

THE OUTSTANDING RUSSIAN PHYSICIST S. I. VAVILOV *

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OUR sessions today and tomorrow are devoted to the bright memory of Sergeĭ Ivanovich Vavilov in connection with the seventieth anniversary of his birth.

The setting aside of such dates, associated with the lives and work of the greatest scientists, allows us to shed light through scientific reports upon the outstanding contribution to the progress of world science made by their works. The reports which we will hear or have already heard at this jubilee meeting are devoted to reviewing the discoveries and most important results of the classical works of Vavilov and his school in the field of luminescence; we will also examine ideas in this special field which are associated with his name and continue in their development under his students, affecting many areas of science and technology.

Vavilov will be remembered in history not only as an outstanding researcher who opened new paths for the subsequent development of certain very important fields in the study of light phenomena, but also as a very great scientific organizer who had tremendous influence on the building up, not only of Soviet physics but also of other areas of Soviet science at the most important stage of its evolution.

Everyone knows, of course, the versatility of Vavilov's work, which left such a deep imprint, whose effect on the life of our country was not at all confined to the domain of the U.S.S.R. Academy of Sciences and its institutes.

S. I. Vavilov was a patriot in the highest sense of the word: he devoted the utmost effort to public and social work, was simultaneously President of the Academy of Sciences, director of two very large institutes, deputy to the U.S.S.R. and R.S.F.S.R. Supreme Soviets and municipal soviets, and chairman of the All-Union Society for the Propagation of Scientific and Political Knowledge. He was an outstanding expert in the history of our national and world science, and an exceptionally talented popularizer of science who left a whole series of remarkable popular-scientific essays and monographs as well as classic works on the history and methodology of science. He is also known as a bibliophile and an expert on library and publishing matters, to whose development in our country he made a considerable contribution.

*Opening address at the joint session of the U.S.S.R. Academy of Sciences Physics and Mathematical Sciences Division and the P. N. Lebedev Physics Institute Scientific Council on March 27, 1961, dedicated to the memory of S. I. Vavilov. The reports of I. M. Frank, V. L. Levshin, and I. V. Kuznetsov, read at the same session, follow.

In a short introductory address it is not possible to touch on all the aspects of this varied activity and the creative make-up of Vavilov as a scientist and public figure.

Much could be said about Vavilov's activity as one of the leaders of the Division of Physics and Mathematical Sciences throughout his time at the Academy. He participated actively from the time of his election in 1932 as Member of the Academy of Sciences, later as a member of its presidium, and finally as its president.

It is impossible to separate Vavilov's organizational work from the enormous undertakings which, from his first steps as academician to the last hours of his life, he tirelessly and unendingly conducted as director and leader of laboratories of the Academy Physics Institute he created, within whose walls this solemn session devoted to his memory is convoked today.

Vavilov begins the foreword to his book "The Physics Office—The Physics Laboratory—The Physics Institute" (published in 1945) with the words: "Along with the whole U.S.S.R. Academy of Sciences, the P. N. Lebedev Physics Institute observes in June, 1945 the two hundred and twentieth anniversary of its existence as the oldest center of experimental physics research in our country."

These are characteristic words for Vavilov. It is characteristic that he saw in the Institute he created, ordained to make its great contribution to the construction of Soviet science and culture, a continuation of the best old traditions of academic science and physics (whose history he sketched with such love and deep knowledge in the cited book). Moreover, according to its founder, the Physics Institute of the Academy had to become "the center of physics research in our country."

In the light of those imagination-staggering conquests of science and technology of which we in our times are the yearly witnesses (I have in mind, of course, man's conquest of outer space), it is relevant to recall a venture dating from the early period of Vavilov's work at the U.S.S.R. Academy of Sciences. I am referring to the uniting in cooperation of a diversified group of scientists, initiated and carried forward thanks to Vavilov's unusual energy, in the study of phenomena in the highest layers of the atmosphere, the stratosphere.

In 1934 an All-Union Conference on the Study of the Stratosphere was convoked at the Academy of Sciences in Leningrad and conducted according to a program

worked out under Vavilov's leadership, a program encompassing an astonishing range of subjects. Many of the scientific and technological problems touched upon by this conference nowadays occupy a central position in a complex of investigations carried far beyond the limits of the stratosphere by powerful modern means. In the list of authors of the conference proceedings we may find, along with the name of Tsiolkovskii, the names of outstanding researchers and workers, the most active participants in those recent events which I just mentioned. Then also was instituted the permanent Commission for the Study of the Stratosphere, which operated for a number of years under Vavilov's chairmanship and whose functions were subsequently transferred to the Geophysical Institute.

Vavilov was elected Academician in 1932, and founded the Lebedev Physics Institute in 1934. Both of these dates are singular pivotal points in the history of physics, determining to a considerable degree its further development. I have in mind the discoveries of the neutron and positron in 1932, and of the phenomenon of artificial radioactivity in 1934.

Vavilov transferred his activity in 1934 to Leningrad and assumed the leadership of the already very important Optical Institute. At the Academy of Sciences Physico-Mathematical Institute he created and directly conducted the work of that small nucleus of youths from which subsequently developed the leaders of some of our greatest laboratories. In the Leningrad period prior to the founding of the Physics Institute, a discovery of world-wide importance was made—the discovery of Vavilov-Cerenkov radiation.

