LTP, Russian abbreviation FNT) in 1975. Soon LTP became one of the leading physical journals of the USSR existing in two equivalent formats: FNT (in Ukrainian, Russian, and English) and LTP — purely English version published by the American Institute of Physics.

A rather unusual for physical research institutions of that time were four mathematical laboratories (applied mathematics, geometry, functional analysis, computer science



and mathematical physics) organized in the ILTPE from the very beginning. This was exclusively BI's invention not related to Shubnikov's ideas. It brought to the institute the leading representatives of the well-known Kharkiv mathematical school as well as numerous young mathematicians and theoretical physicists and boosted strongly the research potential of the institute and the mathematical activity in Kharkiv. This is one more manifestation of the breadth of mind and foresight of BI as the organizer of science. Note that a similar mathematical component was created in the late 1960s at the Landau Institute for Theoretical Physics, organized by I. M. Khalatnikov in 1965 in the Moscow suburb Chernogolovka. In 1986 these laboratories of the ILTPE were converted into the Mathematical Division of the ILTPE proved to be one of the internationally known mathematical centers in the USSR and now in Ukraine.

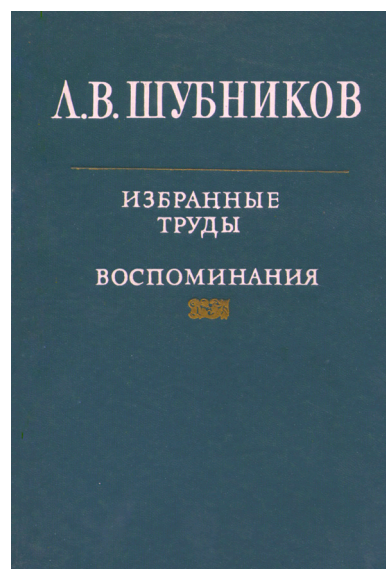
Thus the ILTPE has become one of the leading research units in physics, both fundamental and applied, among a large number of universities and research institutes in the USSR. The work carried out by the scientists of the institute was granted by the highest scientific awards in the field of physics and mathematics. In 1962, the two Lenin's Prizes, the highest scientific distinction in the USSR, were awarded to V. A. Marchenko and A. V. Pogorelov. In 1978 B. I. Verkin, V. G. Manzhelii, and V. A. Buchakchinsky had got USSR State Prize, and in 1985 Yu. A. Kirichenko was awarded by the same Prize. The third Lenin's Prize was received in 1986 by V. A. Mikheev. A year later (1987) I. K. Yanson received the Europhysics prize of the European Physical Society. Finally, in 1990, V. G. Drinfeld was awarded the Fields Medal, the most prestigious award in mathematics. ILTPE international recognition was also very high, despite the Cold War and the special status of Kharkiv as a "closed" city because of its significant military-industrial potential.

#### 4. Verkin: Shubnikov's book

However, for the majority of scientist and common people foundation and development of the ILTPE was not explicitly related to the Shubnikov's ideas. Therefore in order to make Shubnikov's scientific and organizational activities widely known, BI decided to create a book presenting the grandeur and significance of his short and so tragically ended life.

No doubts, BI was exactly the person to implement this goal. He first heard about Shubnikov while still a student. He was the co-author of the term "Shubnikov-de Haas effect" introduced in the article, which contains the first mention of Shubnikov's name 13 years of oblivion after his arrest and death. It was he who discovered the universal metallic character of the de Haas-van Alphen effect. Throughout his life, BI's scientific interests largely follow and develop the directions created by Shubnikov.

The breadth of BI's scientific outlook served him as the basis for clear understanding of the scale of Shubnikov



The cover of the book about Shubnikov [1].

both as a scholar and a personality and his vision of the role and prestige of science in modern society.

Being a clever politician, BI chose the most convenient moment to publish the book about Shubnikov. Until 1985 such an attempt describing honestly the fate of a scientist repressed in 1937 was doomed to failure in the USSR. But the perestroika was already beginning. BI had the highly sharp feeling of time and therefore immediately realized that now is the time. Later it will be possible even more, but it cannot be postponed, because the people who knew Shubnikov and worked with him, there were fewer and fewer.

In accordance with the BI concept, the book was supposed to contain Shubnikov's biography, a survey of his results, his most important papers and memoirs about him, thereby comprising a completely new genre of scientific and memoir literature, as was mentioned later by the well-known historian of science V. Ya. Frenkel [35]. This innovation idea of BI proved to be very attractive and timely: later in the same genre, a number of books were written on the life and work of other prominent scientists, see, e.g., [36].

