

Life of Scientific Activity[†]

(On the 100th Anniversary of the Birth of Georgiy Yevstafyevich Pavlenko,
Member of the Ukrainian Academy of Sciences)

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Georgiy Yevstafyevich Pavlenko was a leading Ukrainian scientist in the field of ship hydrodynamics and theory. He devoted his life to establishing and developing scientific principles of ship-building and water transport.

The numerous scientific works of Prof. Pavlenko have been utilized for many decades now in designing and building modern ships, ensuring their cost effectiveness and safety and in training experts in these fields.

The present brief outline of the life and activity of Prof. Pavlenko has as its purpose to call the attention of scientists and engineers to his studies, which remain timely and significant to the very present.

Georgiy Yevstafyevich Pavlenko was born on March 26, 1898 in the village of Lebyazhe, in the Volchansk region of what then was Khar'kov Province to peasant parents. In 1915 he graduated with honors from the technical high school in Belgorod and was then admitted to Petrograd Polytechnic on the basis of his high-school record. He interrupted his studies after a year and a half of attendance during which time he worked in different water-transport institutions. He resumed his studies in 1922 on the authorization of the Water-Transport Ministry and graduated the Ship Design Department of the Leningrad Polytechnic Institute (LPI) in 1924.

In his degree project G. Ye. Pavlenko applied a method for calculating ship hull vibration worked out by himself, and produced the theoretical drawing by employing the method of rays also of his invention.

In the course of his studies G. Ye. Pavlenko was active in the scientific and engineering student society in which he headed the ship-design section. He combined his studies with work in maritime institutions.

Following his graduation from LPI G. Ye. Pavlenko worked at a shipyard (launching of ships), in the Central Maritime Design Office (1926–1928) as a design engineer, and then as the head of the laboratory. At that time he constructed a small gravity-type water tunnel that served as a prototype in the construction of similar, much larger test tanks.

G. Ye. Pavlenko started his postgraduate studies at the LPI; these he completed in 1928 and continued working at the LPI first as a postgraduate instructor and starting in 1930 as associate professor and chairman of the Ship Theory Department.

In 1930 Prof. Pavlenko was appointed by decision of the Higher Degrees Commission as a full professor in the Hydromechanics Department and in 1937 was awarded the title of Doctor of Technical Sciences (without being required to defend his thesis). A. N. Krylov, member of the

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Academy of Sciences, who evaluated the technical papers presented by Prof. Pavlenko, claimed that each paper alone suffices for awarding a doctorate.

In addition to teaching at the Leningrad Shipbuilding Institute (LSI) which was created in 1930 on the basis of the LPI's Ship Design Department, Prof. Pavlenko was employed as senior staff member at the Naval-Forces Scientific and Engineering Committee (1928–1931) and subsequently as the head of the Ship Seaworthiness Division in the newly-created Shipbuilding Institute (1931–1933) and scientific consultant in the Naval Shipbuilding Institute (1934–1935)

During this period Prof. Pavlenko was involved extensively in teaching, multifaceted and intensive scientific and practical activity, wrote monographs and textbooks, published a number of works on the theory and practice of ship design. At the same time he managed the establishment of a modern ship-theory laboratory at the LSI, participated in international and national scientific conferences and served as an adviser to a group of post-graduate students.

With the start of Second World War Prof. Pavlenko remained in Leningrad, where he was a member of the scientific foursome charged with the city's defense, worked at requests by defense organizations and investigated the performance of ships of the Baltic Fleet under war conditions.

At the end of 1942 Prof. Pavlenko was evacuated to the city of Przhevalsk, where he lead the Shipbuilding Theory Laboratory of the LSI, which was engaged in defense work, was the deputy chairman of the regional committee on study and development of productive manpower, and also served as the chairman of the Ship Theory Department of the Nikolayev Shipbuilding Institute (NSI), which was transferred there during the War; there he was elected as the Head of the Committee for Scientific Assistance of the Defense Effort at the NSI.

By governmental decree Prof. Pavlenko was transferred in March 1944 to Odessa where he was appointed as the Chairman of the Ship Theory Department of the Odessa Institute of Navy



Fig. 1. Professor Pavlenko among the participants of a conference on small-craft engineering in 1934 (in the first row, from left to right: Member of the Academy of Sciences, V. L. Pozdyunin, Prof. Pavlenko, Member of the Academy of Sciences A. N. Krylov, Corresponding Member of the USSR Academy of Sciences Yu. A. Shimanskiy and Prof. V. L. Survillo).

