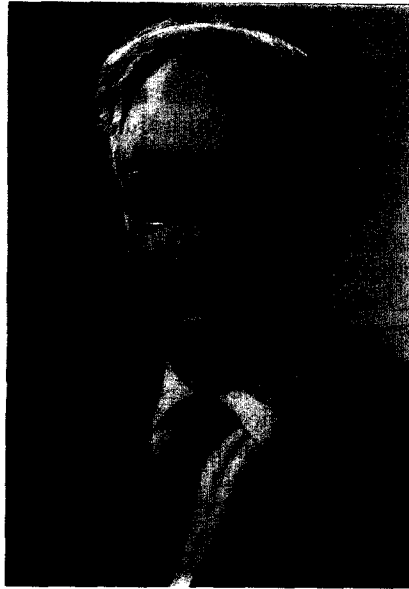




## LEONID IVANOVICH SEDOV† (14.11.1907–05.09.1999)



The outstanding scientist, Academician Leonid Ivanovich Sedov, who laid the foundations of a number of branches of modern mechanics, passed away on the 5th of September 1999. He was the founder of a large scientific school concerned with continuum mechanics which is known all over the world. He also did much to establish the world-wide prestige of Russian science and the development of international links in the field of mechanics and space flight which has had a fruitful effect on the progress and purity of science. His contribution to the creation of a healthy, creative environment in scientific society and to improving the teaching of mechanics and the preparation of new highly qualified personnel is inestimable.

He was one of the few academics who formed the style and nature of modern mechanics over a period of more than half a century in this country after N. Ye. Zhukovskii and S. A. Chaplygin. A brilliantly gifted scholar as a young man, after graduating in 1931 from Moscow University he carried on the work of his great Russian predecessors and set about developing a number of the major branches of modern continuum mechanics, starting with the mechanics of an ideal fluid until the solution, in the 1990s, of certain fundamental problems in the Special and General Theory of Relativity. The breadth of his creative range and depth of development in so many branches of mechanics is striking. He provided the solution of a number of interesting problems in the aerodynamics of the steady and unsteady motions of an ideal fluid with numerous applications, constructed a general theory of wave drag in the motion of ships, provided new flow schemes with the aim of reducing drag, etc. These early investigations were summed up in his first monograph *Plane Problems of Hydrodynamics and Aerodynamics* (1936) which was published three times in Russian and twice in English. He subsequently investigated general problems of the turbulent motions of a homogeneous fluid and a fluid with drag-reducing additives of polymers. He made an outstanding contribution to the gas dynamics of compressors and turbines, high-speed aerodynamics and the development and application of the methods of similarity and of dimensions in mechanics and in the technique of the analysis and treatment of experimental data. He created a general theory of self-similar motions of continua, actively developed with his students and disciples a theory of the mechanics of continua with complicated physicochemical properties which takes

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account of the effects of irreversibility and non-holonomicity, laid the foundations of the theory of motions of chemically reacting mixtures and constructed a model of a complex medium with pulsating gas bubbles in a liquid. He developed mathematical models of continua with additional thermochemical and electromagnetic parameters and established the non-linear constitutive equations for a generalized theory of elasticity with finite deformations and phase transitions. In the General Theory of Relativity, he developed representations on the form of the energy–momentum tensor of a substance in the presence of electromagnetic fields and solved the problem of inertial navigation.

In 1945, he was the first to publish the solution of the self-similar problem of a very intense explosion. It found wide application in calculations of the impact of a nuclear explosion and in hypersonic aerodynamics, and is a pearl among the classical results of gas dynamics.

Subsequently, he successfully used the methods of self-similar solutions in the general theory of the structure of the steady and variable Cepheid stars; new effects in the dynamics and explosive processes in new supernovae were revealed, and known empirical laws were also theoretically interpreted.

Methods for obtaining self-similar solutions with many examples were published in his brilliant book *Similarity and Dimensional Methods in Mechanics*. The number of editions and re-editions of this book has not been surpassed; there are 10 in Russian and several in other languages (English, Chinese, French, Polish, Czech, Vietnamese and others).

The results that he and his coworkers obtained in the field of relativistic mechanics were reflected in the original monograph which he wrote together with his pupil entitled *Foundations of Macroscopic Theories of Gravitation and Electromagnetism* (1989).

