

Personalialia*SERGEĬ NIKOLAEVICH VERNOV*

(on his fiftieth birthday)

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ON July 10, 1960 fifty years have passed since the birth of Sergeĭ Nikolaevich Vernov, one of the distinguished Soviet physicists, a specialist in the field of cosmic rays.

The beginning of Vernov's scientific activity (1931-1932) coincided with the beginning of the intensive investigation of cosmic rays. After D. V. Skobel'tsyn's discovery of cosmic-ray particles in 1927, and the discovery in 1929 of cosmic-ray showers, it became clear that processes that have no counterpart at lower energies take place in cosmic rays. Thereafter, the investigation of cosmic rays became one of the most timely and interesting chapters of modern physics.

Vernov's first work laid the foundation for modern methods of investigating cosmic rays in the stratosphere and beyond its limits by automatic transmission of radio signals. These were brilliant experiments both in their physical conception — to obtain detailed data on the properties of cosmic-ray particles in the upper layers of the atmosphere, and hence to find the answer to the question of the nature of primary cosmic rays — and in the novelty of technique of a physical experiment first conducted in the stratosphere.

Beginning with the first years of his scientific activity, Vernov's work was conducted under the guidance and in close contact with Academician D. V. Skobel'tsyn, one of whose most gifted pupils he was. Around 1939 Vernov performed a large number of researches on the measurement of cosmic rays in the stratosphere at various latitudes. He overcame great difficulties, and succeeded in conducting these interesting experiments in the upper layers of the atmosphere not only in our country (in Leningrad and Erevan), but also abroad, in equatorial regions.

The most detailed information on the nature of the primary cosmic radiation was obtained in the course of a series of stratospheric measurements which he conducted in the years 1946-1949.

With the aid of original apparatus and an ingenious setup of the experiments it was shown that the curve of the altitude variation of the number of charged particles, generating the so-called electron-nuclear showers, discovered by Soviet scientists in experiments in Pamir, has no maximum up to the highest altitudes. Consequently, these particles are primary. Starting from the experimentally-obtained law of the absorption



of the primary component by the atmosphere, Vernov drew the important conclusion that primary cosmic-ray particles interact strongly with matter.

Under his guidance Soviet physicists prepared themselves very carefully, and conducted experiments in the stratosphere during the 1949 equatorial expedition of the U.S.S.R. Academy of Sciences in the region of the Indian Ocean. These experiments showed very convincingly that the data of some foreign authors on the absence of the so-called east-west asymmetry were erroneous. Such an asymmetry actually did exist, and the cosmic-ray particles have a positive electric charge. For his distinguished achievements in the investigation of cosmic rays in the stratosphere Vernov was awarded in 1949 the first-order Stalin prize.

Under Vernov's guidance the interaction of high-energy protons with matter in the stratosphere was widely studied. Experiments conducted with the aid of rockets (1947-1948) have shown that collisions of high-energy protons with nuclei give rise to an electron-photon cosmic-ray component. On the basis of these experiments the hypothesis was advanced that fast-

decaying mesons, which are responsible for the formation of photons and electrons, are generated in these processes. Later this hypothesis was fully confirmed by the discovery of  $\pi^0$  mesons.

S. N. Vernov and his co-workers obtained during two expeditions (in 1949 and 1951) experimental data which proved the existence of a nuclear cascade process at primary cosmic-particle energies of  $10^{10}$  ev. In this work a study was made of the fundamental characteristics of the interaction processes of high-energy protons with nuclei, and of the dependence of these processes on the energy of the primary cosmic particles in the energy range of  $3 \times 10^9$  to  $3 \times 10^{10}$  ev. The extensive series of works carried out under Vernov's guidance on the investigation of the interaction of cosmic rays with matter made it possible to explain the incipience of secondary cosmic radiation in the atmosphere, and to describe this process quantitatively.

Vernov is not only an eminent scientist with a broad and versatile outlook but also a large-scale organizer who is able to rally and direct scientific groups to the fulfilment of tasks connected with basic directions of cosmic-ray investigations.

At his initiative interesting investigations of the elementary interaction processes of particles with energies of  $10^{11} - 10^{13}$  ev with nuclei are at present being conducted by means of a high-altitude aircraft. Under his guidance a special laboratory building equipped with unique apparatus was constructed at the Moscow State University for the investigation of the interaction of ultrahigh-energy particles ( $10^{14} - 10^{16}$  ev) with matter. With his direct participation a network of stations for uninterrupted cosmic-ray recording was set up in the U.S.S.R., which is conducting a broad series of investigations within the program of the IGY-IGC.

For his great scientific achievements Vernov was elected in 1953 a corresponding member of the U.S.S.R. Academy of Sciences.

His gifts as a great scientist and organizer were particularly clearly displayed in the cosmic-ray investigations by means of the Soviet artificial satellites and cosmic rockets. With the aid of original apparatus installed on board of these satellites and rockets, and as a result of a subtle analysis of the results of the measurements, he discovered the outer radiation zone of the earth, and investigated in detail both this outer as well as the inner zone. The study of radiation belts of the earth is of primary significance, not only for the study of the physical properties of interplanetary space, but also for a series of theoretical and practical problems in present-day geophysics. For the discovery of the outer radiation belt of the earth, and for the study of its properties Vernov was awarded the Lenin prize in 1960.

S. N. Vernov is the director of the Scientific Research Institute of Nuclear Physics of the Moscow

State University and the head of the special departments of its physics faculty. He combines much organizational work with fruitful scientific work on the study of cosmic rays in all its manifold and diverse directions: starting with the study of processes in cosmic space and of cosmic-ray variations due to astrophysical phenomena, and including nuclear processes caused by cosmic-ray particles with ultrahigh energies.

Celebrating S. N. Vernov's fifty-year jubilee, the Soviet scientific community wishes him health, and further creative achievements in his scientific work.

#### A List of S. N. Vernov's Main Works

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- 6.\* Investigation of Cosmic Rays in the Stratosphere near the Magnetic Equator, *Doklady Akad. Nauk SSSR* **23**, 138 (1939).
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\*References marked by an asterisk were written in conjunction with other authors.

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