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ALEKSEĬ VASIL'EVICH SHUBNIKOV

(on his eightieth birthday)

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MARCH 29, 1967 marked the eightieth birthday of the distinguished Soviet crystallographer, Academician A. V. Shubnikov. Shubnikov is rightly considered the dean of Soviet crystallography and crystal physics. His work in the field of symmetry theory, crystal physics, and the theory of crystal growth exerted and continues to exert a profound influence on the development of solid state physics and a number of related branches of physics and technology.

Shubnikov's scientific education and his first independent steps are connected with such names as E. S. Fedorov, V. I. Vernadskiĭ, and A. E. Fersman. Shubnikov himself considers his immediate teacher to have been the distinguished Russian crystallographer G. V. Wulff. It was Wulff who fostered the development of viewing crystallography as a physical discipline. But the fact that at present crystallography as a science does not merely borrow from physics but contributes a great deal to it is in the first place the achievement of Shubnikov and his school.

A characteristic feature of the study of crystal physics by Shubnikov and his school is the consistent application of the theory of symmetry, and in particular that of generalized symmetry, to a study of anisotropy and the physical properties of a material medium related to it. Shubnikov thus developed and in essence reformulated the symmetry principle of Pierre Curie, as well as generalized earlier work of Pasteur and van't Hoff on the influence of the dissymmetry of molecules on the optical activity of the medium. This symmetry approach underlies many of Shubnikov's crystallographic works, among which one of the foremost is the discovery of piezoelectric textures in 1940. Another important discovery of his, mentioned here as an example, is his prediction (subsequently realized in electron microscopy) of the possibility of visual observation of atoms and molecules when manochromatic rays pass through two superimposed crystallographic gratings. The piezoelectricity of crystals and textures, ferroelectric phase transitions, crystal optics, the optics of gratings, group waves—the development of these and other branches of physics is connected with Shubnikov's and his students' names.

Shubnikov's distinguished works in the field of the theory of symmetry were crowned in 1951 with the development of the study of antisymmetry and his derivation of the 58 crystallographic antisymmetry point groups. A natural development of these ideas is the derivation (carried out by other authors) of the antisymmetry space groups, subsequently called Shubnikov space groups. The study of antisymmetry is rightly considered to be the most important achievement in the field of crystallographic symmetry since the time of the work of A. V. Gadolin and E. S. Fedorov. Antisymmetry has already found application in physics (magnetic symmetry groups), although it is perfectly obvious that its physical contents is far from exhausted. Recently Shubnikov has done much work to extend the sphere of application of antisymmetry (antisymmetry of coordinate systems, the symmetry and antisymmetry of *similarity*, coherent group waves, etc). His recent opening lec-

ture of the Seventh International Congress of Crystallography in Moscow was devoted to this subject. Shubnikov sees in a consistent study of symmetry, and in particular of antisymmetry, a source of new physical ideas. The connection between antisymmetry and combined inversion, and its possible application to elementary particle physics, the dissymmetry of time, the dissymmetry of atoms and ions and the possible unipolarity of the electric conductivity of dielectrics in a magnetic field connected with it—such is the range of problems united by symmetry which Shubnikov is working on at present.

Shubnikov likes to repeat often that crystal physics is unthinkable without the crystals themselves. His distinguished contribution to the science of crystal growing cannot merely be measured by the series of monographs and dozens of articles on this subject. Under Shubnikov's immediate direction an industry has been created in this country for the production of technologically important crystals. More than four decades separate potassium bichromate—the first crystal grown by Shubnikov in Wulff's laboratory, from ruby, the basis of today's quantum electronics. This time saw under Shubnikov's direction and with his direct participation the establishment of industrial growing of Rochelle salt, quartz, and corundum. Each of these crystals is connected with the development of an independent branch of solid state physics, acoustics, physical and applied optics, and radio electronics. These and other of Shubnikov's achievements in the field of theoretical and applied crystallography have been recognized by two well-deserved State and numerous government prizes.

Shubnikov has given much effort to the organizational tasks of science. It is to him that we are indebted for organizing in 1944 the Institute of Crystallography of the USSR Academy of Sciences, whose director he was for twenty years. The setting up of a department of crystal physics at Moscow University, which he has directed from the time of its creation, the establishment and editing of the journal "Kristallografiya," his participation in the organization of the International Union of Crystallography and of the international journal of crystallography "Acta Crystallographica," his appearances at numerous international crystallographic congresses constitute a far from complete list of Shubnikov's achievements in the field of organizing science and strengthening international scientific relations. One should emphasize especially his part in establishing and developing the relations of Soviet crystallographers and physicists with those of the socialist countries. The decade of joint work of the Institute of Crystallography of the USSR Academy of Sciences and the Physics Institute of the Bulgarian Academy of Sciences in the study and application of photoelectrets is one of the numerous examples of such collaboration.

Shubnikov has written more than 300 papers, and all of them do not merely teach but also educate. One could write a large, separate article about him as a pedagogue and his many years of activity at four of this country's universities. No such articles, however, nor the numerous textbooks and monographs written by Shubnikov himself, can replace direct contact with him which by good luck fell to the lot of his numerous co-workers and students, each of whom has experienced to some extent the influence of his creative individuality and character. His expression of physical ideas in terms of geometrical pictures, his view of the physical world in terms of pictures, or all that he himself calls the "crystallographic turn of mind," his use of deep and at first sight unexpected analogies connected with his view of the main object of any science as being the necessity "to compare the uncomparable and distinguish the indistinguishable," the combination of an abstraction in the fullest sense of that word with a fine, resourceful and visually elegant experiment devoid of trifles—those are only some of the features of Shubnikov's many-sided creative profile.

The style and nature of Shubnikov's scientific creativity are in amazing harmony with the clarity and directness of his arguments, and the discerning and fundamental nature of the solutions accepted by him.

Shubnikov approaches his eightieth birthday overfilled with energy and new ideas, actively working on timely problems of crystal physics and the formation of crystals.

On March 28, 1967 a decree of the Presidium of the Supreme Soviet of the USSR awarded Alekseĭ Vasil'evich Shubnikov for his distinguished achievements in the development of Soviet science and in connection with his eightieth birthday the title of Hero of Socialist Labor, presenting him with a Lenin Order and a golden "Sickle and Hammer" medal.

Congratulating him cordially on his anniversary, Soviet crystallographers and physicists wish him the best of health and the accomplishment of all his creative plans for the benefit of Soviet science.

Translated by Z. Barnea