*S. I. VAVILOV—EMINENT SCIENTIST AND LEADER OF SOVIET SCIENCE**

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Usp. Fiz. Nauk **75**, 205-213 (September, 1961)

Last March marked the seventieth birthday of the eminent physicist and leader of Soviet science, the great public figure, Academician Sergeĭ Ivanovich Vavilov, who passed away ten years ago. The scientific community took note of this date by holding a series of scientific conferences. We print in this issue several papers read at the joint meeting of the Presidium of the U.S.S.R. Academy of Sciences and the scientific community on March 24. Some of the reports read at conferences held at the P. N. Lebedev Physics Institute and the S. I. Vavilov Optics Institute in connection with this occasion, are also here.

COMRADES, on the occasion of the seventieth anniversary of his birth, today's session is dedicated to the memory of the president of the U.S.S.R. Academy of Sciences, Academician Sergeĭ Ivanovich Vavilov, one of the finest Soviet scientists and a distinguished public figure.

Vavilov was not merely a leading scientist, but one of the best representatives of scholars of the new socialist society. He was endowed with a combination of remarkable qualities of a real scientist-scholar, a scientist-citizen, a leader of youth, a popularizer of learning and a deep student of the history of the development of science in its fullest extent. Besides, he was a fascinating man, warm, sensitive, invariably considerate and always ready to help people.

He possessed another noble trait—a highly developed sense of duty. To him "I should" meant "I can." He could properly be called a Man with a capital "M."

It is difficult to describe fully in a comparatively brief address the various accomplishments of this remarkable scientist of our epoch and of the heritage he left behind. Vavilov spent almost 20 years in the Academy, five as president. He left a deep imprint on its history. My task is made easier by the fact that the scientific aspects of his activities will be brought out in a more detailed fashion in the final report. Thus, I mention only the salient points in his main scientific work.

Vavilov showed interest in science in general and in physics in particular early in his student life, more precisely, in the latter part of secondary school. Through his initiative there, a group devoted to natural science was organized, in which he took the most active part. Vavilov fell in love with books while still in school, and we know that this love for books was maintained throughout his entire life. Not a single Sunday went without his spending time in book stores and second-hand bookshops. It was a great pleasure for him to search out rare editions, both Russian and foreign, and not only in his specialty, physics, but also in the history of science, philosophy and art.

Vavilov received his higher education at Moscow University and was graduated from the Department of Physics and Mathematics in 1914. The chair of physics at Moscow University was headed at that time by the eminent Russian scholars Umov, Lebedev, and Sokolov. Vavilov had the unique opportunity to take a course in general physics from Peter Nikolaevich Lebedev. An immediate guide of his at the university was another notable physicist—Peter Petrovich Lazarev, later to become a full member of our Academy. Partly under his influence, Vavilov became especially interested in physical optics, a field to which he dedicated his entire life and in which he achieved such outstanding scientific success.

In the university, Vavilov demonstrated great talent, exceptional working ability, perseverance and love for scholarly endeavor. In 1913, one year before graduation, his first scientific paper "Photometry of Differently Colored Sources" was published in the Journal of the Russian Physics and Chemistry Society. In his student years, he carried out, with apparatus designed

*Introductory speech at the meeting of the Presidium of the U.S.S.R. Academy of Science, March 24, 1961.

by himself, interesting work devoted to the study of the nature of the chemical activity of light. For this work, published before his graduation, he was awarded in 1915 the gold medal of the Society of the Friends of Science, Anthropology, and Ethnography at the Moscow University.

In the spring of 1914, he was graduated with honors. However, he refused the offer to remain at the university in preparation for a professorship, in spite of the magnificent prospects this afforded, to say nothing of exemption from military service. Vavilov did not feel able to remain at a university from which all the progressive professors left after the havoc caused by the reactionary minister of education Kasso.

