Anatoliĭ Petrovich Aleksandrov (on his eightieth birthday)

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Academician Anatoliĭ Petrovich Aleksandrov, a leading physicist, an eminent organizer of Soviet science, and president of the Academy of Sciences of the USSR, turned 80 on 13 February 1983.

Aleksandrov was born to the family of a teacher in the city of Tarashcha in the Ukraine. After finishing a technical high school in Kiev he began to work as an electrician; from 1923 to 1930 he taught physics and chemistry in a Kiev school. Combining his teaching with his studies in the physicomathematical department at Kiev University, from which he graduated in 1930, Aleksandrov began independent research while still an undergraduate. In 1929 he published his first scientific paper, "High-voltage polarization in ceresine," reporting work he had carried out at the Kiev Roentgen Institute, where a small group of young physicists had formed and was studying dielectrics under the guidance of professor V. K. Roshe. This research attracted the attention of Academician A. F. Ioffe, who in 1930 invited the entire group to work at the Leningrad Physicotechnical Institute, where the physics of dielectrics was the foremost topic at the time.

Aleksandrov began his scientific activity at the Leningrad Physicotechnical Institute with research on dielectric breakdown in dielectrics. He carried out some precise experiments of fundamental importance, which irrevocably refuted the erroneous idea, popular at the time, that the dielectric strength of insulating films increases with decreasing film thickness. Aleksandrov's experiments showed that "weak spots" play an important role in the dielectric breakdown of insulators. The idea that weak spots play a special role proved extremely valuable and was subsequently used to interpret experimental data on the brittle fracture of solids. This research served as the foundation for a statistical theory of brittle strength which was derived by Aleksandrov, S. N. Zhurkov, and others. This theory subsequently became an integral part of our understanding of the strength of materials.

In 1933–34 Aleksandrov carried out a systematic study of the physical and, in particular, electrical properties of polystyrene. From this work he reached the conclusion that it was not advisable or promising to make widespread use of polystyrene as a high-voltage insulator, and this conclusion was completely supported by later work.

In the mid-1930s the foundations of the physics of polymers were laid, and polymers came into widespread industrial use as structural materials and

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electrical insulators. Because of this development, the physical research on high-molecular materials assumed practical importance in addition to its purely scientific importance; those directions in physics which had practical applications were always the ones in which Aleksandrov was most interested. Foreseeing the vast future of polymers, he and his colleagues, in collaboration with P. P. Kobeko, developed a multifaceted program of research on the physical properties of polymer materials at the Leningrad Physicotechnical Institute. Aleksandrov developed methods for analyzing the evolution kinetics of hyperelastic deformation over broad ranges of temperature and rate of stress. Measurements for a wide variety of high-molecular materials revealed several physical aspects which were common to all polymers and also revealed the intimate relationship between mechanical relaxation and electrical relaxation. This series of studies, carried out by Aleksandrov from 1933 to 1941, constituted the major part of his doctorate dissertation. The results of this research became the basis for several branches of modern polymer physics, were incorporated in text-

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books and monographs, and for many years determined the direction of many fields of polymer physics. It should also be noted that the results of this research dealing with the elasticity and strength of rubber and the plasticization also had direct practical applications: they were used to solve the problem of the industrial production of high-quality synthetic rubbers and plastics.

During the Great Patriotic War, Aleksandrov headed the navy's effort to protect ships from magnetic mines, and the methods developed in his laboratory during the prewar years were adopted around the world. Taking part in this research, in addition to the direct collaborators of Aleksandrov, were many scientists from other laboratories at the Leningrad Physicotechnical Institute, including I. V. Kurchatov. The measurements developed at the Leningrad Physicotechnial Institute to protect ships against mines played an important part in the success of the Soviet Navy during the war.

It was during this period that Aleksandrov blossomed as an organizer of scientific research and development and as a leader in the effort to make practical use of research results. The authority of this physicist, his profound understanding of engineering questions, and his constant good will, combined with insistence on high standards and persistence, are qualities which aided Aleksandrov then and later in molding teams to solve ambitious and important problems.

The year 1943 marked the beginning of a new stage in the history of Soviet science and engineering. In that year a large number of Soviet scientists and engineers were mobilized to solve the central scientific and engineering problem of the twentieth centry: the problem of mastering nuclear energy. As is well known, this program was headed by I.V. Kurchatov. Aleksandrov and his laboratory were immediately brought into this program. He soon became leader of a large team of Leningrad scientists and engineers who worked on nuclear problems.