Engineers (OINE) where he remained till May 1958. In February 1954 he was additionally appointed as a senior scientific staff member of the Institute of Hydrology and Hydraulic Engineering of the Ukrainian Academy of Sciences in Kiev.

The years of Prof. Pavlenko's sojourn in Odessa are characterized by intensive scientific work, great scientific-organizational and teaching activity. In the OINE he headed the scientific research sector of the Institute, served as an advisor to a group of graduate students, actively participated in investigations for ensuring seagoing safety. Simultaneously Prof. Pavlenko prepared a number of monographs, including fundamental works [1, 2], constructed new instruments and devices for hydrodynamic investigations in test basins and also a device for monitoring and controlling ship loads.

In 1958, after being elected as a Corresponding Member of the Ukrainian Academy of Sciences, he moved to Kiev where he led the Divisions of Ship Fluid Mechanics of the Institute of Hydrology and Hydraulic Engineering (currently the Fluid Mechanics Institute of the Ukrainian Academy of Sciences), retaining, at the same time, his position as professor of the Shipbuilding Theory Department of OINE.

In 1961 he was elected as full-fledged member of the Ukrainian Academy of Sciences specializing in fluid mechanics.

In Kiev Prof. Pavlenko continued his scientific activity, primarily in the field of hydrodynamics of inland ships, guided post-graduate students, monitored the construction and equipping of the university's test basin on the basis of his conceptual design.

On Prof. Pavlenko's initiative a series-produced *Moskvich* class diesel-powered passenger ship was converted into a research vessel which was subsequently utilized for testing an experimental specimen of a system developed by him for automatic control of the ship's main propeller as a function of the depth of the waterway.

Poor health forced Prof. Pavlenko to retire in 1962, but, as far as possible, he continued his scientific activity in the Institute as a consultant to the very last days of his life which ended on March 4, 1970.

Prof. Pavlenko left this world full of creative ideas, in the middle of work over a manuscript devoted to reminiscences of the establishing and development of his country's shipbuilding science.

The scientific legacy of Prof. Pavlenko consists of 110 works in print, of which 30 are monographs with a combined volume of 300 signatures (a signature is 16 pages). Manuscripts of two monographs, several papers and scientific reports and also the unfinished *Reminiscences* which is a biographical work of historical interest, remain unpublished.

Professor Pavlenko dealt with a number of aspects of formulation and solution of a large number of scientific problems in the theory of shipbuilding and navigation, where his contributions are of fundamental significance.

A number of works by Prof. Pavlenko is concerned with *ship geometry*. Here he suggested a method for constructing engineering drawings of ships which, to a certain extent, systematizes the design of the shape of the hull, simplifies it and scientifically verifies this process [3, 4]. These works also contain interesting ideas pertaining to the relationship between the ship's geometry and its fluid mechanics, implementation of which will allow, with the aid of computers, to analytically develop optimal hull shapes.

Works by Prof. Pavlenko [5, 6] contain theoretical principles and practical methods of rational layout of the outer skin of the hull, whereas the monograph [7] presents principles of constructing simplified-line hulls which have significant technological advantages while retaining almost the same quality of hydrodynamic performance as standard ship lines. One of Prof. Pavlenko's post-graduate students, V. Ye. Pyatetskiy, utilized these ideas and actually implemented them on in-land ships operated in shallow waters.

Theoretical principles of the *statics of a floating body* are presented in the monograph [1], which is concerned with the relationship between a body's geometry and the gravity forces acting on it. Vector methods of determining the effect on moving solid and liquid masses on the seaworthiness of ships are used in solving problems of ensuring navigation safety of ships [8–10]. These studies were intended for practical use by the ship's crew and by ship maintenance and service personnel.

One may conditionally include in this classification also problems of providing stability of ships under different operating conditions (subjected to squalls, developing storms, etc.), which were for first time solved by method of dynamics and hydrodynamics; a universal diagram of ship stability was also suggested.

Professor Pavlenko made a significant distribution to the development of the *theory of ship oscillations*: he presented new data on accounting for the nonlinearity of the acting forces, relative velocity and associated inertia of water in the work of resistance forces. His monograph [14] presents new data on the results of studies in the general theory of ship oscillations in arbitrary waves, on the oscillation of ships from the point of view of the theory of probability, etc. This book was extensively recognized for many years.