Called in 1914 to military service, Vavilov very soon after the beginning of the first world war, landed on the front where he spent four years. With his peculiar interest in science and with his initiative and energy, Vavilov managed to occupy himself with scientific work even amidst conditions at the front. By then radio communication had become indispensable in military operations. In the engineering division, having acquired a practical knowledge of wireless telegraphy, Vavilov became interested in scientific problems in this field and developed a new method for radio direction finding, tested under front conditions. At the field wireless station he set up and carried out still another interesting experiment, with both theoretical and practical implications, on the frequency of a loaded antenna.

The war ended. The October socialist revolution occured and a new page in Vavilov's life and activity began.

In the new Soviet republic, conditions were immediately created for the development of science. At the initiative of Peter Petrovich Lazarev in Moscow, an institute of physics and biophysics was organized in Moscow by the National Health Commissariat. In this institute, under Lazarev's direction, Vavilov began his exceptionally fruitful scientific work, and became, very shortly, a full fledged scientist.

Vavilov's career as a pedagogue was spent in Moscow, at the Higher Technical Institute, at the Moscow University, and at the Moscow Higher Zootechnical Institute, where he was appointed professor of physics in 1920. In 1929, he was appointed professor and head of the department of general physics of the Moscow State University, where a group of the more talented youth rallied around him—senior students, graduate students, and young scientific workers, many of whom became afterwards outstanding scholars.

The beginning of the Thirties marked a new period in Vavilov's life and scientific activity. In 1931 he was elected a corresponding member of the Academy of Sciences, and in the following year he became an Academician. At the suggestion of the founder of the State Optical Institute, Academician Rozhdestvenskii, Vavilov was appointed in 1932 scientific head of this institute and from that time, for 20 years, he did not cease working there. For 30 years he was assistant director of the scientific department of the State Optical Institute which now bears his name. Only after his election to the post of president of the Academy of Sciences was Sergei Ivanovich forced to relinquish this position, since he had to move to Moscow. However, he maintained close ties with the Optical Institute right up to his death, as a member of the Scientific Council and the head of the Luminescence Laboratory. This guidance was not a formal one, as with everything he directed or engaged. Being president of the Academy, for all the many responsibilities attached to this post, Vavilov spent no less than one week a month in Leningrad, devoting a great deal of time to the Optical Institute. The experiments he and his coworkers performed at the State Optical Institute made a great contribution to the founding of the Soviet optical-mechanical industry, which, to all intents and purposes, was non-existent in our country before the revolution.

Simultaneously with the work in the Institute of Optics, from 1932, Vavilov directed the Physics Division of the Institute of Physics and Mathematics of the Academy of Sciences. The rapid growth of the Physics Division was due to his immense, indeed, inexhaustible energy. In two years, in 1934, after the transfer of the Academy from Leningrad to Moscow, the Physics Department was reorganized as the Institute of Physics of the Academy of Sciences, which Vavilov headed continuously right up until his death. At that time, there was no center in Moscow for physical science and the creation of an institute of physics on a wide base became an extremely necessary task. Under his guidance, the Institute of Physics changed in the course of time into an excellent scientific-research institution, engaged in all the basic divisions of the physical sciences. Vavilov managed to attract a range of eminent physics scholars and young men to the Institute.

Vavilov was for many years a member of the Division of Physical-Mathematical Sciences and a member of the Presidium of the Academy, and always took a leading part in its scientific administration.

He published some 500 scientific papers about 100 of which report major scientific investigations in the field of physical optics.

Experiments on photoluminescence and on the nature of light occupy the major place in Vavilov's scientific work. Photoluminescence attracted his attention at the beginning of his scientific activities and remained his main field to the end of his life. The luminescence phenomenon itself has been known for several centuries. However, at the time when Vavilov began its study very little was known of the physical nature of the photoluminescence and its properties; this field was a very narrow part of physical optics. Vavilov devoted almost 30 years to the study of photolumi-

nescence and its nature. Through his work and that of the Soviet school of luminescence which he created this field of physics was raised to the rank of a leading branch of modern physical science.

The fundamental laws governing the energy relations in luminescence were laid down by Vavilov; his great achievement was the discovery of the law of the constancy of the quantum yield of luminescence, known as Vavilov's law.

