# *LEV ANDREEVICH ARTSIMOVICH*

(on his fiftieth birthday)

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ON February 25, 1959 our scientific community celebrated the fiftieth birthday of the outstanding Soviet physicist, Academician Lev Andreevich Artsimovich.

Artsimovich was born to a professor of statistics in Moscow. His outstanding capabilities have enabled him to graduate early from the Belorussian State University and at the age of 21 he began working at the Leningrad Physical-Technical Institute (LFTI). The LFTI, then headed by Academician A. F. Ioffe, was the outstanding center of physical science in our country. The atmosphere of scientific enthusiasm, characteristic of the staff of scientists at the LFTI, has exerted a highly favorable influence on the formation of Artsimovich's scientific style. Within the walls of the LFTI he performed his first scientific research, and it is there that his scientific world outlook was formed. The range of Artsimovich's investigations was very extensive, but all his work was aimed at the solution of problems encountered at the frontiers of modern physics. Artsimovich's first researches involved the optics of x-rays, particularly the difficult problem of total internal reflection in the x-ray region of the spectrum.[1] This work was performed by Artsimovich jointly with A. I. Alikhanov.

In 1934-1935, Artsimovich together with I. V. Kurchatov and others engaged in a study of the properties of the recently discovered neutron, particularly the very interesting reaction of capture of a neutron by a proton. It was shown very clearly in this investigation that the cross section for the capture of slow neutrons by protons is relatively quite large.[2] In 1936 Artsimovich together with A. I. Alikhanov and A. I. Alikhanyan engaged in the verification of the derivation of the American physicist Shankland of the possible violation of the conservation laws in the Compton effect. In record brief time they formulated an original experiment, which has confirmed the validity of the conservation laws in electron-positron annihilation and at the same time refuted Shankland's conclusions.[3] These investigations already showed clearly the characteristic features of Artsimovich's working style: clarity of physical thought, ability of setting up an experiment accurately and thoroughly, and ability to analyze the results with great rigor.

These outstanding abilities as an experimental physicist served Artsimovich in good stead when working on the central topic of his research at the LFTI — investigations of the interaction between fast electrons and matter. It must be noted that in the middle thirties our information in this region was quite incomplete. It is enough to recall that the experimental data on Bremsstrahlung and angular distribution of electrons were in disagreement with the theoretical data by two orders of magnitude. Artsimovich's experiments yielded a wealth of factual material on the dependence of the intensity of Bremsstrahlung and of the total energy loss on the energy of the incident electrons. A thorough analysis of the results obtained have permitted Artsimovich to prove the very simple, but very important premise that modern quantum-

mechanical theory of the passage of fast electrons through matter is in agreement with the experimental data, within the limits of experimental error.[4,5,6] Thus, any doubts of the correctness of the theory were dispelled, and a way was opened for further detailed investigation of these processes.

During the war Artsimovich has engaged in electron-optics, specifically in the theory of chromatic aberration of electron-optical systems,[7] and carried out theoretical and experimental research in the field of electron-optical converters. This field of electronics is at the present time most extensively used in physics and engineering.

In 1945 Artsimovich and I. Ya. Pomeranchuk investigated theoretically the important problem of the role of radiation losses in the betatron. This research has made it possible to establish the limiting energy that can be reached when this method is used to accelerate electrons.[8]

The tremendous rate of progress in various applications of physics in the post-war years have also changed the approach to the solution of many physical problems, having necessitated a greater concentration of efforts on the solution of certain very weighty problems. The scientific director of one of such problems, namely the creation of an electromagnetic method for isotope separation, was Artsimovich. The problem was to progress from the currents then obtainable in laboratory mass spectrometers (on the order of $10^{-10}$ amperes) to currents on the order of an ampere, and it was necessary to convert the capricious precision instruments into reliable engineering apparatus. During the course of solving this problem Artsimovich analyzed thoroughly the aberration-free focusing of wide-angle ion beams in axially-symmetrical magnetic fields. Artsimovich has proposed the construction of a new ion-optical source system, now in use in all modern systems.[9] As a result of the great scientific activity of the staff of physicists led by Artsimovich, the staff has successfully coped with all the difficulties involved, and pure stable isotopes are now used extensively in experimental physics, biology, medicine, and engineering.

In the beginning of the fifties Artsimovich became involved in one of the most promising, interesting, and at the same time most difficult problems of modern physics, that of producing controllable thermonuclear reactions. Plasma physics, which is several decades old, still contains many "blank spots" that require new experimental data as well as a deep all-out theoretical analysis.

The group of physicists headed by Artsimovich began with the study of high-intensity pulse discharges in rarefied deuterium. During the course of these experiments it was possible to obtain, although for a short period, a highly-ionized plasma, heated to millions of degrees. In 1952 this group of associates has uncovered a new physical phenomenon, namely that at low pressure a high-power pulsed discharge in deuterium is a source of neutrons and hard x-rays.[10] Here, apparently, was a way towards producing a controllable thermonuclear reaction. Only a deep critical approach to the analysis of all results including his own, and a demanding and insistent way of carrying out many thorough control experiments, a characteristic of Artsimovich's, have prevented his group from drawing too hasty conclusions. The investigations were continued. It was soon shown that a gas discharge that is self-constricting in the presence of a longitudinal magnetic field has paramagnetic properties.[11,12,13,14] The neutrons were found to result not from a thermonuclear process, but from a specific accelerating process. Research on a controllable thermonuclear reaction is now being carried out over a wide front. A splendid survey of the work of Soviet physicists in this direction is the paper delivered by Artsimovich at the second conference on peaceful use of atomic energy in Geneva, in September, 1958.[15]

Another important aspect of Artsimovich's activity is his pedagogic work. Already in 1930 he began teaching at the Leningrad Polytechnical Institute, and later lectured at the Leningrad University. In the postwar years he lectured on atomic and nuclear physics, first at the Moscow Engineering-Physics Institute and then at the Moscow State University.

The rigorous and clear statement of problems, clarity of exposition, and cleverness of style, inherent in Artsimovich's lectures, are always exceedingly popular among his students.

Artsimovich's scientific merits have been greatly valued by the scientific community of our country. In 1946 he was elected a corresponding member, and in 1954 a full member of the Academy of Sciences of the U.S.S.R. In 1953 he became a Stalin Prize laureate, and in 1958 a Lenin Prize laureate. The Administration of the U.S.S.R. has awarded Artsimovich with several Orders of the Soviet Union.

In my own name, and in the name of his friends and of many physicists of the Soviet Union I congratulate Lev Andreevich, wish him health, happiness, and further success in his creative work for the benefit of our Fatherland.

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[13] L. A. Artsimovich, Ibid. page 87, 1958.

[14] L. A. Artsimovich, Ibid. page 101, 1958.

[15] L. A. Artsimovich, Research on Controllable Thermonuclear Reactions in the U.S.S.R. Second U.N. International Conference on the Peaceful Use of Atomic Energy. 15 (p) 2298.

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