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PERSONALIA

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In memory of Yakov L'vovich Al'pert

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Yakov L'vovich Al'pert, an outstanding physicist who made a fundamental contribution to the development of the physics of the ionosphere and of the propagation of radio waves, died on 6 October 2010 as he approached the hundredth year of his life.

Ya L Al'pert was born on 1 March 1911 in the village of Ivnitsy, not far from the city of Zhitomir in Ukraine. Here, he graduated from a seven-year school and then a vocational school. In 1929, he moved to Moscow, where he studied by correspondence at Moscow State University and graduated from it with honors in 1939. Beginning in 1929, Yakov L'vovich set to work as a draftsman and thermotechnician.

Between 1931 and 1934 he worked as senior radio technician at the radio testing station of Narkomsvyaz on Shabolovka street. It was there that he started his research career by designing instruments to study the propagation of radio waves.

In 1935, Ya L Al'pert was accepted for a job in the P N Lebedev Physical Institute of the USSR Academy of Sciences and for several years worked under the guidance of Academician L I Mandel'shtam and then Corresponding Member of the Academy N D Papaleksi, studying the propagation of radio waves along Earth's surface. That was the period when special attention was paid to exploring the phase structure, dispersion, and velocity of propagation of radio waves in the neighborhood of the Earth. Ya L Al'pert created for this purpose a special phase interferometer. The measurements he conducted both on the surface of the Earth and in the air with the balloon had crucial importance.

In 1944, Ya L Al'pert began a study of the fine structure of the ionosphere. For this purpose he built a unique ionospheric station that allowed him to trace separately the pulses of ordinary and extraordinary waves reflected from the ionosphere. To interpret these findings, he developed a special statistical method for analyzing the received signals. The result was the first construction of the picture of small-scale irregularities, i.e., of the small-scale structure of the ionosphere.

The same station was used to observe ionospheric behavior during the solar eclipse of 9 July 1945. Ya L Al'pert found that the lunar eclipse of the corpuscular fluxes coming from the Sun disturbs the propagation of radio waves. By comparing the time of observation of these disturbances with the time of the optical eclipse, Al'pert was able to calculate the rate of the corpuscular flows: 400–500 km s^{-1}.

In fact, this result was the first measurement of the solar wind velocity! It is the solar wind that determines the structure of the magnetosphere and the physical processes in the polar ionosphere of Earth.

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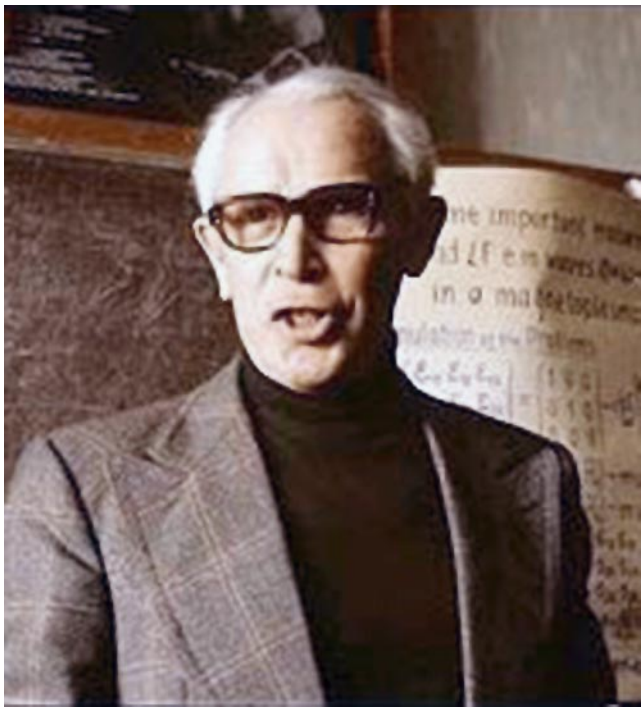
Translated by V I Kisin



Yakov L'vovich Al'pert
(01.03.1911 –06.10.2010)

In 1951, Ya L Al'pert's fruitful scientific activity at the Lebedev Physical Institute was interrupted: in the course of the antisemitic campaign against 'cosmopolitanism' he was dismissed from the staff of the institute, without a word of explanation. From 1952 on, Ya L Al'pert worked at the Research Institute of Terrestrial Magnetism. Later, and with Al'pert playing an active role in it, this institute was transferred to the USSR Academy of Sciences as the Institute of Terrestrial Magnetism, the Ionosphere, and Radiowave Propagation (IZMIRAN in *Russ. abbr.*). Here Al'pert succeeded in gathering over several years an excellent group of highly skilled young researchers.

