In memory of Dmitriĭ Ivanovich Blokhintsev

B. M. Barbashov, G. V. Efimov, A. V. Efremov, B. B. Kadomtsev, and M. A. Markov

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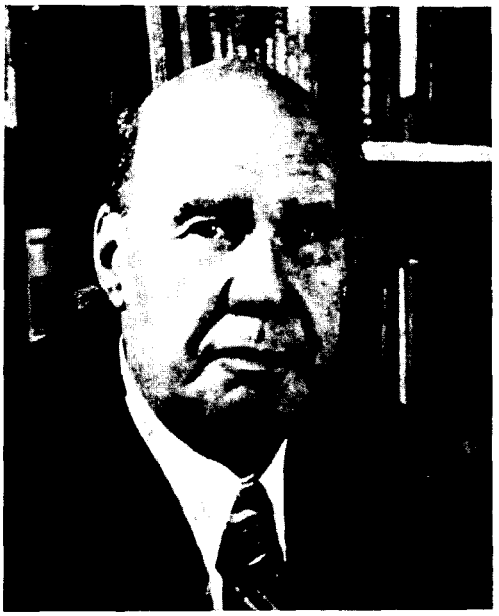
On January 27th, 1979 Dmitriĭ Ivanovich Blokhintsev died in his 72nd year. He was a leading Soviet physicist, a great administrator of scientific research, a Hero of Socialist Labor, Laureate of the Lenin and State prizes, associate member of the Academy of Sciences of the USSR, and member of the editorial board of the journal "Soviet Physics, Uspekhi."

The untimely death of D. I. Blokhintsev is a heavy loss for all who had the good fortune to know and associate with this remarkable man. The name of D. I. Blokhintsev is inseparably linked with the formation of atomic technology. He was one of those rare universal scientists who are able to encompass problems of physics ranging from profound mysteries of the microworld to engineering projects of large experimental installations, from atomic technology to the methodological foundations of science.

Dmitriĭ Ivanovich Blokhintsev was born on the 11th of January 1908 in the family of a student of the Petrovskaya Agricultural Academy, who later became an agronomist. In his childhood he was fascinated by technical design, aviation, rockets and astronomy and later, after becoming acquainted with the works of K. E. Tsiolkovskiĭ, he corresponded with him and carried out experiments with rocket motors. This acquaintance with the great scientist and with his perception of the world, at the foundation of which lay admiration for the beauty and harmony of the world and also the highest degree of respect for nature and man, was decisive in the future development of D. I. Blokhintsev.

After graduating from Moscow Technical College of Business and Industry he prepared to enter the Air Force Academy, but Rutherford's famous experiments in atomic fission compelled him to turn his attention to the remarkable possibilities of atomic energy, and this determined the future course of his life. He entered the physics department of Moscow University in 1926.

His teachers were the remarkable physicists and mathematicians L. I. Mandel'shtam, S. I. Vavilov, N. N. Luzin, D. F. Egorov and I. E. Tamm. I. E. Tamm had the strongest influence on D. I. Blokhintsev and became his director of studies in graduate school. Those were the years of the creation of quantum mechanics and of the explanation of many problematical physical phenomena with its help. The first works of D. I. Blokhintsev were connected with the explanation of a number of the electronic properties of metals and solids. In his first scientific publication (jointly with I. E. Tamm), published in 1932, the electron energy function for metals was calculated. Later he turned to the theory of electron movement in the periodical field of a crystal and generalized Bloch's theory for the case of overlapping bands. He obtained the formula for the energy of overlapping bands which permitted the explanation of a number of anomalous and thermoelectrical effects in metals. Solid-state current detectors were one of the objects of intense experimental studies in those years. The essence of this phenomenon was lost in the irrelevant details of models then proposed. D. I. Blokhintsev had shown that the effect of detection was connected with the appearance of the space charge near the surface boundary of semiconductors, which leads to the nonlinearity of Ohm's law. This idea was put at the foundation of specific calculations of semiconductor detectors.



DMITRIĬ IVANOVICH BLOKHINTSEV (1908-1979)

In the following years D. I. Blokhintsev became interested in optical phenomena. Studying the Stark effect in a strong alternating magnetic field, he had shown that the intensity of the light radiated by atoms depended nonlinearly on the intensity of incident light. This work, was apparently, the first investigation in nonlinear optics, which has developed so significantly in recent times.

Another puzzling phenomenon—the strikingly long fluorescence time of crystalline phosphors—attracted great interest at that time. Turning to this phenomenon, D. I. Blokhintsev showed that it is caused by the appearance of local electronic states in the forbidden energy gap with local deformation of the lattice or at impurities, and that this localization hindered the recombination of an electron with a "hole" in another place and considerably increased the fluorescence time.

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That work and following works dedicated to details of fluorescence kinetics and to the theory of heteropolar and colored crystals played an important role in the development of this aspect of the quantum theory of solids.

