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# VLADIMIR ANDREYEVICH BABESHKO
## (60th birthday tribute)†

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Vladimir Andreyevich Babeshko, Academician of the Russian Academy of Sciences, Rector of Kuban' State University and Vice-President of the Union of Rectors of Russia, celebrated his 60th birthday on 30 May 2001.

V. A. Babeshko was born in the village of Novotitarovskaya in the Dinsk district of the Krasnodar region. Having graduated with distinction from the Mechanics and Mathematics Faculty of Rostov State University in 1964, and then having completed (ahead of schedule) a post-graduate course, he defended his Master's thesis in 1966 and his Doctor's thesis in 1974. He worked as Professor of the Department of Elasticity Theory of the Rostov State University, from 1971 to 1982 he was Deputy Director of the Scientific Research Institute of Mechanics and Applied Mathematics of Rostov State University, and from 1982 he was Rector of Kuban' State University. In 1987 he was elected as a corresponding member of the Russian Academy of Sciences, and in 1997 as a full member of the Academy.

Professor Babeshko is a reknowned specialist in the field of continuum mechanics and has developed remarkable ideas and obtained first-class results in the field of mixed problems of elasticity and electroelasticity theory, equations of mathematical physics, and acoustics. He has brought his organizational talent to bear in science, and his work has determined the main direction of research of many of his pupils and colleagues in Russia and abroad. His scientific interests cover almost all areas of

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continuum mechanics: problems of geophysics, seismology, foundation building, machine building, acousto-electronics, flaw detection, geoecology, and mathematical models in economics.

His scientific activity has been characterized by a combination of rigorous thinking and the ability to explain complex effects simply. His rare ability to anticipate the scientific result of research, the gift of generating ideas, a depth of inference, and a high level of research make it possible to speak of him as an outstanding mechanics scientist. In his work, classical methods for solving dynamic mixed problems, including contact problems, developed by N. I. Muskhelishvili, I. N. Vekua, F. D. Gakhov, V. D. Kupradze, M. G. Krein, I. Ts. Gokhberg, and others, and based on reducing boundary-value problems for differential equations to singular integral equations, have been developed further.

Using multidimensional integral transformations and factorization of relatively special multidimensional manifolds, he developed a method for reducing the boundary-value problems for differential equations to systems of multidimensional integral equations convenient for subsequent investigations. He was the first to demonstrate the unique solvability of a number of basic dynamic contact problems of elasticity theory for non-classical regions, and also to show in what cases uniqueness is lost.

He can be credited with developing new methods for solving systems of multidimensional integral equations. In this case he had to generalize and substantially develop the method of factorization, developed by *N. Wiener* and *E. Hopf*, for the case of matrix functions of many complex variables. He proposed effective algorithms for the numerical factorization of functions and matrix functions arising in problems for an elastic layer and multilayer media, and created a number of methods for solving integral equations: the method of infinite systems, the method of fictitious absorption, and the method of generalized factorization, which are widely used in the mechanics of deformable bodies.

These methods were used to solve problems which could not easily be solved by other methods. The body of mathematics he developed for analysing multidimensional systems of integral equations made it possible to investigate dynamic mixed problems of the mechanics of deformable bodies in the presence of combinations of inhomogeneities. The theory of the propagation of elastic waves in multilayer inhomogeneous structures with parallel oriented inhomogeneities of limited dimensions (punches on the surface of media, inclusions, voids/cracks, cover plates, electrodes, etc.) was constructed, generalizing investigations carried out by Rayleigh, Love, Stonely, V. A. Fok, L. M. Brekhovskikh, and other scientists. This theory has numerous applications – in particular, in seismology it enables the Earth's structure to be modelled considerably more accurately.

He also proposed the theory of directed seismic antennae excited by phased vibroseismic sources, and developed the theory of the control of wave flows of different types of waves under the Earth's surface. Through his work, Russia has occupied a leading position in this field.

The theory of wave processes in unbounded media with inhomogeneities which he constructed enabled him, together with academicians I. I. Vorovich and I. F. Obraztsov, to discover the effect termed high-frequency resonance, the possibility of which had previously been ruled out. It was established that, for certain combinations of inhomogeneities (cracks, inclusions, etc.) and certain ratios of their sizes and other parameters, the wave process can be localized in the zone of inhomogeneities, and here large strains arise and resonance can occur at finite energy. In previous models simulating the layered Earth, infinite energy was required. Babeshko derived general conditions for the localization of the wave process and the existence of resonances for combinations of different inhomogeneities.

