

## In memory of Lev Solomonovich Polak

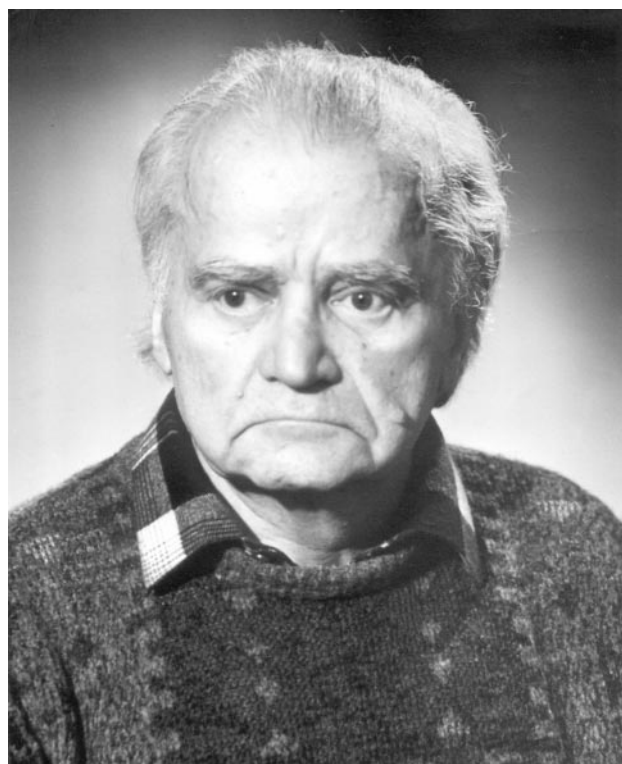
DOI: 10.1070/PU2002v045n08ABEH001214

The physics community mourns an irreplaceable loss. Lev Solomonovich Polak, outstanding figure in physics and physical chemistry, the founding father of the Russian school of plasma chemistry and a brilliant physics historian died on April 16, 2002, at the age of 94. We lost an awe-inspiring person who lived a very difficult life, who devoted to science more than 70 years of his life, a brilliant scientist and science manager who possessed encyclopedic knowledge and left to us his extensive and diverse scientific and literary heritage, as well as numerous followers in physics and plasma chemistry, nuclear geophysics and history of physics. Two of the fields in the broad spectrum of Polak's activities were definitely predominant: plasma chemistry and the history of physics.

Despite the many years that L S Polak was forced to spend in labor camps and in internal exile (nearly 20 years!) which inevitably affected his personality, he managed to retain a kind and responsive heart and a vivid sense of humor. Even in his 70s and 80s he looked 20 years younger and was invariably full of ideas and vigor. Lev Solomonovich ('Lev' is Russian for 'lion') indeed had something resembling a lion — short and broad, with a wise, expressive face but with a slightly apprehensive expression around the eyes. He was rather reserved in conversation and in expressing his feelings but this controlled reservation resembled a wound-up spring; sometimes the reserve would snap and then his temperament would break into the open. This used to happen, for example, when he was opening or closing conferences or symposia, or during seminars and conversations when he would be carried away and start speaking of Hamilton or Boltzmann, his beloved heroes, or about his cherished ideas in connection with the mystery of variational principles or the irreversibility of time.

Lev Solomonovich Polak was born on June 15, 1908 in Mitweid, Germany in the family of an engineer who had come from Russia and returned there in 1912. Having graduated from the Leningrad State Institute of Economics in 1929 and the Physics-Mathematics Faculty of the Leningrad State University in 1933, and after several years of working in various higher-education establishments, L S Polak became a professor, and then head of the physics and physical-optics chair of the Leningrad Institute of Precision Mechanics and Optics (1931–1936). In 1932 he also started working in the Institute of Chemical Physics of the USSR Academy of Sciences, and from 1933 at the Institute of History of Sciences and Technology of the Academy.

