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REM IVANOVICH SOLOUKHIN

(on the 80th anniversary of the birth of Lenin Prize Winner, Corresponding Member of the USSR Academy of Sciences, Academician of the BSSR Academy of Sciences Rem Ivanovich Soloukhin)

On November 19, 2010, Rem Ivanovich Soloukhin would have turned 80 years old. In 1976, the President of the BSSR Academy of Sciences offered him the opportunity to head the A. V. Luikov Heat and Mass Transfer Institute for developing studies pertaining to physical gasdynamics and high-temperature physics in Belarus. The jubilee issues of the Journal of Engineering Physics and Thermophysics (No. 6 in 2010 and No. 1 in 2011) are devoted to the 80th anniversary of the birth of R. I. Soloukhin (1930–1988).

R. I. Soloukhin was born on November 19, 1930 in the town of Gus'-Khrulstalnyi in the Vladimir Region. In 1953, he graduated from the Physical Department of Moscow State University (Chair of Thermal and Molecular Phenomena); R. I. Soloukhin performed his prediploma practical work and diploma project at the G. M. Krzhizhanovskii Institute of Power Engineering in the Laboratory of Combustion Physics headed by Professor A. S. Predvoditelev.

Main Stages in the Scientific Activity of R. I. Soloukhin

◇ in 1955, he becomes a graduate student of Moscow State University and continues working at the G. M. Krzhizhanovskii Institute of Power Engineering;

◇ in 1958, he defends a candidate's dissertation at Moscow State University and begins working at the Moscow Physics and Technology Institute at the Chair headed by M. A. Lavrentiev;

◇ in 1959, among the first team of young scientists, together with Academician M. A. Lavrentiev, he moves to Novosibirsk to work in Science City (Akademgorodok), where at the Institute of Hydrodynamics of the Siberian Branch of the USSR Academy of Sciences he develops the scientific trend started at the G. M. Krzhizhanovskii Institute of Power Engineering; he takes an active part in setting up the Lenin Komsomol Novosibirsk State University — he becomes the first dean of the Physical Faculty and later the pro-rector on scientific and educational work;

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◇ in 1962, he defends the doctoral dissertation (Phys. & Maths.) "Fast Processes in Shock Waves". It turned out to be the first doctoral dissertation in physics and mathematics in the young Akademgorodok;

◇ in 1965, for investigations of detonation in gases Rem Ivanovich is awarded the Lenin Prize (together with B. V. Voitsekhovskii and Ya. K. Troshin). In the same year, Soloukhin receives the academic title of professor;

◇ from 1965 through 1972, he is the head of the Chair of General Physics at the Lenin Komsomol Novosibirsk State University;

◇ in 1967, Soloukhin is invited to be the deputy head of scientific work by Academician G. I. Budker — the director of the large Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences;

◇ in 1968, Soloukhin is elected Corresponding Member of the USSR Academy of Sciences in Mechanics;

◇ from 1971 through 1976, he is the director of the Institute of Theoretical and Applied Mechanics of the Siberian Branch of the USSR Academy of Sciences;

◇ from 1972 through 1976, he is the head of the Chair of Physical Kinetics and Optics of the Lenin Komsomol Novosibirsk State University;

◇ from 1976 through 1987, he is the director of the A. V. Luikov Heat and Mass Transfer Institute and the head of the Chair of Thermophysics at the Lenin Belarusian State University;

◇ on January 6, 1988, R. I. Soloukhin passed away after a prolonged illnes.

Publications on R. I. Soloukhin

1. **N. A. Fomin** and R. J. Emrich, In memoriam, Rem Ivanovich Soloukhin, *Experiments in Fluids*, 1989, Vol. 7, pp. 433–434.

2. **N. A. Fomin**, To the Memory of a Teacher. On the 60th Anniversary of the birth of R. I. Soloukhin. Collected papers "Nonequilibrium gasdynamics: Diagnostics and modeling," 1991, Minsk, Heat and Mass Transfer Institute, BSSR Academy of Sciences, pp. 3–13.