Further work by Prof. Pavlenko in this field were devoted to developing the theory of pitching and heaving originated A. N. Krylov, Member of the Russian Academy of Sciences as far back as 1898, which included final design formulas, also suitable for ships with nonrectilinear sides [15]. He also developed a new theory of ship's roll [16] and a new method for calculating the safety of a ship in waves [17], which were incorporated into the curriculum of technical colleges.

In 1936 Prof. Pavlenko suggested a device for utilizing the energy of the ship's oscillation for propelling the ship [18, 19] in the form of a number of fins to be placed to the sides of the ship. Experimental studies validated the original assumptions and the effectiveness of employing such devices on real ships.

Of great significance are the studies of Prof. Pavlenko in the *resistance of water to a ship's motion*, particularly the wave-resistance components [20] combined with a method for calculating it from data on the theoretical drawing and solving the variational problem on determining the shape of a least-resistance ship [21–23], which quite satisfactorily conformed to the experimental data of a series of investigations by Taylor. In 1951 Prof. Pavlenko suggested a method for determining the ranges of desirable and undesirable speeds of ships by means of a diagram for practical use [24]. In 1953 he published a fundamental monograph [2], which has been accepted as a textbook and a practical handbook without losing actuality for many decades.

Professor Pavlenko devoted a great deal of attention to developing the *theory of the ship's screw* in papers [25, 26], where he presented the principal aspects of a ship's propelling screw – the load on it, allowing for the presence of the shroud and optimal distribution of the load along the blade.

In his paper [27] he presents algebraic formulas, which give an idea about the structure of the flow about the propelling screw and analyzes cases of mutual interaction between screws, with the ship's bottom, the walls of the waterway. This topic has been developed further in the postgraduate thesis by A. A. Kostyukov, titled *The Propelling-Screw Induced Velocity Field* (1949).

Professor Pavlenko also investigated the interaction between the propelling screw, the engine and the hull in the articles [28, 29], where he laid the foundation of a new discipline – the propulsion dynamics of a ship, which was subsequently developed by Prof. V. I. Nebesnov and his school.

Studies by Prof. Pavlenko concerning *gliding of ships* are of great significance. He developed a hydrodynamic theory of the motion of a glider [30], a technique for investigating ship gliding by using models [31], solved the problem of stability of glider motion [32]. At the same time, Prof. Pavlenko performed a preliminary analytic study of the phenomenon of porpoising [33] and suggested an explanation of the physical substance of this phenomenon. As far back as then he pre-

dicted the possibility of utilizing the porpoising mode in planning space and interplanetary voyages both in the landing of the craft and also in their start from a water surface.

Aspects of *inland navigation* are discussed in his books and papers [34–37], where he validated the feasibility and selection of ways for improving the cost-effectiveness and safety of operation of inland-navigation vessels and ensured the construction and successful testing of the automation system suggested by him on several ships [38]. Unfortunately, at that time this promising automation system was not developed further because no reliable domestically produced fathometer was then available.

It is clear that the above brief list of scientific endeavors of Prof. Pavlenko does not provide a complete description of his multifaceted interests and, particularly, activity. It should be noted that Prof. Pavlenko was a leading experimenter and inventor and his suggestions underlie original measuring instruments for investigating the seaworthiness of full-size ships and ship models. The LSI Ship-Theory Laboratory, which included a new type of test basin, equipped by a system of devices allowing to markedly increase the velocity of towing of models and significantly widening the circle of investigations, was established according to his plans and under his direct leadership [39].

It was on suggestions of Prof. Pavlenko that the test basin of OINE was upgraded and the general-purpose test basin of our Institute was constructed.

The scientific endeavors, lectures and reports of Prof. Pavlenko have a profound theoretical basis, are particularly clear and coherent, laconic and distinct, something which is usually encountered only in classical works. He makes a successful use of the large arsenal of mathematical methods, over which he had complete mastery and which he developed in solving complex and new problems of shipbuilding science. These attributes of the scientific creativity of Prof. Pavlenko were noted by A. N. Krylov and V. L. Pozdnyunin, members of the Russian Academy of Sciences.

In addition to extensive scientific activity, Prof. Pavlenko served for about 30 years as a lecturer and teacher in technical colleges, guided postgraduate students and his books and texts were and are used by generations of shipbuilding experts.

Many of Prof. Pavlenko's students and followers became famous scientists and engineers, were granted high-level degrees and positions, led (or continue to lead) scientific teams and institutions of higher technical education (these are professors, A. M. Basin, S. N. Blagoveshchenskiy, Ya. I. Voykutskiy, Yu. M. Guliev, A. A. Kostyukov, V. G. Pavlenko, A. N. Panchenkov, Yu. V. Remez, V. V. Semenov-Tyanshanskiy, V. G. Sizov, G. A. Firsov, I. G. Khanovich, all of them PhDs, and many others).

