Steklov, Vladimir Andreevich | Encyclopedia.com

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(*b* Nizhni Novgorod [now Gorky], Russia, 9 January 1864;

d. Gaspra, Crimea, U.S.S.R., 30 May 1926),

Mathematics, mechanics.

Steklov's father, Andrey Ivanovich Steklov, a clergyman, taught history and was rector of the Nizhni Novgorod seminary; his mother, Ekaterina Aleksandrovna Dobrolyubov, was a sister of the revolutionary-democratic literary critic Nikolay Dobrolyubov. In 1874–1882 Steklov studied at the Alexander Institute in Nizhni Novgorod; after graduation he entered the department of physics and mathematics at Moscow University, transferring a year later to Kharkov. A. M. Lyapunov, who had been lecturing there since 1885, soon became his scientific supervisor. In 1887 Steklov passed his scientific supervisor. In 1887 Steklov passed his final examinations, and the following summer it was suggested that he remain at the university to prepare for an academic career. He was appointed university lecturer in mechanics in 1891; two years later he presented his master's thesis, and in 1896 he was named extraordinary professor of mechanics. After defending his doctoral dissertation in 1902, Steklov was elected professor; Lyapunov then moved to St. Petersburg, and Steklov obtained the chair of applied mathematical society, he served successively as secretary (1891), deputy chairman (1899), and chairman (1902–1906).

In 1906 Steklov transferred to the chair of mathematics at St.Petersburg University. His profound lectures, open sympathy with the aims of progressive students, and acute criticism of the tsarist order–especially at the universities–added new dimensions to the scientific and educational activity of the department of physics and mathematics and attracted numerous students. In St. Petersburg, Steklov laid the foundations of the school of mathematical physics that achieved considerable distinction, particularly after the October Revolution. Among his pupils were such prominent scientists as A. A. Friedmann, V. I. Smirnov, and Y. D. Tamarkin.

In 1910 V. Steklov was elected a member of the Academy of Sciences (he had been a corresponding member since 1902), and in 1916 he became a member of its board of directors. From then on, especially after becoming vice–president of the Academy in 1919, Steklov devoted most of his time to that organization. During the civil war, military conflicts, economic decline, and the early phases of reconstruction, he proved to be a brilliant scientific administrator. For eight years he worked tirelessly to maintain, and later to enlarge, the activity of the Academy and to reorganize it in order to bring science and practical requirements closer together. This work embraced all aspects of academic activity, from repairing old buildings and restoring the network of seismic stations to publishing academic proceedings and books, providing foreign periodicals for libraries, and organizing new institutes within the Academy. The Institute of Physics and Mathematics was organized in 1921 on Steklov's suggestion, and he served as its director until his death. In 1934 this institute was divided into the P. N. Lebedev Institute of Physics and the V. A. Steklov Mathematical Institute, both of which became centers of scientific activity.

Along with organizational work, Steklov continued his scholarly pursuits. In his later years he produced a series of articles on the theory of quadratures and on Chebyshev's polynomials, a monograph on mathematical physics, a popular book on the importance of mathematics for mankind, and biographies of Galileo and Newton.

Steklov's early works were devoted mostly to mechanics. In his master's thesis he pointed out the third case in which the integration of equations of a solid body moving in an ideal nonviscous fluid (under certain suppositions) is reduced to quadratures. The two earlier cases were described in 1871 by Rudolf Clebsch, and the fourth (and last) by Lyapunov in 1893. Steklov also treated problems of hydromechanics.

Steklov's principal field of endeavor, however, was mathematical physics and corresponding problems of analysis. Many problems of potential theory, electrostatics, and hydromechanics are reduced to the boundary-value problems of Dirichlet and Neumann when it is necessary to find a solution of Laplace's differential equation satisfying some boundary conditions on a surface S enclosing the region under consideration. Although Neumann, Hermann Schwarz, Poincarè, G. Robin, E. Le Roy, and others had suggested methods of solving such problems, they did not elaborate their rigorous grounding, and their methods were applied to relatively restricted classes of surfaces. The precision of analysis in the general investigation of the problem was first achieved by Lyapunov and Steklov. Steklov presented the first summary of his studies in this field in his doctoral thesis and in the articles "Sur les problèmes fondamentaux de la physique matheèmatique" and "Thèorie gènèrale des fonctions fondamentales." He made a valuable contribution to the theory of fundamental functions (Poincarè's term) or, to use a contemporary expression, the theory of eigen functions depending in a particular way upon the character of the surface S and forming on the surface a normal and orthogonal system; the solution of the boundary-value problems of Dirichlet and Neumann is expressed in terms of these eigen functions. Steklov was the first to demonstrate strictly for a very broad class of surfaces the existence of an infinite sequence of (proper) eigen values and corresponding eigen functions defining them in a way different from Poincaré's. Using a method going back to Fourier, Steklov also solved new problems of the theory of heat conduction subject to some boundary, and initial conditions.

When boundary value problems are considered, an especially difficult problem arises when one wishes to expand an arbitrary function, for example, $f(x)$, subject to certain restrictions, into a convergent series of the form where each A_k is a constant and the eigen functoins $U_k(x)$ form a normal and orthogonal system. Particular cases of this kind had occurred since the latter half of the eighteenth century. From 1896, Steklov devoted numerous works to the elaboration of a general method of solving this problem in one, two, and three dimensions; this work resulted in the creation of the general "theory of closedness," the term he introduced in 1910. The condition of closedness established by Steklov is the generalization of Parseval's equality (1805) in theory generalization of Parseval's equality (1805) in the theory of Fourier series. The closed systems are "complete": they cannot be extended by adding new funtions without loss of orthogonality; only closed systems may be used for solving the mentioned problem. In the simplest case, when it is necessary to expand a continuous function $f(x)$ on the segment (a, b) into a series of functions of one normal and orthogonal system $\{U_k(x)\}$ with respect to a weight $p(x) \geq 0$, so that and the coefficients A_k = , the condition of closedness takes the form . Steklov investigated the closedness of diverse concrete systems and defined certain conditions under which the expansions in question really occur. In 1907 he began to use in the theory of closedness an important "smoothing method," which consisted of replacing the function under study–for example,$f(x)$–with some other mean function – $F_n(x)$ = –that in some sense has more convenient characteristics. For example it is contiuous, wheras $f(x)$ is only integrable. This device is now widely used in mathematical physics. Steklov investigated expansions into series not only with the theory of closedness but also by means of asymptotic methods or by direct evaluation of the remainder term in the series.

The rise of the theory of integral equations at the beginning of the twentieth century, which led to new, general, and effective methods of solving the problems of mathematical physics and expansions of functions on orthogonal systems, inspired Steklov to improve the theory of closedness, although he did not participate in the elaboration of the theory of integral equations itself.

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