These books define the level of advancement of world science in the corresponding branches of mechanics and for many years to come will serve as an object of study and imitation by following generations of researchers in the field of mechanics. His work, which was generally on theoretical problems (in his thinking, he was a theoretician) did not prevent him from solving special-purpose problems in developing technologies. He brought clarity to many problems of technology and helped to solve them. In a number of branches of technology, his ideas, suggestions and specific scientific results have found important practical embodiment. These include shipbuilding, in particular, the submarine fleet, aviation, rocketry and space technology, explosive with peaceful and military uses, electrodynamics, chemical engineering and many other applications associated with the progress in science and technology in the second half of the twentieth century.

The clearest and rational formulation of a problem, mathematical rigour, the clarity of the solution and the depth of its analysis characterize his scientific approach. Together with this, he looked profoundly into experimental work, evaluated experimental results of a fundamental nature, actively participated in the applications of the theoretical results he obtained and was the author of many patents (he was awarded the title “Inventor of the USSR” and was proud of this). One was always struck by the breadth of his scientific interest, erudition and the depth of his investigations in many of the different branches of mechanics.

His talent also showed up in his teaching. He loved teaching, performing his tutorials with enthusiasm and spirit, devoting much of his effort and time to it and giving lectures while being in charge of departments at the Moscow Aviation Institute (1931–1935), the V. V. Kuibyshev Military-Engineering Academy (1938–1941), the Moscow Polygraphic Institute (1947–1950), and the Moscow Institute of Physics and Technology (1950–1953). From 1937, he was a professor and, from 1953, head of the Department of Hydrodynamics at Moscow University which he directed until the end of his life. Here, in his alma mater, he fully revealed his talent as a teacher and educator of young scientists. His lectures, which were rich in content, in hydromechanics, the mechanics of continua, his direction of numerous scientific seminars and undergraduate, post-graduate and doctoral work give birth to the large world-famous Sedov scientific school, in which there are scholars of all ranks from holders of a first higher degree to academicians and all categories from experimentalists to pure theoreticians. Many of them, who had simply attended his lectures and his well-known Moscow seminars, which always took place in a large auditorium with both young, old and venerable scholars present, referred to him by the name of “Teacher”. For many years, this Moscow seminars were regularly held in the old building of Moscow State University and, subsequently, in the Mathematical Institute. It now still continues to take place under the direction of his former students. Even just belonging to the Sedov scientific school enhances the scientific standing of his students; they carry the imprint of the grandeur of the “Teacher”. His well-known two-volume university textbook *The Mechanics of Continua* appeared in 1968 as a result of his many years activity in research and teaching as well as those of his students. In 26 years, more than five editions have been published and it has been translated in many countries.

In recent years he has carried with pride the title of “Professor Emeritus of Moscow University”, a symbol of his enormous service to science and education.

His role in establishing and developing scientific links between the scholars in the field of mechanics in this country and their overseas colleagues is inestimable. His regular participation since the mid-1950s in international conferences opened up to foreign scientists the very high level of research in mechanics in this country and created permanent interest in the scientific results of Russian scientists. The high sense of duty to the homeland helped him as a representative on the standing interdepartmental committee for the coordination and control of research in the field of the organization and implementation of interplanetary communications (1957–1968) where he properly and authoritatively presented abroad the outstanding, pioneering achievements of the Soviet Union in space exploration at the early stages of its triumphant achievements, at annual international congresses on astronautics. During these years, he was a symbol of the first achievement of our science and technology in space exploration and, for a long time, he was given the name “Padre del Sputnik”. His compulsory (due to the strictest state secrecy) crucial mission was perceived by the majority of outstanding constructors in rocketry and space technology in this country with understanding. The “Chief theoretician of space exploration”, M. V. Keldysh who, up to the last years of his life, had maintained the warmest and friendliest relations with Sedov, imposed this mission on him. Sedov was recognized abroad as the leader of our scientists in the field of mechanics, he made use of his enormous authority and was constantly selected for the leading posts in international unions and federations.