At the present time, luminescence has wide practical significance and is used in television, radar, defense, automation, in the study of nuclear decay, in biology, medicine, and many other fields.

One of the most practical uses of luminescence is fluorescent lighting. Under Vavilov's direction problems connected with the creation of fluorescent lighting and so-called "daylight lamps" were successfully solved in the luminescence laboratory of the Institute of Physics of the Academy of Sciences, in the Optical State Institute, in the All-Union Electrotechnical Institute, and in industry, and especially in the Electric Bulb Plant in Moscow. The significance of these lamps in the national economy is in their low operating cost and their close approximation of daylight. The use of fluorescent lighting in industry has increased labor productivity.

Many different methods of luminescent analysis of great practical significance were worked out under his direction and have found wide application in medicine, chemical technology, in mineral prospecting, and various branches of industry.

To Vavilov belongs credit for the development of ultraviolet and fluorescent microscopy. Under his immediate supervision at the State Optical Institute new original principles of ultraviolet absorption microscopy were worked out, new achromatic reflecting objectives were created, and a method of optical color transformation of the ultraviolet image was developed.

Under Vavilov's direction and through his initiative, our luminescence microscopy was brought to such a state of development that it has become an important research tool in biology, medicine, geology, and in the control of a host of industrial processes. Basic research under Vavilov's direction has led to the development of a completely new type of microscopy, combining ultraviolet and luminescent microscopy. Luminescent microscopy in the ultraviolet region of the spectrum has opened new, highly promising possibilities in research into the biochemical processes in the living cell.

The great series of experiments carried on by Vavilov and devoted to phenomena observed in extremely weak light, at the threshold of visibility, which he demonstrated to furnish direct proof of the quantum nature of light, were remarkable for their scientific daring and successful results.

Finally, one of his most important scientific accomplishments is his leading role in the discovery that a glow of a radically new type is produced in a medium in which fast electrons move. One of his students, Pavel Alekseevich Cerenkov, working under his immediate direction, discovered and investigated this phenomenon, which had received the name "Vavilov-Cerenkov radiation." A complete and exact theory of this phenomenon was subsequently given by the Soviet scientists, Igor Evgen'evich Tamm and Il'ya Mikhaĭlovich Frank. This discovery, besides its great theoretical significance, has important practical applications, such as the Cerenkov counters for fast elementary particles, which are very extensively used in modern nuclear physics. The significance of this scientific discovery was attested to by its winning the Stalin Prize of the first degree, and later the Nobel Prize. Unfortunately, this last prize, which Vavilov deserved by right, could not be presented to him, since the official rules do not permit the Nobel Prize to be awarded posthumously.

This is a far from complete list of Vavilov's main works during his relatively short life.

The close tie between theory and practice was a remarkable feature of Vavilov's scientific activity. All his work in the field of optics and illumination was utilized in industry. The practical application of the results of scientific work and the union of science and production were regarded by him as a most important problem which Soviet scientists must solve at all costs.

The results of Vavilov's scientific endeavors were extremely important, but he is honored not only because of them. A distinctive trait of his was the rare ability to combine scientific research with the art of widely popularizing knowledge and with research in the history of science.

The dissemination of scientific knowledge among the masses was considered by Vavilov to be one of the important responsibilities of the scientist. He often recalled the words of Nekrasov: "Sow wisdom, the good, the eternal, sow and the Russian people will thank you." Vavilov constantly emphasized that to be able to convey scientific knowledge simply, profitably and intelligibly and yet without lowering the scientific level of the given subject is a very difficult task, requiring great effort.

Vavilov possessed both literary talent and the unusual gift of being able to expound the most difficult scientific problems in an attractive and popular manner. Every one of his popular science books can serve as an example of depth in the disclosing of scientific contents and of simplicity in its exposition. His books "Experimental Basis for the Theory of Relativity," "The Eye and the Sun," "On Warm and Cold Light," "Lomonosov and Russian Science" and others have become most valuable additions to Soviet popular science literature.