Even his early works reveal a profound understanding of quantum mechanics, a fresh point of view and an originality of thought which at times anticipated the future development of physics. Especially characteristic in this respect was his work on the calculation of "the shift of spectral lines caused by reciprocal action of the radiation field" (1938), which essentially contained the theory of Lamb's shift, discovered only ten years later. Unfortunately, this important work was not understood at that time and remained unpublished.[1)]

In 1934 Blokhintsev defended his doctoral dissertation and in 1936 was elected professor of theoretical physics at Moscow University. From that time his activity was closely connected with the physics faculty of Moscow University where he was chairman of the department of theoretical nuclear physics.

During those years he gave a variety of theoretical courses among which one should especially mention the course in quantum mechanics, which became the foundation of his widely known textbook "Foundations of Quantum Mechanics" which has gone through five editions in the USSR since 1944 and has been translated into five foreign languages.

From 1935 to 1947 D. I. Blokhintsev conducted intensive scientific work at the P. N. Lebedev Institute of Physics and directed the work of young Ukrainian physicists at the Kiev Institute of Physics. In the years before the war he concentrated his attention on theoretical questions of quantum mechanics: the conception of quantum ensembles, interpretation of the wave function as an objective characteristic of the quantum ensemble, the analysis of the measurement process. These works played an important role in the development of the methodological foundations of contemporary quantum mechanics. The monograph "Theoretical Questions of Quantum Mechanics" published in 1966 is a generalization of these studies.

The Second World War forced many institutes to shift their activity to problems of defense, in particular, to improving the sound locations of airplanes, to protecting ships from acoustic mines, and others. The group of acoustics specialists from the Institute of Physics of the Academy of Sciences (FIAN) worked on those problems. Existing theory allowed only for linear approximation in sound propagation laws in homogenous and stationary media. It was obviously insufficient. It was necessary to develop acoustic theory for inhomogenous and moving media. D. I. Blokhintsev, proceeding from the general equations of gasodynamics, obtained basic acoustic equations for the general case. Various acoustic phenomena in inhomogeneous and moving media (including turbulent media) for both subsonic and supersonic velocities were explained and calculated. Afterwards they were collected in the monograph "Acoustics of an Inhomogeneous Moving Medium," published in the USSR and abroad.

During the last years of the war and immediately after, the problem of the possession of atomic energy became very important for the USSR. From 1947 Blokhintsev actively participated in the development of Soviet atomic science and technology under the direction of I. V. Kurchatov. Kurchatov strongly influenced D. I. Blokhintsev's development as a director of large scientific and technical projects. Since that time the name of D. I. Blokhintsev has been closely connected with the history of the peaceful uses of atomic energy.

From 1950 he concentrated totally on work at the Institute of Physics and Energetics in Obninsk. When the Soviet government approved I. V. Kurchatov's proposal for the construction of the world's first atomic power station, the scientific direction of planning and construction was entrusted to D. I. Blokhintsev. In the middle of 1954 the First Atomic Power Station provided its first electricity. The station's 25-year period of successful performance has confirmed the correctness of the choice of reactor type and of the station's basic parameters. This work was awarded the Lenin prize.

It is natural that in those years theoretical and technological problems of chain reactions and atomic reactors attracted the special interest of D. I. Blokhintsev. He participated directly in the development of effective methods of calculation of slow and intermediate neutron reactors as well as industrially promising fast neutron reactors ("breeders"), and took part in the construction and initial operation of the first reactors of that type.

Reactors attracted the attention of D. I. Blokhintsev not only as the basis of power installations but also as an intense source of neutrons for the most diverse scientific applications. In the middle of the fifties when the construction of a reactor for research purposes was being widely discussed in Obninsk, D. I. Blokhintsev, in coauthorship with other scientists, made an original proposal—the fast-neutron pulsed reactor (FNPR), which worked by means of very short pulses. At a very small average power this reactor generated pulses no less powerful than the most powerful reactors of continuous operation. The modulation of the reactivity in the first reactor was made simply by rotating a disk with inserted fission material, which periodically for a very short time switched the reactor into the supercritical regime. It was built at the Laboratory of Neutron Physics in Dubna. After many years of operation this reactor has proven itself a remarkable instrument for studies in nuclear physics and in the physics of solids, liquids and elementary particles. Recently D. I. Blokhintsev was scientific director of planning for the improved and more powerful reactor FNPR-2.

In 1956 by the initiative of the Soviet government the joint Institute of Nuclear Research (JINR) was organized in Dubna. It united the efforts of the socialist countries in studies of elementary particles and the nature of nuclear forces, and of their peaceful uses. The

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[1)]See the review of Ya. A. Smorodinskiĭ. Uspekhi Fizicheskikh Nauk, 1949, v. 39, p. 325.

Committee of Plenipotentiary Representatives of eleven countries unanimously elected D. I. Blokhintsev first director of UINS. Leading scientists of the Soviet Union and socialist countries were attracted to the work at JINR. In addition to the two already existing laboratories for nuclear problems and high energies, three new laboratories—of nuclear reactions, neutron physics and theoretical physics—were organized, the last two at the initiative of D. I. Blokhintsev. During his tenure as director (1956-1965), the institute assumed its final organizational form and became a most important research center with international prestige and recognition, as well as an effective school for scientists of the socialist countries. In later years D. I. Blokhintsev was a director of the laboratory of Theoretical Physics of JINR.