The work on the book actually began in 1985, when Olga Nikolaevna Trapeznikova, Shubnikov's widow, and their son Mikhail Lvovich Shubnikov visited the ILTPE on the invitation of BI. Olga Nikolaevna told about the work of Shubnikov in Leiden and Kharkiv and presented to BI several reprints of the works made by Shubnikov and her in Leiden. At the same time, on behalf of BI, the Department of Information of the ILTPE (head V. G. Gavrilko) began collecting materials about Shubnikov.

At the end of October 1986, BI invited us to participate in the writing of the book. Our first reaction was negative since we had never been engaged in the history of science, although, of course, we understood its importance and

were interested in it as a majority of the researches. But BI possessed the gift of conviction. He so vividly outlined for us the scientific and aesthetic perspectives and the importance of this completely new kind of activity that we finally agreed, inspired with his enthusiasm.

In January 1987, in the implementation of this BI plan, we went to Leningrad to see Olga Nikolaevna Trapeznikova. For two weeks we visited her every day in Peterhof and spent the whole day talking. The result was twenty-two-hour tape cassettes with recordings of these conversations, many photographs and documents, recordings of a conversation with A. V. Timoreva, and excerpts from an unpublished manuscript of S. E. Frisch [37] concerning Shubnikov (A. V. and S. E. were the closest friends of L. V. and O. N. from their university years).

This was followed by meetings with former students and colleagues of Shubnikov. Preparing for these meetings, each time we discussed with BI their strategy because we should not forget that we were to talk about quite horrible times and events that many of our interlocutors were still reluctant to recollect and to discuss.

A series of meetings began with people living in Kharkiv — B. G. Lazarev, A. I. Akhiezer, V. P. Klyucharev, G. A. Milyutin, A. I. Sudovtsov, and N. S. Rudenko. B. G. Lazarev showed us the manuscript of the calculations by L. D. Landau related to the work of Lazarev and Shubnikov on measuring the magnetic moment of proton, and A. I. Akhiezer presented the manuscript of his memoirs about L. D. Landau, a significant part of which was devoted to Shubnikov.

We also met the former Shubnikov's students from other cities of the USSR: N. Ye. Alekseevsky (Institute for Physical Problems, Moscow), A. K. Kikoin (Polytechnic Institute, Yekaterinburg), I. E. Nakhutin (All-Union Institute of Scientific Information, Moscow). A. K. Kikoin, in particular, told us about L. D. Landau's course in general physics, which was supposed to include a chapter written by Shubnikov describing experimental methods. He also told the story of the "anti-Soviet strike", when, in protest against Landau's dismissal from the Kharkiv University, his colleagues from the KIPT (E. M. Lifshits, A. S. Kompaneets, I. Ya. Pomeranchuk, and V. S. Gorsky), as well as L. V. Shubnikov, A. K. Kikoin, and N. A. Brilliantov applied for resignation.

None of us, including BI, had heard of this strike before. One of its participants, A. I. Akhiezer did not mention it during our meetings. When we discussed this story with BI, he expressed concern that the information given by A. K. Kikoin was not completely precise — after all, we were talking about the events that happened over 40 years ago. BI immediately proposed a solution: "if everything was as it was described by Kikoin, some materials should be present in the Kharkiv university archives — we should look for them". The result exceeded all expectations. BI sent to the university archives the member of the ILTPE Department of Information L. K. Snigireva who

found all the statements of the strike participants about their resignation, the details of the meeting on which they were convicted, and their own, written later, statements of repentance. The statement of L. V. Shubnikov was written with such dignity that it could only be called "penitent" with a very big stretch.

In 1987, through Professor Klipping (Germany), who was visiting ILTPE, BI established contact with the famous English scientist Martin Ruhemann, one of the leading employees of Shubnikov's cryogenic laboratory in the 1930s. Klipping sent BI extracts from the memoirs of Meissner, who came to Kharkiv, and Ruhemann agreed to publish in the book his article from the journal "New Scientist" on Kharkiv physics in the 1930s. V. G. Gavrilko and L. K. Snigireva, who by that time had attained skills of professional archivists, found a report (1933) and an article (1936) by Shubnikov about the cryogenic laboratory of the KIPT, as well as the report on the session of the physical group of the USSR Academy of Sciences (1937) held in Kharkiv and the leading role of Shubnikov's laboratory in the origin and development of low temperature physics in the USSR.

All the collected materials had to be processed. First of all, this referred to the recollections of Shubnikov's former students and colleagues. It was also necessary to find and translate into Russian his papers, published in English and German. The quality of photographs given by O. N. Trapeznikova needed serious correction. But the most time-consuming and important was the processing of the materials contained in the tape recordings we made. The amount of what had to be done was enormous.