Vavilov headed the mass movement of Soviet scientists and was one of the initiators in creating the

All-Union Society for the Propagation of Political and Scientific Knowledge, envisioning the task of this society to be the conveying of this knowledge, by all means possible, to the masses. He was the president of this society until his death.

Vavilov had an extraordinary understanding of the popularization of science. He not only considered those who were coming in contact with the given field of knowledge for the first time, but also readers with a solid background or even specialists, but interested in problems unrelated to their particular field of science. A committee under Vavilov's direction published, besides popular-science books and brochures aimed at the general reader, several special series: "Classics of Science," "Literary Monuments," "Accomplishments and Problems of Contemporary Science," and others.

Vavilov's works on the history of science also helped popularize knowledge. He worked a great deal on problems in the history of natural science and his works in this field are extremely interesting. The most important of Vavilov's works in the history of science are those dedicated to Newton. He translated Newton's "Optics," adding a large commentary and many explanatory notes, wrote a reliable scientific biography of Newton, and finally, completed the huge and difficult task of translating Newton's lectures on optics and adding his highly important explanatory notes. He also wrote a valuable paper on the physics of Lucretius, and made a valuable contribution to the history of Russian Science with his work on the life and scientific activity of the founder of Russian Science, Lomonosov. Under his direction, interesting new material on Lomonosov was discovered and published, Lomonosov collections were published, and Lomonosov readings were organized. The edition of the complete scientific works of Lomonosov was the result of his initiative.

In the field of the history of science as in every other area of his activity, Vavilov showed himself to be a remarkable organizer. He was chairman of the Committee for History of the Academy of Sciences and of the Committee for History of the Physical and Mathematical Sciences all his life. The memorial museum dedicated to Lomonosov was founded in Leningrad in the former Art Chamber through his initiative.

The significance of Vavilov's work on the philosophy of science is very great. In his works "Lenin and Contemporary Physics," "The New Physics and Dialectical Materialism," and others, writing of the very latest discoveries in contemporary physics and critically analyzing them, he demonstrated that progressive, advancing science can be developed only on the basis of Marxist-Leninist materialistic scholarship. He fought violently against all the idealistic concepts of contemporary bourgeoise philosophers and physicists.

Vavilov was not only a talented author but also an outstanding editor. In the archives of many publishing houses it is possible to find many manuscripts in his handwriting and his reviews of books or articles.

Immense erudition, deep culture, and wide general knowledge and interests enabled him to take a direct part in the publication of material devoted not only to physics, but also to philosophy, the history of science, literature, painting, and music.

His work for the Soviet encyclopedia occupies a special place in Vavilov's activities. He authored a whole series of articles in the first edition of the Great Soviet Encyclopedia, being at that time the physics editor. But he accomplished an even more amazing job in the second edition, as chief editor, a post to which he was appointed in 1949. In spite of the inumerable duties as president of the Academy of Sciences and director of a host of scientific institutions and organizations, Vavilov very willingly took on the responsibility in the creation of a genuine Marxist encyclopedia that would meet the demands of our great era. His work as chief editor of the Great Soviet Encyclopedia was exceedingly fruitful, owing to his really encyclopedic knowledge, great erudition, and deep understanding of the requirements of such an encylopedia. He did not limit himself to the general directorship of the encylopedia as chief editor, but edited many articles himself, painstakingly inspecting and correcting many of them. Literally to within a few hours of his death he corrected articles which he carefully inspected and which contain valuable corrections and notes by him.

In the war years, with the organizing of scientific research under new conditions and with new tasks, Vavilov's organizing ability really showed itself. Plans and projects were reviewed, under his direction, for the work of the State Optical Institute and the Physics Institute of the Academy of Science toward the war effort. In spite of the difficult conditions in which both institutes found themselves in the evacuation period, they successfully solved several problems in the production of new types of optical devices, which were subsequently employed in weapons of the Soviet Army. These efforts, not only under Vavilov's direction but also through his immediate participation, were inestimable. In 1943 he was appointed Head of the State Defense Commission.

