Pavel Alekseevich Cherenkov (on his eightieth birthday)

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Pavel Alekseevich Cherenkov, a remarkable experimental physicist whose name is associated with one of the major discoveries of our time, celebrated his eightieth birthday on July 28, 1984. Cherenkov was born in the village of Novaya Chigla in Voronezh region. He also obtained his primary and secondary schooling there. In 1928 Cherenkov graduated from the Physico-Mathematical Faculty of Voronezh State University and during the two subsequent years was engaged in pedagogical activity in the secondary school of the town of Michurinsk.

In 1932 Cherenkov became a graduate student in the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR and at the suggestion of S. I Vavilov began investigating the luminescence of solutions of uranyl salts under the action of γ radiation of radium. These investigations led Cherenkov to the discovery of a remarkably beautiful physical phenomenon. He discovered that the γ radiation produces in a pure liquid a weak bluish glow which differs sharply from luminescence.

In a subsequent series of very laborious experiments in which he utilized the method of photometry of light emission at the threshold of vision Cherenkov established the most important properties of the new radiation: its universal nature, its insensitivity to the factors of luminescence quenching, the increase of the energy in the emitted spectrum with increasing energy of the primary γ quanta, the threshold character and the unusual polarization. This enabled S. I. Vavilov to conclude in 1934 that the new form of radiation is associated not with γ quanta, but with electrons formed in solutions as a result of Compton scattering of γ rays, and represents bremsstrahlung of these electrons.

In a new series of experiments in which he investigated the influence of a magnetic field on the brightness of the visible light emission from liquids irradiated by radium γ rays Cherenkov proved rigorously that the light emission is indeed brought about not by γ rays, but by secondary Compton electrons, and, what is the most important point, in these experiments Cherenkov discovered the principal property of the new radiation—its preponderant emission in the direction of motion of the Compton electrons.

The discovery of the property of directed emission turned out to be decisive for the true understanding of the nature of the new phenomenon. The theory which explained fully all the principal properties of the radiation was constructed in 1937 on the basis of classical electrodynamics by I.E. Tamm and I. M. Frank. They showed that the emitted light observed by Cherenkov represents the radiation of a charged particle moving uniformly with a velocity greater than the velocity of light in the medium.

In a new series of experiments carried out in 1936–1937 Cherenkov with his characteristic mastery of experimental technique quantitatively confirmed the Tamm-Frank theory by measuring the dependence of the characteristic angle of emission on the velocity of the particles and on the index of refraction of the medium having determined the distribution of energy in the spectrum of the radiation and the absolute brightness of the emitted light.

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Detailed quantitative investigation of the properties of the new radiation and the understanding of its nature enabled Cherenkov to advance in 1937 an interesting suggestion concerning a possible application of the new effect for the determination of velocities of charged particles. This suggestion subsequently became the basis for construction of Cherenkov counters, Cherenkov spectrometers and chambers for the detection of charged particles. Without these instruments it is now impossible to visualize high energy physics. The application of Cherenkov detectors in science is now on such a scale that without fear of contradiction one can assert that P. A. Cherenkov is now one of the most widely known physicists in the world. In 1946 S.I. Vavilov, I. E. Tamm, I. M. Frank, and P. A. Cherenkov were awarded the State Prize of the First Degree for the discovery, investigation and explanation of a new form of radiation. Later in 1958 P. A. Cherenkov, I. E. Tamm, and I. M. Frank were awarded the Nobel Prize in Physics "for the discovery and explanation of the Cherenkov effect."

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In post-war years the scientific interests of P. A. Cherenkov were connected with investigations of cosmic rays. These investigations resulted in the discovery of multiply-charged ions in the composition of the secondary component of cosmic radiation.

Beginning from 1946 Cherenekov participated in the design and construction of the first electron accelerators in the laboratory headed by V. I. Veksler. In January 1948 the first betatron in the USSR was put into operation in that laboratory under the direction of Cherenkov. Later P. A. Cherenkov together with a team of co-workers from the laboratory of V. I. Veksler were awarded a State Prize of the USSR for their participation in the construction of a 250 MeV synchrotron (S-25).

For a number of years the S-25 synchrotron in terms of its characteristics occupied a leading place in the world among installations of this class.

Beginning with 1959 Cherenkov became the head of the laboratory for photomeson processes of the Physics Institute of the Academy of Sciences of the USSR. Under Cherenkov's guidance fundamental investigations of photon-nucleon interactions were carried out there, in particular processes of photofission of the lightest nuclei were studied in detail at energies up to 250 MeV. For this series of papers Cherenkov and his collaborators were awarded a State Prize of the USSR for the third time.

Desiring to improve the experimental facilities of his laboratory Cherenkov headed work on designing and construction in the city of Troitsk of a new scientific center of the Physics Institute of the Academy of Sciences including a more powerful synchrotron, this time of 1.2 GeV energy and a modern measuring and detecting center.

The first physics results using this new accelerator were obtained in the late 1970's. In particular, the undulator radiation from the orbit of a circular electron accelerator was investigated experimentally for the first time. By simple and convincing experiments so characteristic of P. A. Cherenkov measurements were made of the spectral, angular and polarization characteristics of the radiation from an undulator installed in the straight-line gap of the synchrotron. Moreover, in 1981 the new accelerator was used to carry out a very complicated and laborious experiment which made it possible for the first time to investigate the process of Compton scattering by an unstable particle—the pion.

In addition to the work using the synchrocyclton of the scientific center of the Physics Institute of the Academy of Sciences Cherenkov's laboratory carried out investigations of the electromagnetic processes at high energies using the accelerators in Dubna, in Serpoukhov and at CERN. An important stage in carrying out these investigations was, in particular, the production in 1970 together with the Institute of High Energy Physics and the Erevan Physics Institute of an electron beam at the 70 GeV Serpukhov proton accelerator.

At present in addition to directing work carried out by his laboratory using the accelerators at the Physics Institute of the Academy of Sciences of the USSR, at Serpukhov and at CERN Cherenkov is deeply involved in the design of a new high current continuously acting electron accelerator for investigating fundamental properties of matter in the medium energy range.

It is characteristic of Cherenkov, as it is also of the majority of the most prominent scientists, that they strive to be in constant contact with scientifically inclined young people. For more than twenty years Cherenkov has taught at the Moscow Engineering Physics Institute. Many physicists who are now prominent regard him as their teacher.

The name of the outstanding Soviet scientist Pavel Alekseevich Cherenkov is well known not only to the world scientific community. Cherenkov is also known as a man devoting much effort and energy to the struggle for peace. For many years he has been a member of the Presidium of the Soviet Committee for the Defense of Peace, a member of the Soviet Committee for European security and collaboration, a member of the Pugwash movement of scientists. For his active participation in the struggle for peace and the security of peoples Cherenkov has been awarded the medal of the World Committee for the Struggle for Peace and medals of a number of national committees.

In 1974 when the seventieth birthday of P. A. Chernkov was being celebrated it was emphasized that he is full of creative powers, energy and enthusiasm. It is a pleasure also now, ten years later, to note that this remarkable man is active as in the past both in science and in matters associated with struggle for peace.

Translated by G. M. Volkoff