Polak wrote and defended his PhD thesis after entering the postgraduate course of the Academy in 1933, on the History of Sciences. His work *W R Hamilton and the principle of stationary action* was brilliantly defended in 1936; the



Lev Solomonovich Polak  
(15.06.1908 – 16.04.2002)

examination commission included the full members of the Academy Aleksei N Krylov and Sergei I Vavilov. This thesis was published in the *Proceedings of the Institute of the History of Sciences and Technology of the USSR Academy of Sciences*. Not long before that, he also published several important papers in the *Archive of the History of Sciences and Technology* on the history of mechanics and physics in the 18th and 19th centuries. Even though the first research papers (of 1932 and 1933) written in collaboration with V N Kondratyev and published in *Zeitschrift für Physik* were devoted to problems of physical chemistry, the PhD theses and the series of papers of 1935–1936 indicate that the main topic for Polak's research at that time was the history of physics and mechanics. It seemed that the 28-year-old scientist was starting a wonderful career. However, the director of the Institute of History and Science Technology N I Bukharin was arrested in February 1937; many members of staff of the institute fell victim to Stalin's terror, and this fate befell L S Polak too. Soon after the arrests the Institute was disbanded.

Academician A N Krylov who was the scientific adviser of L S Polak in his postgraduate years and whom Polak always regarded as his teacher, made an attempt to somehow help the

imprisoned young scientist, by writing a summary report on his papers. The report mentioned his ‘talent as a mathematician’ and his ‘vast erudition’, his ‘brilliantly defended thesis’ and also that Krylov and Vavilov as members of the examination commission “needed to point out not weaknesses of the thesis but its strong points about which L S Polak chose not to speak in his concluding words”, that his “... rare ability to digest the essentials of a project and achieve a correct understanding even outside his field of expertise made me sure that L S Polak has promise to become an outstanding scientist” — such were the words written by A N Krylov. The report did not help, however, and Polak was sentenced to incarceration for ‘participating in counter-revolutionary terrorist activities in the ranks of the Trotsky–Zinoviev organization’.

So started the appalling years of prisons, labor camps, and exiles. “18 years, 5 months and 11 days I remained ‘an enemy of the people’, doing time in 12 prisons ..., three labor camps, and two exiles” — thus begins L S Polak’s book of memoirs about this frightening story of his life (*This is how it was: Essays*, Moscow, 1996; a large part of these memoirs were also published in the journal *Questions of the History of the Natural Sciences and Technology*, 1992, No. 1–3). However, even during these years L S Polak managed to do scientific and engineering research in oil chemistry and in development of geophysical techniques of prospecting for oil deposits. The MVD (Ministry of Internal Affairs) still has reports on this work in its archives. In his labor camp memoirs L S Polak describes how he, together with another imprisoned physicist V K Frederiks, wrote at the beginning of 1940s in the Ukht-Izhemlag labor camp the paper “On the theory of anisotropic liquid” which ‘could’ have become a significant contribution to the physics of liquid crystals’. This paper was published more than 50 years later as an appendix to the book about V K Frederiks written by A S Sonin and V Ya Frenkel’ (Moscow: Nauka, 1995).

In 1946 L S Polak was released from prison but banned from residing in more than 200 towns of the USSR, including Moscow and Leningrad. Nevertheless, he illegally traveled to Moscow and found employment in the Special Laboratory of the Petroleum Institute that was organized to develop the USSR version of the system for neutron prospecting for oil. This work was accomplished in collaboration with G N Flerov and the resulting instruments were successfully tested.

In 1948 Polak was rearrested and sentenced to exile, which he lived through in the Krasnoyarsk region of Siberia, and in Norilsk and Guriev. He was sent to join a geophysics prospecting team, and between 1950 and 1955 he headed a special geological survey team conducting radioactive prospecting and also the laboratory on the study of physical properties of sedimentary rocks.

In 1955 L S Polak was released as completely innocent of any crime (‘rehabilitated’ was the official term); he returned to Moscow and obtained a position in the recently organized Institute of History of Natural Sciences and Technology of the USSR Academy of Sciences and soon after this also started working at the Institute of Petrochemical Synthesis of the Academy of Sciences, as head of a laboratory (1957). Thus with a gap of almost a quarter of a century the situation of the 1930s has repeated itself: L S Polak resumed working with new vigor in two fields which to a great extent excluded one another, as if in the spirit of the complementarity principle: in the history of physics and in physical and radiation chemistry, and then also in plasma chemistry.