In 1946 Aleksandrov was appointed director of the Moscow Institute of Physical Problems of the Academy of Sciences of the USSR. He held this post until 1955. Under his guidance the Institute carried out many extremely complicated research and development projects to meet the urgent need to develop atomic science and engineering; this work was carried out in addition to the work on the purely physical problems which were traditional at the Institute.

The scientific and organizational efforts of Aleksandrov reached full bloom in the adoption of atomic energy in various parts of the economy. This field became Aleksandrov's major field, when, in 1948, he was appointed deputy to Kurchatov. It would be impossible to exaggerate Aleksandrov's contribution to the development of nuclear reactors. Major scientific and engineering projects were carried out under his scientific guidance to develop the atomic industry of the Soviet Union.

Nuclear power plants for ships were developed and constructed under his direct supervision. The icebreaker *Lenin*, launched in 1959, was the world's first nuclear-powered surface vessel and clearly demonstrated the broad potential applications of nuclear power in the navy.

Aleksandrov also played a leading role in developing a series of research reactors, primarily the MR, the VVR, the high-flux SM, the pulsed graphite IGR, etc.

When Kurchatov died in 1960, Aleksandrov replaced him, and to this day he heads the I. V. Kurchatov Institute of Atomic Energy, Moscow.

As before, he leads all the reactor projects being carried out at the Institute or under the scientific direction of the Institute. A broad experimental base for research on the thermophysical characteristics of power reactors has been established under Aleksandrov's direction. A long list of unique physical prototypes and full-scale critical installations have been used for detailed research on the composition of the active zones and to determine the basic physical characteristics of reactors being developed.

In the early 1960s Aleksandrov headed an effort to develop 440-MW mass-production water-cooled, water-moderated power reactors, and today these reactors are in operation at several Soviet and foreign power plants. Aleksandrov is presently devoting a major effort to improving these reactors: raising their power to 1000 MW or more and improving their safety and reliability. Aleksandrov also started and pursued the development of a single-unit highpower (1000-MW electrical) uranium–graphite channel reactor with a boiling coolant and direct vapor feed to turbines. The flexible fuel cycle and the possibility of raising the unit power further made this reactor the basis of a second important direction in large-scale nuclear power and are responsible for the massive effort to construct these reactors in our country.

Work is continuing on the improvements of nuclear power plants for ships. Power plants for the atomic icebreakers *Arktika* and *Sibir'* were developed and constructed at the initiative of Aleksandrov and with his direct participation. In 1977 the *Arktika* reached the geographic North Pole—the first surface vessel to reach that point under its own power.

Aleksandrov is gifted in knowing precisely when fundamental research results should be introduced into technology and when new engineering developments open up new opportunities for research. In the early 1960s, for example, Aleksandrov—forseeing the practical applications of superconductivity—directed an effort to construct apparatus to liquefy helium at the Kurchatov Institute. When completed, this was the largest such installation in the USSR, and it went on to support a broad effort in both fundamental research in low-temperature physics and the applications of superconductivity. Aleksandrov is an active participant in this work.

Aleksandrov is making a major effort to expand the sphere of applications of nuclear power sources. He advanced the concept of an optimum structure of nuclear energetics. In collaboration with others at the

Kurchatov Institute, he is developing atomic heating plants and reactors for use in energy-intensive branches of the economy.

In 1943 Aleksandrov was chosen a corresponding member of the Academy of Sciences of the USSR, and in 1953 he became a regular member. Since 1960 he has been on the Presidium of the Academy, and in 1975 he was elected president of the Academy. In this responsible office Aleksandrov is focusing primarily on choosing the most promising research directions and on mobilizing talent and material resources to solve problems of importance for scientific and technological progress. An important part of his activity is the development of science in the Union Republics and the branches and scientific centers of the Academy. Aleksandrov devotes much effort to strengthening and expanding international scientific collaboration.

To his strenuous efforts as a scientist and a scientific administrator, Aleksandrov adds a high level of community and political activity. Since the XXIII Congress of the Communist Party of the Soviet Union he has continuously been elected a member of the Central Committee of the Party. He is a deputy of the Supreme Soviet of the USSR.

The Soviet State holds Aleksandrov's efforts for Soviet science and technology in high esteem. He has been designated Hero of Socialist Labor three times; he has been awarded several Orders of Lenin; he has been awarded the Order of the October Revolution and other Soviet orders; he has received several honors from foreign governments; and he is a winner of the Lenin and State Prizes of the Soviet Union.

Translated by D. Parsons