In spite of his heavy administrative responsibilities, D. I. Blokhintsev continued his intensive studies in the physics of elementary particles, to which he had always been drawn. He studied the spectra of nucleons passing through matter, established the division of the nucleon's structure into central and peripheral regions, studied the hydrodynamic approach to the multiple creation of particles and showed how it contradicts the principles of quantum mechanics.

In connection with the discovery of "deuteron peaks" in the quasielastic scattering of high-energy protons by nuclei, D. I. Blokhintsev in 1957 proposed the idea of fluctuations in the density of the nuclear matter, which as a unit are capable of absorbing a large momentum.

This approach led to the possibility of a satisfactory description of the phenomenon in question and allowed him to predict the creation of "clusters" in nucleon-nucleus collisions. The idea of "fluctuons" attracted fresh interest 20 years later, when so-called "cumulating" particles had been found. At present these studies are developing in the new and promising direction of relativistic nuclear physics.

Fundamental problems of theoretical physics always attracted Blokhintsev. A number of his works were devoted to the quantum field theory. He first proposed the idea of the existence of several vacuums and of a spontaneous transition between them, which is used intensively in contemporary efforts to develop a unified theory of elementary particles. He first appreciated the contribution of weak interaction at high energies and showed the existence of the so-called "unitary limit," beyond which the appearance of completely new prospects in the physics of elementary particles was predicted. This led W. Panofsky to observe after Blokhintsev's lecture at Berkeley, "You work, it seems, for the distant future." Now only after 20 years physicists approached closely to the "unitary limit."

To resolve the problem of ultraviolet divergencies in the quantum field theory, he turned to the study of nonlocal and nonlinear interactions. The study of essentially nonlinear fields led him to the conclusion that the notion of point coordinates loses its meaning if the mass spectrum of a particle is limited from above, and leads to the necessity of a change in the microworld geometry. His monograph "Space and Time in the Microworld" (1970) dealt with these problems.

D. I. Blokhintsev always devoted much attention to the philosophy and methodology of science. In his papers ("Lenin and Physics," "On the Physical Foundations of Quantum Mechanics" and others) he often had to defend the dialectical interpretation of quantum mechanics. His last works in this direction were dedicated to the role of science in the contemporary scientific-technological revolution and to the relationship between pure and applied science.

D. I. Blokhintsev emphasized many times in his papers and speeches that a scientist must not stand apart from the life of society in a narrowly professional shell: "we may say 'Lord lettest now Thy servant depart in peace'[2] only when we are sure that our ideas and our creations will be used only for the good of people and only for their happiness." Of this his entire career as scientist and citizen serves as a striking example. D. I. Blokhintsev was a member of the Lenin Prizes committee, a member of the Soviet Committee for the Defense of Peace, a delegate to the XXII Congress of the Communist Party of the Soviet Union, and more than once was elected member of the Moscow regional Party committee. He was an advisor to the Scientific Council attached to the Secretary General of the United Nations, vice president (1963–1966) and president (1966–1969) of the International Union for Pure and Applied Physics of the UN (IUPAP).

The outstanding scientific services of D. I. Blokhintsev were marked by high rewards: the Lenin prize, twice the State prize of the USSR: he received the Golden Star of the order of Hero of Socialist Labor, four orders of Lenin, the order of the October Revolution, the order of the Red Banner of Labor and a number of other orders and medals of the USSR and the socialist countries.

In 1938 D. I. Blokhintsev was elected associate member of the Academy of Sciences of the Ukrainian Soviet Socialist Republic and associate member of the Academy of Sciences of the USSR in 1959. D. I. Blokhintsev was an academician of the Academia Leopoldina in the German Democratic Republic, an honorary member of the Hungarian Academy of Sciences, an honorary Doctor of Technical Sciences of the Higher Technical School in Prague, an honorary Doctor of Humboldt University in Berlin and of Karl Marx University in Leipzig, a member of the Bulgarian Physical Society.

Till the last day of his life Blokhintsev was full of ideas and creative plans. In one of his last works he proposed a simple explanation for the unexpectedly small time of conversation of ultracold neutrons, and he was studying one of the most difficult problems of contemporary theory—the problem of the retention of quarks.

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[2] *Editor's Note*: The Russian expression here, "nyne otpushchaeshi," is apparently a translation of "nunc dimittis" from Luke 2:29, the complete verse of which is given in the translation above.

D. I. Blokhintsev's many-sidedness revealed itself not only in his scientific but also in his aesthetic perception of the world. He was an original artist whose paintings were exhibited many times and reproduced in magazines. He was a poet and a profound and intelligent connoisseur of painting, sculpture and music.

His kindness and responsiveness, his talent as scientist and teacher, the breadth of his interests and avocations and his high principles attracted people to him. He taught many scientists who today are successfully at work in various areas of contemporary science and technology.

D. I. Blokhintsev accomplished much, and will be long remembered by those who knew, worked and associated with him.

Translated by D. Kirillov