In the history of sciences area, he continued along the lines of his PhD research and in 1957 presented and defended his DSc thesis on *Variational principals in mechanics, their evolution and some applications in physics (1622–1926)*, later described as a fundamental work of prime importance not only for the history of sciences but also for analytical mechanics and theoretical physics as a whole. In 1960 it was published as a monograph while a year before this Polak was published a collection of ‘ground-breaking papers’ on the history of variational principles of mechanics and physics (from Pierre Fermat to Paul Dirac) that he prepared. Polak’s contribution to this field of theoretical physics, its history and its philosophy is a most important one. The nature of variational principles, the variational structure of the main equations of physics, their ‘unreasonable effectiveness’ formed the scope of problems that stimulated L S Polak’s thinking for almost his entire life. It was Polak’s achievement that he was one of the first (at least among the historians and methodologist of physics) to understand the fundamental importance of Noether’s theorems on the relation between conservation laws and symmetry principles, and specifically for understanding the nature of the variational principles themselves.

In fact Polak did not limit his horizon in the history of sciences to variational principles and published numerous articles in the same period on various aspects of the history of analytical mechanics, quantum mechanics, optics, the theory of heat and some others. This was also the time when he started — and continued until his last days — his heroic science enlightenment (and research) work needed for publishing the classic works in physics. For more than 20 years he was a member of the editorial board of the Academic series *Classics of Science* that was founded long ago by Sergei Vavilov himself. Eight outstanding volumes of this series were published under his editorial wing, as a rule with his large summarizing articles. It is very significant that in the last years of his life Polak returned to his favorite hero — William Rowan Hamilton, having not only published his works but also written a book about him (1993, “Scientific Biographical Series of Russian Academy of Science”). Six years later Polak published a book about another hero of his — Ludwig Boltzmann. The high intensity of Polak’s work on the history of sciences persisted until the last years of his life. L S Polak was a brilliant historian of physics but this was not enough for him; he succeeded in making his enthusiasm contagious and organized a circle of colleagues who joined their activities in this field. Under his direct guidance, a double-volume of collected papers was prepared: *Development of Physics in the USSR, 1917–1967*, an impressive monument to the ‘golden years’ of Soviet physics. The editor-in-chief of this publication was L A Artsimovich, L S Polak being his deputy.

In parallel, L S Polak worked intensively on problems of radiation and physical chemistry. For the first time in the USSR, L S Polak achieved the generation of stabilized hydrocarbon free radicals using ionizing radiation, developed an original technique for the preparation of stereoregular polymers and for radiation-induced polymerization of layered and channeled inclusion complexes; he also investigated radiation-induced catalytic processes for directed organic syntheses. The radiation-induced chemical processes developed in this work (radiation-induced chemical cracking, synthesis of higher carboxylic acids) are important for the progress of modern technology.

His tremendous erudition in areas contiguous to physical chemistry allowed him to generate novel, original approaches to problem solving when formulating a research project. For instance, he was the first to apply the Mössbauer effect to the chemical analysis of ores and minerals, and the instrument developed on the base of this research was successfully tested. He was the first to apply the Mössbauer effect for studying the processes of adsorption, chemisorption and catalysis.

In the mid-1960s Polak created an important new research field — plasma chemistry — at the junction of plasma physics and chemistry (combined with other fields of physics, such as gas discharge physics, electrodynamics, optics and so on). The term ‘plasma chemistry’, ‘plasmachemical reaction’ and ‘plasmachemical processes’ took root in the Soviet scientific literature after the publication of the monograph *Kinetics and Thermodynamics of Chemical Reactions in Low-Temperature Plasmas* that L S Polak edited (Moscow: Nauka, 1965). These terms reflect the fact that specific chemical objects are considered, and that the chemical reactions occur in a plasma, in such a way that physical and chemical phenomena cannot normally be considered independently. The understanding of this complication was an important step that predetermined success in the progress of the new approach: indeed, the methodology of research in this field became clear.