Professor Pavlenko participated actively in social life, in the work of scientific and technical societies of the shipbuilding industry and water transport, was a member of the Presidium of the Technical Council of the Ministry of Maritime Fleet, member of Scientific-Methodological Council at the Main Administration of Institutions of Higher learning of the Ministry of Maritime Fleet and was a member of the editorial board of the Morskoy Transport (Sea Transport) Publishing House.

Prof. Pavlenko was awarded government prizes for selfless work during WW2 and post-war years and in 1945 was accorded the title of "Honored Worker of the Maritime Fleet".

The depth and volume of interests of Prof. Pavlenko, the perfection and completeness of studies of various phenomena in science as well as in daily life is extraordinary. Professor Pavlenko knew and loved life in its various manifestations, worked extensively and fruitfully and was knowledgeable in ways of good and interesting leisure. He went hunting, fishing, mushroom picking, loved to travel, was very familiar with the his country's nature, participated in sports (tennis, chess) and was a good skater. Music (the violin and the piano) was a special passion of his. Small family concerts with the participation of friends and acquaintances frequently took place in his house.

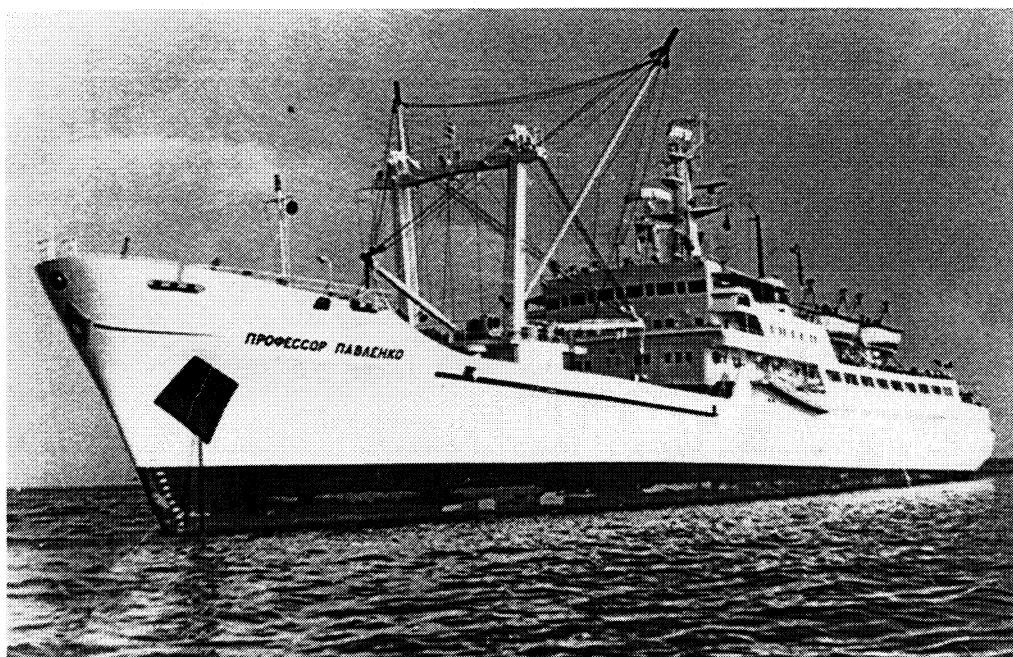


Fig. 2. The *Professor Pavlenko* teaching and research ship.

During holidays, which he spent primarily in rural surroundings, he invited postgraduate students and coworkers and then scientific discussion and interesting stories of the hospitable host were supplemented by tasty and abundant food served to everybody by the attentive and good-hearted hostess, his wife Valeriya Vladimirova Pavlenko.

In memory of Prof. Pavlenko a memorial tablet was placed on the building of our Institute and, by decision of the Presidium of the Ukrainian Academy of Sciences his book [40], which in addition to certain previously published fundamental works by Prof. Pavlenko, contains several unpublished manuscripts from his archives, was published in 1978. One of the teaching and research ships were named after Prof. Pavlenko.

The blessed memory of the prominent scientist in the field of fluid mechanics and shipbuilding, Member of the Ukrainian Academy of Sciences, Prof. Pavlenko is retained by his students and followers, is contained in his prominent studies to which we turn even now and which will play an important role in the development of the nation's shipbuilding and water transportation for many years yet.

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