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LEONID IVANOVICH SEDOV
(on the 100th anniversary of his birth)☆

The 14th November 2007 marks the 100th anniversary of the birth of an outstanding scientist of our time, Academician Leonid Ivanovich Sedov. His contribution to classical and modern mechanics was great. His scientific achievements were recognized worldwide. Academician M. A. Lavrent'ev said of him: "Leonid Ivanovich Sedov is a brilliant representative of Russian science and its pride".

Professor Sedov laid the foundations for many modern branches of mechanics that have been productively developed up to the present, and he founded the great scientific school of continuum mechanics which is world famous. In the second half of the twentieth century, he did much to affirm the worldwide prestige of Russian science and to develop international ties in the area of mechanics and astronautics, influencing the progress of science and education. The path that he took through life is a brilliant example of the selfless serving of science and covers an entire epoch in the development of mechanics in Russia. His contribution to ensuring the healthy creative conditions in the scientific community, to the improvement of the teaching of mechanics, and to the training of new highly skilled personnel is invalueable.

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His scientific activity, which began, after he graduated from Moscow State University in 1931, in the Central Aerohydrodynamic Institute (TsAGI) under the patronage of Chaplygin, was associated with the solution of a number of what were then central problems of the aerohydrodynamics of steady and unsteady motions of an ideal fluid with numerous applications, and in particular was associated with the construction of the general theory of modelling the drag of bodies during their motion in a fluid. These and other results were the subject of his doctoral dissertation 'The theory of plane motions of an ideal fluid' (1937). His work on this topic culminated in the monograph 'Plane Problems of Hydrodynamics and Aerodynamics' (1939), of which there were three subsequent editions in Russian and two in English. He continued to study the motions of an ideal fluid until the end of his life with his colleagues from TsAGI and collaborators at the Institute of Mechanics of Moscow State University. The construction of the general theory of wave drag during the motion of ships was completed, new patterns of flow of an ideal fluid were discovered, including those with the formation of cavity zones in order to reduce drag, etc. These patterns were confirmed experimentally.

His research covered a wide range of problems. These were general problems of turbulent flows of homogeneous fluid and fluid with small polymer additives reducing the drag of bodies. He made a great contribution to the gas dynamics of compressors and turbines and high-speed aerodynamics (working as Deputy Head of Scientific Research at the P. I. Baranov Central Institute of Aviation Motors (TsIAM) in 1949–1954). From 1937 he was a Professor and from 1953 a Director of the Department of Hydromechanics of Moscow State University. This department attracted not only the most talented students from the Faculty of Mechanics and Mathematics of Moscow State University but also promising graduates from universities of other cities, who came to carry out postgraduate work in the department. Many of them became academicians, prominent professors and teachers and employees at research and design organizations.

In the 1950s, Sedov and his students in the department developed a general theory of self-similar motions of continua, and many of his postgraduate students defended thesises on self-similar solutions of various new problems of continuum mechanics. In 1945, Sedov himself was the first to obtain the solution of the self-similar problem of strong explosion. The successful solution of this problem was ensured by obtaining the finite integral of a system of equations by considering the theory of similitude and dimensions with spherical, cylindrical and plane waves. It was widely used when calculating the action of a nuclear explosion, and modelling the drag of bodies at hypersonic speed, and is a pearl among classical results in gas dynamics.

Subsequently, he successfully used methods of self-similar solutions in the general theory of the structure of Cepheid stars, new effects were revealed in the dynamics and explosive processes of new and supernova stars, and well-known empirical behaviour patterns in the stellar astrophysics were interpreted. Methods of obtaining the self-similar solutions with multiple applications were set out in his monograph "Methods of Similitude and Dimensions in Mechanics", widely known and popular among applied mathematicians and physicists throughout the world. The book was first published in 1944, and there were 11 editions in Russian and several editions in English, Chinese, French, Polish, Czech, Vietnamese and other languages. This is a reference book for all mathematicians, and the methods of similitude and dimensions are now always included in student programmes of Mathematics and Mechanics faculties of Russian universities.

As a result of generalizing the requirements of the first and second laws of thermodynamics in the form of the principle of virtual work, Sedov formulated the basic variational equation from which already known models stemmed, and from which new models were also constructed (in particular, within the framework of the general theory of relativity).

Fundamental results obtained by him and his students in the field of relativistic mechanics were outlined in Sedov's original monograph, written jointly with his student A. G. Tsypkin, "The Principles of Macroscopic Theories of Gravitation and Electromagnetism" (1989).

Being a theoretician, he carried out detailed experimental investigations, posed and generalized experimental problems, took an active part in applications of his own theoretical results and produced many inventions (he was awarded the title "Inventor of the USSR", something in which he took great pride).

Professor Sedov's talent was also revealed in his teaching. He loved to teach, and did this skilfully, with enthusiasm and emotion, devoting much effort and time to it. He gave lectures and headed 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 1953 he was a Director of the Department of Hydromechanics at Moscow University, which he ran until the end of his life. Here, in Moscow State University, his alma mater, his talent as a teacher and educator of young scientists was fully realized. The management of many scientific seminars and the work of undergraduates, postgraduate students and doctoral candidates gave birth to the world-famous Sedov Scientific School, in which there are scientists of all classes, from masters of

science to academicians, and all categories, from experimentators to pure theoreticians. He is referred to as "teacher" by many of those who simply attended his lectures and his famous all-Moscow seminars which always attracted a huge audience – from young to old and eminent scholars. Just belonging to his school raises the scientific rating of students – they bear the mark of greatness of their teacher. A revolutionary new phase in teaching the hydromechanics and mechanics of deformable solids was marked by the appearance of the original monograph "An Introduction to Continuum Mechanics" (1962), with which Sedov made a considerable contribution to the development of continuum mechanics from a collection of individual disciplines into a unified science. In subsequent years, the famous two-volume university textbook 'Continuum Mechanics' (1968) appeared, which during the following 26 years was reprinted 5 times and which can be found in bookshops in many countries. Continuum mechanics is now taught not only in universities but also in technical colleges.