At this point colleagues in physics, chemistry and technology started to form a team around L S Polak to try and solve theoretical and applied problems of plasma chemistry. The applied problems were being solved in close cooperation with Academician M F Zhukov who had close friendly ties with L S Polak for many years. Erudition and intuition allowed L S Polak to determine the main thrust of research in plasma chemistry and to coordinate the efforts of many research groups; it would be fair to call him the motor of the plasma chemistry community.

In 1965 a monthly colloquium “Generation, investigation and applications of low-temperature plasma” began to work under L S Polak’s guidance at the Institute of Petrochemical Synthesis of the Russian Academy of Sciences. In 1972 the first All-USSR symposium on plasma chemistry was convened; thus was launched a sequence of plasma chemistry research conferences in USSR. In 1991 they were reorganized into International Symposia on Theoretical and Applied Plasma Chemistry. Plasma chemistry schools were run on a regular basis. For 30 years L S Polak was the chairman and irreplaceable leader of all these plasma chemistry forums.

L S Polak led the creation of theoretical approaches to plasma chemistry (the kinetics of chemical processes at high energies and nonequilibrium chemical kinetics) and their application to the study of plasmachemical and many other types of chemicals processes. These works of L S Polak and his followers was highly original, was accompanied by multifaceted theoretical and experimental analysis of plasma-chemical processes by the most up-to-date research tools, and led to the creation of the scientific foundations of plasma chemistry. These results were widely recognized both in our country and abroad. Thus the school of plasma chemistry in our country was founded and hundreds of scientists in Russia and abroad regard L S Polak as their Teacher.

L S Polak carried considerable organizational responsibilities. He was head of research on plasma chemistry, deputy chairman of the Learned Council on Chemistry at High Energies of the Academy of Sciences of the USSR, and a member of the Plasma Physics Learned Council of the Russian Academy of Sciences. L S Polak was a member of

the editorial boards of international Journal of Plasma Chemistry and Journal of Low-Temperature Plasma Physics, and he was for a long time a member of the editorial board of the journals *Chemistry at High Energies* and *Petrochemistry*. At the same time he was actively continuing his activities in the history of science. Until very recently L S Polak was chairman of the section of history of physics of the National Union of the History of Natural Sciences and Technologies. He saw his main task at this post as organizing representative scientific conferences devoted to important jubilees such as, for example, the 50th of quantum mechanics, the century since Einstein’s birthday, the 150th anniversary of J C Maxwell’s birth, the 100th of Niels Bohr, 300 years after the first publication of Isaac Newton’s *Principia* and so on.

The participants of these conferences and of the plasma-chemical forums remember these outstanding gatherings which were almost always opened by the brilliant and profound introductory words of Lev Solomonovich. Ever since the journal *Voprosy Istorii Yestestvoznaniya i Tekhniki* (Questions of the History of Natural Sciences and Technologies) was launched, L S Polak was invariably a member of its editorial board. Many of today’s historians of physics and mechanics were influenced in some way by L S Polak and consider themselves as his followers. Emotionless statistics are only a partial witness of the ‘monstrous work potential’ of L S Polak: he authored and co-authored more than 600 research papers, including 20 monographs which had several publication runs in the USSR and were translated abroad; eight volumes of selected classical works of physics and mechanics were published under his editorship in the series *Classics of Science*. More than 60 PhD and DSc dissertations were presented under his supervision. In 1970 L S Polak was awarded the distinction “Honored for Activities in Science and Technology in the Russian Federation”, and in 1985 he received, as a member of a team of authors, a USSR State Prize.

Even though L S Polak never forgot the appallingly difficult years in labor camps and exile, he remained a humane man, kind to the people around him; keen intelligence and humor were essential parts of his personality. This is the image of Lev Solomonovich Polak that is remembered by all those who had the good fortune of having worked with him or simply met him.

É I Asinovskii, V P Vizgin, V L Ginzburg,  
Yu A Ivanov, T D Il’ina, V S Kirsanov,  
Yu A Lebedev, G É Norman, V M Orel,  
N A Platé, D E Slovetskii, V E Fortov