And then we saw once again what a brilliant organizer BI was. Almost the entire institute took part in this work. The translation and editing of Shubnikov's papers in foreign languages were carried out by the leading scientists of the institute of the corresponding profile. The photographs were processed by V. L. Bysov, now a professional photographer, whose artwork is well known in Kharkiv and beyond. Cassettes with recordings of conversations with O. N. Trapeznikova were assigned to the various departments of the institute, and each department presented an exact typewritten version of the corresponding transcript.

However, the transcripts were only a zero approximation of the final result. And we ourselves were already engaged in its subsequent editing. Note that this was a twenty-two-hour conversation, often with repetitions and deviations, a variety of sub-topics including events with a huge number of participants, and what participants! — P. Dirac, P. Ehrenfest, A. Einstein, de Haas, A. Ioffe, P. Kapitsa, L. Landau, I. Obreimov, L. Shubnikov, etc. On the advice of BI, all this material was divided into two parts. The first of them was to serve as the basis for the biographical article of the book (Ref. 1, pp. 5–19). The second one was to be converted into the memories of O. N. Trapeznikova (Ref. 1, pp. 256–291). We hope that we managed to convey in these memories the charm of Olga Nikolaevna's personality.

A detailed review of the scientific works of L. V. Shubnikov was also written (Ref. 1, pp. 20–39).

It is worth mentioning that when the book was already in print, we found one more paper by Shubnikov and de Haas [38], which sheds light on the strong competition between Cambridge, represented by Kapitsa, and Leiden, represented by Shubnikov and de Haas. Both groups investigated the magnetoresistance of bismuth. In this “bismuth fever” each side had its own advantages: Leiden — low temperatures and high purity and quality of samples, Cambridge — strong magnetic fields. Eventually, this is Leiden that became the winner of the competition. It turned out that it is the high purity and meticulous perfection of bismuth crystals that are the main conditions for observing oscillations of magnetoresistance. These crystals were obtained by a special method developed by V. de Haas, I. V. Obreimov, and L. V. Shubnikov and known as the method of vertically directed crystallization from the melt. As a result, the article “History of the discovery of the Shubnikov–de Haas effect” [19] which was not included in the book appeared in the LTP, alas, just before the BI obituary.

The book about a scientist of Shubnikov’s level certainly deserved to be published in the most prestigious all-Union publishing house “Nauka” of the Academy of Sciences of USSR. However, the “Nauka” used to publish scientific biographies, memoirs and collections of works separately, avoiding the “mixing of genres” that was implemented in our book according to BI’s idea. Therefore, the book was submitted to the “home” publishing house “Naukova Dumka” of the Academy of Sciences of the Ukrainian SSR.

BI, not usually inclined to overestimate his achievements, was this time quite satisfied with the final result. The book was undoubtedly a success!

Even before its publication, BI carried out active work to popularize the book. In 1989, on his initiative, a detailed essay [39] on the life and scientific activity of Shubnikov was published in the journal “Priroda”. Then, in the prestigious series of the All-Union Society “Znanie”, the brochure “L. V. Shubnikov and Low Temperature Physics” [40] was published. Following this, the newspaper “Vecherny Khar’kov” published a long interview [41] with BI, entirely dedicated to Shubnikov. The next act was the talks at the meeting “Ioffe Readings”, which were held annually at the Leningrad Institute of Physics and Technology. These talks were also subsequently published in the materials of the Readings [42].

At the same time, the annual prize named after L. V. Shubnikov, awarded for the best work of the ILTPE was established. BI also applied to the Academy of Sciences of the Ukrainian SSR with a proposal to establish a prize of the Academy named after L. V. Shubnikov. At first, this proposal was not accepted because of a formal obstacle — Shubnikov was not a member of the Academy (he did not even manage to become a Doctor of Science!). Finally, this obstacle was overcome and currently, there is the L. V. Shub-

nikov of the National Academy of Sciences of Ukraine for outstanding achievements in the field of experimental physics.

The book was published in 1990. Its first presentation took place at the House of Scientists in Kyiv. At this time, BI was already not well, but he could not afford to be absent in such an important event for all of us and made a presentation with his characteristic brilliance. In mid-June BI planned to hold a presentation of the book at the institute. All former colleagues of Shubnikov were invited to this event at ILTPE: B. G. Lazarev, N. E. Alekseevsky, I. E. Nakhutin, A. K. Kikoin, F. I. Likhter, G. A. Milyutin, A. I. Sudovtsov, and, of course, O. N. Trapeznikova. Unfortunately, B. I.’s illness and death and then the events that took place in the USSR and soon led to its collapse, did not allow this important event to be held.

