remember that the syllabus was mentioned least. Sergeĭ Ivanovich spoke extensively about Italy and Leonardo da Vinci.

I started the series of lectures a week or two later. They were terrible. For some reason, I decided to base geometric optics on variational principles and the result was that the students could not understand a word. This was aggravated by the fact that I got into a muddle with the drawings (the sagittal section was particularly difficult). The students revolted and asked for my removal. They had heard rumors from more senior students about Sergeĭ Ivanovich's lectures. Somehow, the students were pacified, but a week later the trouble recurred. The Dean sent the representatives of the students to Sergeĭ Ivanovich, who advised patience. Sergeĭ Ivanovich's charm did the trick and, by the end of the semester, all was well again.

At about the same time, Sergeĭ Ivanovich assigned to me an experimental project. Until then, I was working under the supervision of G. S. Landsberg. Sergeĭ Ivanovich was worried by the fact that, in his paper on the quantum yield of fluorescence (Vavilov's Law), he had to use published data on the energy distribution in the spectrum of a mercury lamp. The necessary equipment was not available and he used to joke about his unsuccessful attempts to use an old galvanometer which gave him a lot of trouble. Sergeĭ Ivanovich suggested that this work should be repeated, and measurements should be carried out not only of the fluorescence intensity but also of the intensity of the spectral lines producing this emission. After some unsuccessful attempts to use the old galvanometer, I replaced it with an ordinary low-resistance mirror galvanometer and developed a photoelectric circuit for detecting the deflection of the light spot. At the time, such systems were not available commercially and the device helped to solve the problem.

Although Sergeĭ Ivanovich gave me a free hand, he always enquired in detail about the progress of my researches whenever he visited the All-Union Electrical Engineering Institute where this work was being done. Having obtained the results, I continued to delay publication of the paper and Sergeĭ Ivanovich published these data (with the appropriate reference to me) in tables which were issued under his editorship.

When I finally wrote the paper, which Sergeĭ Ivanovich carefully read and edited, I naturally suggested that he should be one of the authors. He declined, despite all my arguments, and this too, was an important lesson to me.

During the last years of his life, Sergeĭ Ivanovich was, of course, totally overburdened by a mass of different duties. However, he never gave the impression of being in a hurry and we were so used to this that we took it for granted. Later, when Sergeĭ Ivanovich was no longer with us, we realized in retrospect the sheer volume of all his work and that, despite its superficial variety, there was an underlying internal unity.

I last saw Sergeĭ Ivanovich directing a seminar. He complained about his heart which interfered with his work. He died next morning.

These brief recollections can hardly do justice to the debt which I owe to this remarkable man.

Sergeĭ Ivanovich Vavilov in the Optics Institute

P. P. Feofilov

Usp. Fiz. Nauk **117**, 167–176 (September 1975)

PACS numbers: 01.60.+q

Having survived the initial preparatory period of its development during the early thirties, the optical industry of the Soviet Union was, in the words of D. S. Rozhdestvenskiĭ, "ready for takeoff" and was preparing to deploy "all its resources for peaceful but also military purposes." The growth of the industry presented new and previously unfamiliar problems to science. On the other hand, scientific problems had to become more closely linked with the problems presented by industry.

The Optics Institute was prepared for these new demands by its history, beginning with the original ideas of D. S. Rozhdestvenskiĭ about "a scientific institution of a new kind in which science and technology would be intimately connected." At this time, the State Optics Institute had a broad range of interests with a differentiated structure and employed about 160 scientists. However, this was not enough to satisfy the needs of the optical industry which in 1930 was unified in the All-Union Association of Optico-Mechanical Industry. D. S. Rozhdestvenskiĭ wrote at the time that the staff of the State Optics Institute should increase by a factor of 4–5 in the course of the next 5–6 years. Having foreseen this development of the Institute, D. S. Rozhdestvenskiĭ began to look for a successor, a young energetic scientist with extensive knowledge of optics, who would be capable of directing a complex scientific organization such as the Optics Institute already was at that time. His choice was Sergeĭ Ivanovich Vavilov, a professor at Moscow University, well-known for his work in optics, who had only just been elected Member of the Academy of Sciences. After some negotiations which, in addition to D. S. Rozhdestvenskiĭ, involved T. P. Kravets (who knew Vavilov well from the Lebedev School and from Lazarev's Institute of Physics and Biophysics), and after a number of difficulties were overcome, Vavilov arrived in Leningrad in 1932 and took over the post of Scientific Chief of the State Optics Institute, which he held until he was elected President of the USSR Academy of Sciences in 1945.

His years as Scientific Chief of the State Optics Institute were not easy. They saw the rapid growth of the Institute, an expansion of its range of interests, the unavoidable growing pains, and finally the War, when all possible effort had to be mobilized for the front line, but

[2)]Based on rewritten chapters of the paper "Sergeĭ Ivanovich Vavilov" published in "Fifty Years of the S. I. Vavilov State Optics Institute" (Mashinstroenie, Leningrad, 1968, p. 587).

there was also the other important problem of preserving the scientific potential of the Institute so that it would be ready to face new problems in the post-war period. In actual fact, the Institute emerged with great honor from its many trials, and S. I. Vavilov turned out to be a distinguished successor to D. S. Rozhdestvenskiĭ.

For many years, the State Optics Institute was Vavilov's main preoccupation. However, one must remember that he was also Director of the Physics Institute of the USSR Academy of Sciences which was transformed under his leadership from a modest institution, comprising not more than ten members of staff, to one of the major institutes in the country, the famous P. N. Lebedev Physics Institute of the Academy of Sciences. Nor must we forget the gigantic work of Vavilov as national director and administrator of science, historian and popularizer of science, and distinguished social activist and commentator. Even with all this activity, Vavilov continued his own research work, right up to the last moment, in the one field of optics closest to him—luminescence.