Of great value for the further development of ideas derived from this discovery was the fact that Vavilov, albeit an optical physicist, from the very beginning of his organization of the Physics Institute allotted considerable attention to nuclear physics.

From the nucleus of youths formed and directed for many years by Vavilov (into which new youthful energies were later infused in Moscow) there developed very great nuclear laboratories in our own and several other institutes which have to their credit discoveries of the first order.

It is known that in the very beginning of Vavilov's activity at the Academy of Sciences, certain members of its presidium suggested that he concentrate the work of the Institute (which he then headed) upon the region of his specialty, luminescence phenomena.

Vavilov, however, did not agree to this, trying as he was to create an institute which (according to his words cited above) should become "the center of physics research in our country."

After the transfer of the Academy of Sciences to Moscow, he did create such an institute, and he attracted the greatest physicists of Moscow to it.

The Physics Institute has to this day remained an institution of wide scope, such as its founder had wished to see. The rich scientific legacy of such

eminent scientists, heading great scientific schools, as L. I. Mandel'shtam, N. P. Papaleksi, and G. S. Landsberg has been successfully developed. I am not naming all the other well-known and presently active academicians and outstanding scientists now heading the most important sections of the Physics Institute as well as the independent institutes and laboratories which have evolved from it (such as the Acoustics Institute, the two laboratories of the Joint Institute for Nuclear Research in Dubna, and the Institute of Nuclear Physics of the Moscow State University).

In all ten years have elapsed since his untimely death. The rate of progress of contemporary science, which is developing in a "chain reaction," is such that important barriers separate the physics (and the science in general) of our day from that of sixty-year-old Vavilov. During this time science has entered a "qualitatively" new era in its evolution.

The history of the discovery of Vavilov-Cerenkov radiation and its role in the recent progress of physics are in this sense typical.

This phenomenon, passed over by classical physics (although it could have been predicted), was discovered more than 25 years ago. Its importance for extensive applications in nuclear physics, which would lead to its international recognition through a Nobel prize in 1958, was revealed only very recently. In giving an example of these unexpected applications, we may see to what extent progress in seemingly very unrelated branches of science is interconnected.

It is well known that the use of Cerenkov radiation counters played a considerable role in the discovery of the antiproton.

Another astonishing example is the investigation of cosmic rays by observing the Vavilov-Cerenkov glow emitted by a flux of fast atmospheric shower particles produced by cosmic radiation in the earth's atmosphere. A report on studies made using this method will be heard tomorrow at the Institute seminar session.

We will presently hear the reports of V. L. Levshin and I. M. Frank on the development of Vavilov's special scientific legacy, luminescence, as well as of ideas directly associated with his scientific work.

Progress in still other branches of the Physics Institute, which after his death developed in a sharply ascending curve, could be achieved thanks to Vavilov's efforts in the still young institute which he founded, and to which he devoted so much up to the last days of his life. New fields, quantum radiophysics for example, got their start at the laboratories of his institute.

Most recently we are witnessing how ideas developed in this field are finding unexpected applications and leading to remarkable accomplishments, in particular in the area directly concerning Vavilov, of luminescence phenomena.

As the result of synthesizing ideas deduced, on the one hand, from the molecular generators and radio-wave amplifiers constructed at the Physics Institute, and on the other from the characteristics of fluorescence excitation in certain crystals, light sources (or converters) can now be designed possessing paradoxical properties from the point of view of classical optics, and promising exceptionally valuable applications.

It turns out to be possible to make a light source in the form of a cube (or plane-parallel plate) of crystal with linear dimensions on the order of centimeters which generates light oscillations coherent over its entire volume; the wave plane is parallel to one of the pair of crystal faces. As can be easily understood, such a source emits light in a definite direction, concentrated within a quite small solid angle, and possessing a tremendous instantaneous intensity. Using such a light source, it is in principle possible to illuminate, for example, an area on a lunar surface with linear dimensions of several kilometers.

The history of the genesis of these concentrated light emitters provides a remarkable example of the successful association of separate scientific and technological fields which, as I have already indicated, so characterizes the progress of contemporary science.

The versatility in structure of the Academy Physics Institute has been preserved in accord with Vavilov's

intention, so that great possibilities exist for achievements of a complex nature uniting varied fields of physics.

During the ten years which have passed since Vavilov's death, the Physics Institute has expanded by several fold. Young scientists who began as students of Vavilov while the Institute was still in Leningrad, or as doctoral candidates here in Moscow, now direct large groups and have already founded their own great schools. Only a relatively small core of the older generation, who worked under his direction at the Physics Institute, keeps alive memories gained from personal contact with that fascinating, sympathetic and inspiring man who, cheerful up to the last, was always active in helping them.

But the new generation is also developing and working under the influence of the traditions created at this Institute by its founder Vavilov.

The memory of this outstanding scientist, who contributed so much to the building up of Soviet science, will be preserved forever in the history of Soviet and world physics.

Translated by Mrs. J. D. Ullman