A new period in the history of the Academy began at the end of the war. In July 1945, when Vavilov was elected its president, the directorship of the Academy fell into the confidant, strong hands of a remarkable scholar and unusual organizer.

A task of exceptional importance was placed before Soviet scientists: to place in the hands of the national economy of the Soviet Union, within a short time, the scientific and technological means necessary to successfully build communism, so as to allow for the maximum utilization of the natural resources of the country

and to strengthen its military might. Through his prestige among scientists in all specializations, Vavilov managed to unite a great staff of scientists and fulfill all these tasks.

Possessing a deep understanding of both the essence and methods of science and the interdependence of the sciences, Vavilov actively supported, and in many cases directly led, some especially promising scientific trends which became the basis of future more intensive research. His activity in the wide use of isotopes and their radiations in the national economy, science, and technology is an example. Just a few years after the war our scientists and engineers were able to work with many radioactive and stable isotopes. It was necessary to determine and discover ways to use them even more effectively. He headed the special Scientific Council to the President of the U.S.S.R. Academy of Science, which exercised immediate control, on a national scale, not only over very important research in this field but also over the popularization of the idea of the peaceful uses of atomic energy.

Vavilov was one of the first to appreciate all the prospects of nuclear-particle accelerators and did a great deal towards the construction of the first accelerators in our country. He helped much to build the Soviet 10-Bev accelerator now transferred to the Joint Institute for Nuclear Research.

Vavilov attached great importance to scientific research in the stratosphere. In connection with the development of rocket technology, he paid a great deal of attention not only to the upper layers of the atmosphere, but also to the regions beyond it in outer space, and actively supported our beginning, at that time still young specialists in this field.

The ability to quickly recognize new and promising scientific trends and methods was one of his characteristic traits. He took up and actively supported any such initiative. Here is one example. When a method was developed for the production of domestic nuclear emulsions, Vavilov showed great perserverance in developing and producing these emulsions, which are now one of the basic tools in the research on cosmic rays and nuclear phenomena.

As another example, Vavilov envisioned the future significance of polymers. He designated research on the physics and chemistry of polymers as one of the basic scientific tasks. For this purpose, in particular, the Institute of High Molecular Weight Compounds was founded in Leningrad as early as 1947.

Vavilov considered extensive application of mathematical methods to various fields of science and technology a most important task of science. This has been very rapidly developed in our time. One of the most important steps in this direction was the organization of the Institute of Precision Mechanics and Computer Technology in 1948.

These examples, of course, far from cover all Vavilov's activities, as president of the Academy of Sciences, aimed at the development of the leading trends of contemporary science. These efforts were so wide, varied and immense that it is impossible to enumerate all that he did toward the development of entirely new branches of science.

Vavilov paid a great deal of attention to the publishing activities of the Academy of Sciences. During these years there were many difficulties connected with publication of scientific books and journals: the printing plant of the Academy was made highly inadequate by the growing need of publishing scientific literature, by the lack of skilled printers, and by the limited supply of paper. In spite of this, in large measure thanks to his persistent efforts, the volume of publishing increased quickly. Our Academy published 5500 printers' signatures of books and journals in 1945 and 13900 in 1950.

Vavilov considered the general development of scholarly research in the country as a necessary condition for the successful development of science. As Chairman of the Council for the Coordination of Scientific Activities of the Academies of Sciences of the Union Republics, he immediately directed whatever aid was given to the young academies of the different republics, exercising great care in the training of their scientific staffs, especially those of the various nationalities. 1946-1951 saw the founding of the Kazakh, Estonian and Latvian academies of sciences and many branches. In addition, preparatory work was carried out towards the organization of academies in the Tadzhik and Turkmenian republics, which was completed after his death. We value very highly this aspect of Academician Vavilov's activities.

When we consider the path followed by Vavilov, all the things he did seem almost impossible in both their immensity and their variety. We have been the witnesses to his really titanic and selfless labor. Sergei Ivanovich Vavilov gave his entire efforts, experience, knowledge and his very life in selfless devotion to his native land, to Soviet science, and to the great task of communism.

Translated by Alice R. Naumoff