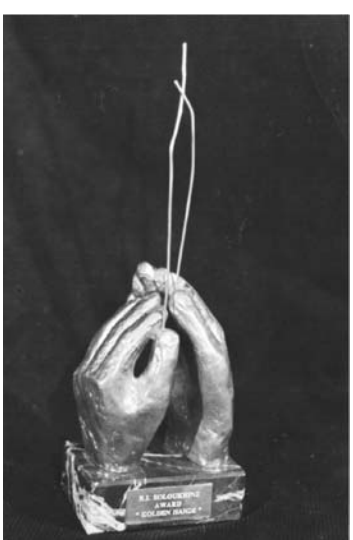
3. **O. G. Martynenko** and V. L. Dragun, Rem Ivanovich Soloukhin (on the 70th anniversary of his birth), *Inzh.-Fiz. Zh.*, 2001, Vol. 74, No. 4, pp. 160–161.

4. **Physics of Shock Waves**, Combustion, Detonation and Nonequilibrium Processes, in: N. Fomin, O. Penyazkov, and S. Zhdanok (eds.), Soloukhin memorial, Minsk, 2005, ISBN-985-6456-47-9.

5. **J. H. S. Lee**, My Recollections of Rem Soloukhin, in: *CD Proc. of the 22nd International Colloquium on the Dynamics of Explosions and Reactive Systems*, Minsk, 2009.

6. **N. A. Fomin**, Rem Soloukhin's Gold Hands in shock and detonation phenomena studies, in: *CD Proc. of the 22nd International Colloquium on the Dynamics of Explosions and Reactive Systems*, Minsk, 2009.

R. I. Soloukhin's "Gold Hands"s International Prize



Since 1989, the International Institute of the Dynamics of Explosions and Reactive Systems has awarded the R. I. Soloukhin "Gold Hands" Prize for the best experimental work reported at the International Colloquium on the Dynamics of Explosions and Reactive Systems (ICDERS). This prize is awarded to outstanding specialists-experimenters:

1989	J. Brossard (France)
1991	P. Van Tiggelen (Belgium)
1993	E. Dabora (USA)
1995	R. Knystautas (Canada)
1997	V. V. Mitrofanov (Russia)
1999	G. Dupre (France)
2001	L. G. Gvozdeva (Russia)
2003	S. Dorofeev (USA)

From the Scientific Editors of the Issue

Papers in the jubilee issues of IFZh illustrate the development of R. I. Soloukhin's ideas at the A. V. Luikov Heat and Mass Transfer Institute, as well as developments far beyond this Institute. All papers, except for the editorial one (coauthored by S. A. Zhdanok, O. G. Penyazkov, and N. A. Fomin), were strictly ordered as they were submitted for editing. The editorial paper gives an account of the history of the development of studies on physical gasdynamics and high-temperature thermophysics at the A. V. Luikov Heat and Mass Transfer Institute of the National Academy of Sciences of Belarus that were initiated by Soloukhin. Emphasis is placed on investigations of physicochemical kinetics in nonequilibrium conditions and combustion, detonation, and gasdynamics of explosions and reactive systems that have been conducted at the Heat and Mass Transfer Institute for the past three and a half decades. Also, Soloukhin's studies at the Siberian Branch of the USSR Academy of Sciences in 1958–1976, where the foundations of this scientific trend were laid, are briefly described. N. A. Fomin's paper describes the history of the development of investigations on shock tubes throughout the world, the USSR, and Belarus starting in the nineteenth century. The operational principle of the shock tube and some recent results for high-temperature gasdynamics in shock tubes have been shown. In these studies, Soloukhin's role as a pioneer of experiments on shock tubes at the G. M. Krzhizhanovskii Institute of Power Engineering, in the Siberian Branch of the USSR Academy of Sciences, and in the BSSR (Belarus) is noted.

Siberian Team of Scientists. The first to send a paper for editing from other cities was Prof. G. M. Zharkova (in coauthorship with V. N. Kovrizhina) from the S. A. Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences. This work described the principles of visualization and measurement of surface temperatures and thermal flows using liquid-crystal thermography in an aerophysical experiment. The work unified fundamental studies, some of which were carried out within the framework of the cooperation of the Heat and Mass Transfer Institute and the Institute of Theoretical and Applied Mechanics initiated as far back as by R. I. Soloukhin. Within the framework of this cooperation, a paper of Academician V. M. Fomin and Prof. A. V. Fedorov was prepared, which dealt with mathematical modeling of instabilities in combustion of various-density gases. In the study of Academician G. V. Sakovich (in coauthorship with B. I. Vorozhtsov, O. B. Kudryashova, A. N. Ishmatov, and I. R. Akhmadeev) from the Institute for Problems of Chemical and Energy Technologies, Siberian Branch of the Russian Academy of Sciences (town of Biisk), consideration was given to the formation of a highly dispersed aerosol using the model of an explosive atomizer based on a hydrodynamic shock tube. The role of cavitation in producing a highly dispersed liquid-droplet aerosol was shown. A mathematical model describing the processes of genesis of an aerosol cloud was proposed. The works of the representative Siberian team of authors complement the papers of V. S. Babkin and A. A. Korzhavin from the Institute of Chemical Kinetics and Combustion of the Siberian Branch of the Russian Academy of Sciences, of A. A. Vasiliev and V. A. Vasiliev from the M. A. Lavrentiev Institute of Hydrodynamics of the Siberian Branch of the Russian Academy of Sciences, and of S. A. Afanasieva (written in coauthorship with N. N. Belov, Yu. A. Biryukov, V. V. Burkin, V. M. Zakharov, A. N. Ishchenko, A. V. Skosyrskii, A. N. Tabachenko, I. E. Khorev, and N. T. Yugov) from the Scientific-Research Institute of Applied Mathematics and Mechanics of Tomsk State University. Thus, the Siberian team of authors from five leading academic institutes and universities presented six papers.