The part he played in the establishment and development of scientific ties between Russian mathematicians and their foreign colleagues in the period in which the "iron curtain" existed was invaluable. His regular participation (from the mid-1950s) in international conferences demonstrated to foreign scientists the high level of mechanics research in Russia and raised an interest in the scientific results of Russian scientists.

In the 1950s and 1960s, Professor Sedov symbolized the first advances of Russian space science and technology, worthily representing their successes abroad. He was recognized abroad as a leading Russian applied mathematician, commanded huge authority and was constantly being appointed to management posts of various international scientific unions and federations.

From 1956 until the end of his life, Sedov 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 bureau of this union and for almost a quarter of a century he stood at the head of the International Astronautics Federation (in 1957–1959 and 1961–1980 he was its vice-president, and in 1959–1961 he was its president). Together with T. von Karman, he was one of the founders of the International Academy of Astronautics and was a member of its presidium and vice-president.

From 1953, Professor Sedov was permanent editor-in-chief of the reference journal *Mekhanika*, he was editor-in-chief of the journal *Kosmicheskiye Issledovaniya* and from 1962, for more than 30 years, he headed the main editorial board on physics and mathematics at the publishing house Nauka. For more than 40 years he was a member of the editorial board of the journal *Prikladnaya Matematika i Mekhanika*. His most active participation in the work of the editorial board was his great contribution to maintaining the high scientific prestige of our leading mechanics journal. At the same time he was a member of the editorial boards of a number of academic journals (*Doklady Akademii Nauk, Izv. Ross. Akad. Nauk Mekhanika Zhidkosti i Gaza, and Astrofizika*) and six foreign scientific journals, and for over 30 years he was a chairman of the Academy of Sciences Scientific Council for Fluid Mechanics. Together with N. I. Muskhelishvili, in 1956 he founded the USSR National Committee of Theoretical and Applied Mechanics, and for a quarter of a century he occupied the position of first deputy chairman of this committee.

Professor Sedov took an active part in the setting up the Scientific Research Institute of Mechanics at Moscow State University (1959), in which the main managerial positions and most scientific specializations were taken up by Sedov's most talented students and, in turn, by their students. The study where he worked at the Institute of Mechanics was a place where seminars were held, new ideas originated, important scientific reports were presented and new scientific areas originated. His students would drop into his study without knocking, and he would always greet them warmly, listening to their achievements and requests, and giving wise advice.

Professor Sedov was never an administrator in the generally accepted sense of this word, and when he was a deputy head of scientific research at the NII-1 (1947–1949, where, in particular, the strategic winged supersonic jet-engine rocket was built, far ahead of developments in the USA and other countries) and deputy head of TsIAM (1949–1955), where he personally dealt with extremely pressing problems concerned with the analysis of working schemes, and with the testing and presentation of the test results of aero-engine compressors and turbines, and from 1945, when he worked initially as a senior research fellow and then as a head of the mechanics section of the V. A. Steklov Mathematical Institute of the Russian Academy of Sciences, his management role consisted of the active encouragement of creative research in the team, in determining the main scientific directions, in combating routine and in supporting promising branches of science and technology.

Mention must be made of his numerous lectures and publications on the adherence to principles in science, on the honour and virtue of the scientist, on the need for scientific criticism, and on the pernicious influence of administration in science; he played an important role in organizing and maintaining a high level of science in Russia.

His country highly valued his teaching and organizational activity, and he was named a Hero of Socialist Labour and awarded five Orders of Lenin, two Red Banner of Labour orders, a "Badge of Honour" order and many medals. He was awarded the State Prize of the USSR (1952), the M. V. Lomonosov Moscow State University Prize (1954), the S. A. Chaplygin Prize of the USSR Academy of Sciences (1947), the A. N. Krylov Prize of the Russian Academy of Sciences (1998), the A. M. Lyapunov Gold Medal of the USSR Academy of Sciences (1974) and the Yu. A. Gagarin medal (1984), and he was awarded many orders, medals and prizes by various international academies and scientific societies. He was elected an Honorary and Full Member of over 15 international academies and scientific societies.

Eight years have passed since he died. His acute sense of what held promise and his ability to understand the importance of problems determined the progress of the scientific activity of his school, which continues to thrive and develop. As before, in the Department of Hydromechanics at Moscow State University, new young talents, doctoral candidates, doctors of sciences and academicians are appearing. The research teams he had created at the V. A. Steklov Mathematical Institute and the Institute of Mechanics at Moscow State University, and also his numerous students in many applied institutes and teaching establishments, are continuing research in the most important branches of science.

Professor Sedov was a brilliant representative of twentieth-century world science and a creator of new branches of continuum mechanics. His name will always stand alongside the names of the great Russian mathematicians of the twentieth century – N. Ye. Zhukovskii, S. A. Chaplygin, M. V. Keldysh, A. N. Kolmogorov and S. P. Korolev, and alongside the names of famous foreign scientists – T. von Karman, J. Taylor and W. von Braun. He commanded huge authority abroad. In one French scientific journal it was stated that the most outstanding, great scientists of the twentieth century were Joliot-Curie, Robert Oppenheimer and Leonid Ivanovich Sedov.

The scientific legacy of Professor L. I. Sedov and his many students will stay in the history of mechanics forever.