After corroboration by the United States of the Russian priority, the phenomenon was recognized as a scientific discovery ("The phenomenon of high-frequency resonance in semibounded media with inhomogeneities", 1994), and was later found in fluid mechanics, electrodynamics and ecology. This discovery became the basis for the development of new principles of energy-saving vibration action on deep layers of the Earth, zones of seismic activity for reducing the stress level, and oil deposits with the aim of increasing oil recovery from wells. The phenomenon made it possible to give a rigorous theoretical substantiation to the Oliner principle, established experimentally, which is wisely used in electronics. The discovery initiated the construction by Babeshko of a new theory related to classification of the types of inhomogeneity localizing the wave process and causing resonances that threaten fracture. Such combinations were termed vibration strength viruses.

The body of mathematics in Professor Babeshko's works was always developed for practical purposes.

In particular, the design of the rectangular foundation of the most powerful turbine-driven unit in the world at the Kostroma Gas Distribution and Power Station was carried out under his direct supervision. As a result, the principles of the original method of solving one of the most fundamental problems of three-dimensional elasticity theory – the construction of characteristic (standard) solutions for the neighbourhood of the vertices of polyhedral angles – were laid down.

He solved important applied problems related to flaw detection in the welds of oil pipes, the determination of the seismic stability of buildings and constructions, and the analysis and synthesis of

radioelectronic devices based on surface acoustic waves. He has paid a great deal of attention in recent years to the use of these methods to solve problems in ecology (the strength of industrial structures and waste dumps, and the prevention of pollution when industrial accidents and catastrophes occur) and efficient resource management (the search for mineral resources, and methods of increasing oil recovery from deposits using directed vibration from surface seismic sources).

For almost 20 years, he has been rector of the Kuban' State University (KSU), where he was able within a short time to set up a team of like-minded colleagues. Today's high scientific potential of the KSU is associated in many ways with his name. He is paying a great deal of attention to increasing the material base of the university, to the development of modern scientific areas, to improving training, and to the use of scientific developments of colleagues in the interests of the Krasnodar region. In the North Caucasus, he created a geophysical test range which uses the most powerful vibroseismic sources at present available. As a result of his efforts and those of his pupils, experiments carried out in this test range have raised research on the vibration exposure of the Earth to the international level, as indicated by the fact that the KSU is the only seat of higher education in the Russian Federation that is a member of the Incorporated Research Institutions for Seismology (IRIS) in the US, providing rapid seismic information via the Mirnet system.

His organizational activity has resulted in major joint international scientific projects at the KSU with a number of universities of the United States, Greece, Turkey, Ukraine, and other countries.

He is making a large contribution to the training of highly skilled specialists, as Head of the Department of Mathematical Modelling. He is an excellent teacher and very interesting company.

He has published over 300 scientific papers, including six monographs; he also has several inventions and patents to his name.

Professor Babeshko set up the authoritative Scientific School of Dynamic Contact Problems and Seismology in South Russia, and among his pupils there are 47 masters of science and eight doctors of science. The results of the research by him and his pupils is widely known both in Russia and abroad.

The contributions of Professor Babeshko, a scientist of world renown whose entire working life has been devoted to serving his country, have ben recognized with high government awards: the "Badge of Honour" (1982) and "Friendship of Nations" (1986) orders, and the Vavilov medal (1990). He is a winner of the Lenin Komsomol Prize (1973), a Soros Professor, and an honoured figure in the scientific life of the Kuban' and Adige. He is a member of the Higher Certification Committee, of scientific and technical councils of the Ministry of Education of Russia and the Russian Academy of Sciences (RAS), of the Department of Problems of Engineering, Mechanics, and Control Processes of the RAS, of the Economic Council of the Government of the Krasnodar Region and of the editorial boards of a number of journals, and the Editor-in-Chief of the journal *Priroda, Obshchestvo, Chelovek* (*Nature, Society and Man*).

He carries out a great deal of organizational work, being Vice-President of the Union of Rectors of Russia and Chairman of the South Russia Division of the High School International Academy of Sciences.

His scientific contribution received worldwide recognition with his election in 1990 as a member of the Acoustical Society of America (ASA).

His modesty, charm, wide erudition, straightforwardness and intelligence, and his constant concern for and interest in people, have earned him the respect and admiration of his colleagues and pupils. A strong feature of his character is the responsiveness of his heart and mind, and his dedication.

His many pupils, friends and colleagues, and the editorial board and editorial staff of the journal *Prikladnaya Matematika i Mekhanika*, wish him a happy birthday, good health, many joys in life, and new accomplishments and fine ideas.

*Translated by* P.S.C.