The Moscow Team of authors presented eight studies. The paper of Prof. B. E. Gel'fand (written in coauthorship with S. P. Medvedev, S. V. Khomik, and G. L. Agafonov) from the N. N. Semenov Institute of Chemical Physics of the Russian Academy of Sciences is devoted to the analysis of the problem of discordance of measured (on shock tubes) and calculated magnitudes of the delay of ignition of hydrogen-containing systems. It is shown that the off-design origination of the reaction centers in a low-temperature region leads to flame propagation in the mixture heated by the reflected shock wave. The authors introduced the parameter of time of the mixture combustion in a deflagration mode and suggested that it be used together with the design delay of self-ignition for demarcating and classifying thermal gasdynamic phenomena in compression ignition of hydrogen-containing mixtures in shock tubes. Two works were sent by the Joint Institute of High Temperatures of the Russian Academy of Sciences. In the paper of Academician V. E. Fortov (written in coauthorship with A. V. Emel'yanov and A. V. Eremin), a new physical phenomenon was investigated, namely, the formation of a detonation wave of condensation. The detonation wave was formed by the action of energy released in chemical condensation of carbon nanoparticles behind the shock waves in mixtures that initially contained 10–30% carbon suboxide C_3O_2 or acetylene C_2H_2 in argon. The passage of the shock wave resulted in a rapid thermal decomposition of the initial molecules followed by the formation of condensed carbon accompanied by an appreciable energy release. The temperature and pressure increase in the reactive mixture led to an amplification of the shock wave and to its transition to a detonation mode. Basic kinetic characteristics of the reactions of thermal decomposition of the considered substances and of subsequent chemical condensation were determined, as was their interrelationship with the processes of heat release that form the detonation wave. In the paper of Prof. V. V. Golub (written in coauthorship with D. I. Baklanov, V. V. Volodin, and S. V. Golovastov), a review is given of experimental investigations of gas detonation in connection with the problems of designing a pulse detonation engine, which were conducted at the Department of Physical Gasdynamics of the Joint Institute of High Temperatures of the Russian Academy of Sciences. An analysis was made of the effect of the shape of injectors on the formation of detonation in a gas flow with separate feed of the fuel and the oxidant, the acoustic effect on the ignition region, and a decrease in the predetonation length in the flow of a mixture capable of detonation. An increase in the efficiency of the initiation of detonation by an electric discharge due to the self- and induced external magnetic field was noted.