From 1956 until the end of his life, he was a member of the General Assembly of the International Union of Theoretical and Applied Mechanics (IUTAM), for 20 years (1964–1984) he was a member of the IUTAM office and, for almost a quarter of a century, was at the helm of the International Astronautical Federation (he was vice-president from 1957–1959 and 1961–1980 and president from 1959–1961). Together with T. von Karman, he was one of the founders of the International Academy of Astronautics and he was a member of its praesidium and vice-president.

From 1953 he was the permanent Editor-in-Chief of the abstracts journal *Mekhanika*. He was the Editor-in-Chief of the journal *Kosmicheskiye Issledovaniya (Space Research)* since 1962 and, for more than 30 years, managed a section of the Main Editorial Board for physico-mathematical literature of the Nauka Publishing House.

Over a period of more than 40 he was a member of the Editorial Board of the journal *Prikladnaya Matematika i Mekhanika (Applied Mathematics and Mechanics)*. His very active participation in the work of the Editorial Board made a major contribution to maintaining the high scientific reputation of the journal.

Simultaneously, he was a member of the editorial boards of a number of academic journals (*Doklady Akademii Nauk, Mekhanika Zhidkosti i Gaza and Astrofizika*) and six foreign scientific journals. He was also a permanent representative (for more than 30 years) of the Scientific Council of the Academy of Sciences of the Fluid Mechanics. Together with N. I. Muskhelishvili, in 1956, he founded the USSR National Committee (subsequently renamed the Russian National Committee) on Theoretical and Applied Mechanics and over a period of a quarter of a century, he was the First Deputy President of this committee.

In 1959, he actively participated in the creation of the Research Institute of Mechanics at Moscow State University, in which the principal leading posts were occupied and the majority of the scientific trends were led by his most talented former students who had brought fame to one of the world centres in the development of mechanics. The study at the Institute of Mechanics in which he worked was the place where seminars took place, new ideas were born, important scientific reports were put together and new current scientific trends were conceived. His students walked into this study without knocking!

Sedov was never an administrator in the generally accepted sense of this world. He was Deputy to the Chief of Research at the NII-1 (1947–1949, where, in particular, an aerodynamic supersonic rocket with an air-breathing engine was built for strategic purposes which, at the time, far outstripped anything developed in the USA and other countries) and he held the same post at the P. I. Baranov Central Institute of Aircraft Motor-Building (1949–1955, where he was personally occupied with extremely urgent problems, associated with the analysis of operating schemes and with the examination and presentation of the results of experiments on the compressors and turbines of aircraft engines) and, from 1945, he was senior scientific officer and, subsequently, head of the Division of Mechanics of the V. A. Steklov Mathematical Institute of the Russian Academy of Sciences. His direction involved the active encouragement of a creative scientific start-up for the research group, the determination of the major research lines to be followed, the battle with routine, and supporting potentially promising trends in science and technology.

Also to be mentioned his numerous speeches and publications on matters of principle in science, on the honour and merit of the academic, on the need for scientific criticism, and on the pernicious impact of administration by mere injunction on science; they have played an important role in the organization of science in this country.

The mother country rewarded his outstanding scientific-pedagogical and scientific-organizational activities by conferring on him the title of “Hero of Socialist Labour” and awarding him with five Orders of Lenin, two Orders of the Red Banner of Labour, the order of the “Badge of Honour” and many medals. He was awarded the State Prize of the USSR (1952), the M. V. Lomonosov Prize of Moscow State University (1954), the S. A. Chaplygin prize of the USSR Academy of Sciences (1947), and A. N. Krylov prize of the Academy of Sciences of the Russian Federation (1998), the A. M. Lyapunov gold medal of the USSR Academy of Sciences (1974) and the Yu. A. Gagarin medal (1984). He was also awarded gold medals of the Exhibition of Economic Achievements and many orders, medals and prizes of various international academics and scientific societies. He was elected as honorary and full member of more than 15 international academies and scientific societies.

His scientific activity covered a whole epoch in the development of mechanics in this country, he determined its character for many years and he was proud of it. His selfless devotion and service to science is a shining example to be imitated.

The happy memory of the outstanding Russian scientist, Academician Leonid Ivanovich Sedov will always remain in the hearts of his numerous students, colleagues and the followers of his achievements for the well-being of the fatherland.

*Translated by E.L.S.*