Despite this, since the beginning of the second half of 1990, a whole series of book presentations took place abroad. The first was given by Yu. Freiman in July 1990 at the Institute for Low Temperatures and Structural Research (Wroclaw, Poland). The next presentation took place in October 1990 in Leiden, where Shubnikov has been working for four years 1926–1930. It was conducted at our request by V. Shumeiko. In the weekly journal of the University of Leiden “Marais” (1.11.90), there was published a long article [43] about Shubnikov. The director of the Leiden Laboratory J. A. Maidosh wrote to us about the success of the presentation of the book. Then an analogous presentation in Spain was made by S. Gredeskul. Based on its materials, the journal of the Spanish Physical Society published our article [44] “Lev Shubnikov — the genius of low-temperature physics”. In May 1991, Yu. Freiman gave a talk at the Center for Applied Superconductivity named after L. Shubnikov, created and directed by prof. D. Larbalestier at Madison State University, USA. Replying on the question of Yu. Freiman: “How it happened that the Center bears the name of the Russian (Soviet) scientist L. Shubnikov, although even in his homeland this name is still little known”, Professor Larbalestier said: “He discovered the field of physics that I have been doing all my life”.

According to the list compiled together with BI, the book was sent to many foreign physicists. Thankful letters were sent by F. Dyson, H. Casimir, R. Peierls, L. Tissa, D. Schoenberg, and others. The article [19] on the history of the discovery of the Shubnikov–de Haas effect was also met with great interest. H. Kazimir assessed it as “excellent survey of the discovery of the Shubnikov–de Haas effect”.

The past 30 years have irrefutably proved the correctness of the historical and scientific vision of BI. The publication of the book [1] and subsequent actions for its popularization radically changed the understanding of the role of L. V. Shubnikov in the formation of low-temperature physics as an important independent branch of physics and aroused great interest in his life and work. Moreover, they also aroused a more general interest in the entire epoch of



“storm and onslaught” mentioned above in the physical and mathematical science of Kharkiv in 1920–1930.

### 5. Conclusion

Many former students and colleagues of L. V. Shubnikov, members of the ILTPE, Soviet and foreign physicists and some officials were involved into an exciting process of the book [1] writing. This is acknowledged in the quite long list of their names on behalf of the Editorial Board. However, the main person, the father of the book is undoubtedly Boris Ieremiyevich Verkin. Indeed, the very existence of the book is primarily due to him, his idea, his vision of events and their assessment, his energy and enthusiasm. He clearly saw the ultimate goal and was well aware of its importance and scope. He brought his world outlook and did everything to create a book, which, as it seems to us, everyone who took part in this can be rightfully proud of.

At the beginning of this article, we wrote about the three most important achievements by BI according to him. We dare to think that in fact these are the three stages of a single great accomplishment of BI, intimately linked with the name of Lev Vasilyevich Shubnikov.

Indeed, the first stage was the foundation of the institute, now B. I. Verkin Institute for Low Temperature Physics and Engineering (ILTPE), a universal modern research and development cluster, brilliantly embodied and advanced the scientific and organizational ideas of Shubnikov.

The second stage was the launching of the journal “Low Temperature Physics”, one of the leading journals in this field of physics in the USSR and throughout the world (the publishers of the journal are the ILTPE and the American Institute of Physics).

And the last third stage of BI’s outstanding life became the book about Shubnikov.

We believe that BI had two main reasons to create the book. The first — quite rational — reason was the desire to restore historical justice and to emphasize the pioneering role of L. V. Shubnikov in the formation of low temperature physics. The second — irrational — is expressed in simple words: it’s time to think about the soul. The book became chronologically the last major accomplishment of BI’s life. By this accomplishment alone, he earned a good and lasting memory.

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#### Останнє звершення Б. І. Веркіна

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Описано вирішальну роль Б. І. Веркіна у поверненні із забуття імені Л. В. Шубникова та у відновленні місця, гідного його внеску у фізику низьких температур та її застосування. Спочатку приведено короткий огляд робіт Л. В. Шубникова, деякі з яких мають рівень Нобелівської премії. Коротко описано заснування Б. І. Веркіним Фізико-технічного інституту низьких температур. Окреслено історію написання книги про Шубникова та видатні зусилля Б. І. Веркіна у здійсненні цього останнього, за його словами, досягнення життя.

Ключові слова: Б. І. Веркін, Л. В. Шубников.