In the detailed study of Academician V. A. Levin carried out together with I. S. Manuilovich and V. V. Markov at the Scientific-Research Institute of Mechanics of the M. V. Lomonosov Moscow State University, results of investigating the problems of initiation, propagation, and stabilization of detonation waves in immovable and moving combustible gas mixtures are presented. Numerical modeling of flows was performed by S. K. Godunov's scheme within the framework of an ideal perfect gas with various detonation models. As a result of numerical modeling, pictures of detonation waves in divergent channels are obtained, which ideally coincide with the widely known experimental photographs of R. I. Soloukhin. The work of Prof. I. A. Znamenskaya with Assistant Professor I. V. Mursenkova and head of the Chair of Molecular Physics of the M. V. Lomonosov Moscow State University (from which R. I. Soloukhin graduated) Academician N. N. Sysoev describes results of experimental investigations of shock-wave processes in pulse ionization of the channel surface in the shock tube. A review of the results of investigations of combustion-to-detonation transition (in English) was prepared by Prof. N. N. Smirnov (together with V. F. Nikitin and Yu. G. Phylippov) at the Chair of Wave Processes of the Faculty of Mechanics and Mathematics of the M. V. Lomonosov Moscow State University. The review embraces works from 1881 (Mallard, Le Chatelier, Berthélot, and Vieille) until the present. In this work, emphasis is on describing processes in pulse detonation engines. In the paper of Prof. B. S. Rinkevichyus (written in coauthorship with I. L. Raskovskaya and A. V. Tolkachev) from the Moscow Power Institute, a description of a novel method of optical diagnostics, namely, laser refractography is given. Using this method, the authors carried out quantitative diagnostics of the dynamics of temperature distribution in the boundary layer at a cool or heated sphere in water in the presence of free convection. Professor A. M. Starik (in coauthorship with A. M. Saveliev and N. S. Titova) from the State Scientific Center of the Russian Federation — the Federal State Unitary Enterprise "The P. I. Baranov Central Institute of Aviation Engine Construction" — presented a detailed paper on kinetic processes in plasma formed in combustion of hydrocarbon fuels. An analysis of basic kinetic processes responsible for the formation of ions, electrons, and charged and neutral carbon clusters and nanoparticles in combustion of hydrocarbon fuels was made. It was shown that the formation of a polydisperse ensemble of positively and negatively charged particles is mainly caused by the ion adhesion to primary clusters and secondarily formed particles, and also by the particle coagulation.

The team of authors from St. Petersburg presented two studies on laser-related topics. In the paper of Prof. A. S. Boreysho (written in coauthorship with V. M. Mal'kov and A. V. Savin) from the Public Corporation "Scientific-Production Enterprise 'Laser Systems', D. F. Ustinov Baltic State Technical University (BGTU–Voen-Mekh)," an account is given of the problems of aerooptics and gasdynamics of the highest-power source of continuous coherent radiation — the chemical oxygen–iodine laser. In the work of I. A. Fedorov from the Federal State Unitary Enterprise "Russian Scientific Center 'Applied Chemistry'", consideration is given to the flow structure in the original construction of a hydrogen–fluoride laser with a radially expanding nozzle unit.

The authors from Kazakhstan also presented two works. In a detailed review of Academician Z. A. Mansurov (Institute for Combustion Problems of the Al-Farabi Kazakh National University), which is devoted to the formation of soot of polycyclic aromatic hydrocarbons, fullerenes, and carbon nanotubes in the hydrocarbon combustion, an analysis of studies published in recent years that pertain to soot formation in hydrocarbon combustion is given. The subject of the analysis is the phenomenology, kinetics, and mechanism of soot formation. Consideration is given to the effect of various factors on the formation of polycyclic aromatic hydrocarbons, fullerenes, carbon nanotubes, and soot, and also to the low-temperature, cold-flame soot formation, combustion in an electric field, and paramagnetism of soot particles from the environmental viewpoint. The study of Yu. V. Nuzhnyi from the same Institute develops mathematical techniques of the statistical theory of turbulent heat and mass transfer with account for intermittence. The paper of A. D. Chornyi from the A. V. Luikov Heat and Mass Transfer Institute of the National Academy of Sciences of Belarus is close in range of topics to this work.

Several papers deal with the description of novel theoretical approaches to and computational technologies of solving current problems of high-temperature gasdynamics. These are the works of Prof. V. F. Kuropatenko from the Russian Federal Nuclear Center — the Academician E. I. Zababakhin All-Russian Scientific-Research Institute of Engineering Physics — K. L. Stepanov with coauthors from the A. V. Luikov Heat and Mass Transfer Institute of the National Academy of Sciences of Belarus, and a team of authors from India (L. P. Singh, Mithilesh Singh, and A. Husain) on nonstandard analysis of the focusing of shock waves in a nonideal gas.

In all, these issues include 27 works of leading scientists, mainly from Russia and Belarus, on closely related topics that illustrate the development of R. I. Soloukhin's ideas in new areas of combustion and detonation physics, high-temperature gasdynamics, physics of low-temperature plasma, gasdynamics of high-power gas-flow lasers, physical kinetics, and in mastering novel optical methods of diagnostics.

We are sincerely grateful to all authors who submitted remarkable papers to the jubilee issues and also to the editorial staff of Inzhenerno-Fizicheskii Zhurnal for diligence, high qualifications, and patience in preparing the papers for their publication.

V. A. Levin, S. A. Losev, and N. A. Fomin