With the advent of the sputnik era, immediately after the first launch, Ya L Al'pert began to study the radio signals from the artificial satellites. Using the exact times of 'radio sunrises' and 'radio sunsets' of the satellite, he determined how the density of the ionosphere diminishes above the ionospheric peak density. This was the first determination of the density of electrons in the ionosphere at high altitudes.

Ya L Al'pert intensely studied the Doppler shift of high-frequency coherent signals with a prescribed ratio of frequencies emitted by the satellite. The method proposed by Al'pert allowed analyzing in detail the electron density distribution in the ionosphere. This method continues to be widely used. High-precision Doppler measurements of satellite signals underlie the Global Positioning System (GPS) and the analogous Russian GLONASS system.

From his first days at IZMIRAN, Al'pert conducted important measurements of the propagation of radio waves of low and extra low frequencies in the range of 50–30,000 Hz. Ya L Al'pert developed the theory of propagation of these waves in the waveguide formed by Earth's surface and the ionosphere. Experiments allowed measuring the velocity of radio wave propagation in this waveguide in a wide frequency range. He also studied thoroughly the 'whistler atmospherics' propagating in the magnetosphere.

Al'pert initiated a theoretical study of perturbations of the ionospheric plasma caused by moving space vehicles. As a result, the foundations were laid for 'ionospheric aerodynamics', which is akin to the ordinary hydrodynamics for the motion of bodies in rarefied ionized gases. Two of the authors of the present obituary, A V Gurevich and L P Pitaevskii, remember with great pleasure their teamwork with Yakov L'vovich on this problem, which ended with the writing of a joint review paper for the journal *Physics–Uspekhi* (*Usp. Fiz. Nauk* **79** 23 (1963)), and then the publication of the monograph *Artificial Satellites in Rarefied Plasma* (Moscow: Nauka, 1964). It was the first monograph in the world on a subject that was very new at the time, and therefore it was literally in the next year that it was republished in English under the title *Space Physics with Artificial Satellites* (New York: Consultants Bureau, 1965).

Ya L Al'pert wrote a few more very good books. His monograph *Propagation of Radio Waves and the Ionosphere* published in 1960 (Moscow: Nauka) is a classic text, widely recognized by scientists the world over.

Ya L Al'pert, as one of the best world-class experts in radiowave propagation, took part in Geneva negotiations on strategic arms limitation treaty (SALT).

When Ya L submitted his declaration for emigration from the USSR in 1974, he was immediately removed from the post of department head and the opportunity of working with his colleagues at the Institute became severely restricted. Here again, we recognize the outstanding features of the strong character of Yakov L'vovich. Until permission to emigrate was granted — 13 years later, in 1987 — Ya L continued to work hard and successfully, practically almost at home. During this time he totally reworked his classic monograph *Propagation of Radio Waves and the Ionosphere*, almost doubling the number of pages. In addition, he conducted a wide circle of theoretical studies devoted to the propagation of low- and extra low-frequency radio waves. This work received wide international recognition. In 1978, a special session "Thirty years of research on the propagation of radio waves of ultralow frequencies: A tribute to Professor Ya Al'pert" was organized at the Scientific Symposium of the International Union of Radio Science (URSI) in Helsinki.

After his departure from the USSR, Al'pert settled in the U.S., in Boston. He continued to work, theoretically investigating the propagation of radio waves in a plasma in a magnetic field, and in 2001 he published a major review of his work on this subject in the journal *Physics Reports*.

Al'pert had many students. An even greater number of young people received his help and support in the form of advice, or in any form he could give it, especially in the difficult years of their lives. He always tried to attract talented young people to IZMIRAN and took care of them like a father. His name continues to be kept on the list of founding fathers of the Institute.

The creative activity of Yakov L'vovich was exceptional, his thinking was profound and clear, and he was deeply devoted to science.

Yakov L'vovich Al'pert had a long and dignified life, and his work has entered the golden reserve of science. His friends and colleagues will remember him with love and respect.

A V Gaponov-Grekhov, L P Gor'kov,
A V Gurevich, V E Zakharov, V D Kuznetsov,
A G Litvak, G A Mikhailova, L P Pitaevskii,
V M Sinel'nikov, D S Fligel'