When Vavilov was appointed as the Scientific Chief of the State Optics Institute, the Institute was already a major scientific organization with an exceedingly broad range of interests (Vavilov wrote: "Any optics problem, scientific or technological, which is worth investigating should be investigated at the Institute") and an established structure. The 160 scientists working at the Institute at the time were organized in sectors (laboratories) and groups, each of which systematically investigated a relatively narrow band of problems. Having analyzed this structure and considered "the usefulness and necessity for this undoubtedly complicated structure," Vavilov concluded that the "complexity of the Institute is unavoidable, at least until new major centers of optics research become available in the country. Any attempt at a mechanical division of the Optics Institute into specialist institutes would, in our view, be clearly undesirable. The Institute is not the arithmetic sum of its individual laboratories, but an organic whole, the importance of which is very much greater than the sum of its parts."

Vavilov did not consider it necessary to introduce any essential changes into the existing structure, and during his tenure of the directorship of the Institute most of the developments proceeded along the traditional lines, despite the fact that the size of the Institute and the demands on its scientific and technological facilities increased enormously.

Vavilov fully accepted and retained the main ideas of D. S. Rozhdestvenskiĭ on the interrelationship between scientific and applied work. He wrote in 1934 that "the founders of the Institute had a clear realization that a young Socialist State would demand from them both scientific and technologic results in their natural and intimate interdependence." During the March session of the USSR Academy of Sciences in 1936, he said: "the continuous line running between the profoundly scientific and the specifically technologic problems, which joins the riddles of quantum electrodynamics to difficulties in the technology of the refractory pot containing molten optical glass should, in our view, continue as the axis of the Optics Institute."

The practical realization of these ideas was not easy. It demanded the ability to find the "golden middle" between two opposite tendencies, i.e., "pure" science, completely insulated from practical problems, and extreme practicism both of industrial workers and many of the staff of the Institute. It was essential to combine a high level of scientific work with the specific connection with the opticomechanical industry.

When Vavilov arrived at the State Optics Institute, the individual scientific lines of enquiry were headed by major scientists. Nevertheless, his exceptional erudition and ability to go straight to the heart of the matter in any particular problem enabled Vavilov not only to coordinate the development of this work but also frequently to exert an important influence on these developments.

Vavilov's own scientific interests were, as before, connected, above all, with luminescence. However, there was a number of research projects, frequently well removed from this area, which were initiated by him in the State Optics Institute.

For example, during 1939—1940, some work had to be done on the detection of camouflage on snow. It was based on differences between the spectral characteristics of snow and the camouflage material in the ultraviolet. This eventually led during World War II to research into decamouflaging, some of which was carried out in besieged Leningrad. Considerable effort was devoted to spectrally differentiated aerial photography. Vavilov's special interest in this work was connected with the possibility of using the method of color transformation, developed in his laboratory by E. M. Brumberg roughly at that time, to increase color contrast. A decamouflaging instrument was built at the suggestion of Vavilov, and could be used to carry out observations in the light of any given spectral composition (the viewing tube was a chromoscope). The work on decamouflaging was followed in 1941, at the suggestion of S. I. Vavilov and under his personal direction, by a cycle of investigations into natural illumination at night.

Methods of calculating and estimating optical system aberrations were developed during these years in connection with the necessity of developing high-luminosity wide-angle photographic systems for various purposes. The daily participation of Vavilov in the formulation, development, and realization of this work was exceptionally important even though computational optics was hardly among his main interests in physics.

In 1936, Vavilov initiated research into the properties of dichroic media and the result of this was eventually the development of polarization light filters [see G. P. Faerman: Usp. Fiz. Nauk **114**, 542 (1974); Sov. Phys.-Uspekhi **17**, 956 (1975)].

Vavilov organized the optics group of the Combined El'brus Expedition (1934—1937) of the USSR Academy of Sciences, most of which consisted of scientists from the State Optics Institute. The program of the Expedition was part of a general plan of investigations into the properties of the stratosphere, which was supervised by Vavilov as Chairman of a Commission of the Academy of Sciences. He also initiated the first conference on visibility and transparency of the lower atmosphere, held at the State Optics Institute in the Fall of 1940.

Vavilov was always particularly interested in research into physiologic optics, photometry, and light technology. His interest in problems connected with visual reception of light undoubtedly began during his years in the laboratory of P. P. Lazarev and was strengthened at the Institute of Physics and Biophysics.

He subsequently initiated the establishment of the Commission on Light Technology at the Academy. Vavilov actively participated in the publication of a collection of papers entitled "Problems in Physiologic Optics."

During the War, Vavilov instigated a new edition of the fundamental work "Optics in Military Science" and "Handbook on Military Optics" (he edited these books together with M. V. Savost'yanova). S. I. Vavilov's quiet persistence resulted in the appearance of books such as "The Possible and Impossible in Optics" by G. G. Slyusarev, "Color and Its Measurement" by M. M. Gurevich, the translation of a book by the founder of photometry, P. Bouguer, with commentaries by A. A. Gershun, the translation of "The Theory of the Photographic Process" by C. E. K. Mees, which was edited by Yu. N. Gorokhovskiĭ, and so on.

One of Vavilov's main contributions as the Scientific Chief of the State Optics Institute was his successful attempt to attain and maintain a high level of scientific work at the Institute. By personal example, by impartial but exacting and always benevolent and expert criticism, and by drawing the attention of the scientific community to the most interesting results, he achieved an atmosphere of scientific creativity at the Institute. Young scientists entering the Institute for the first time could not fail to feel this genuine rather than formal atmosphere. Vavilov was not too interested in the formal implementation of plans, but any genuinely new result was greeted by him with enthusiasm. This undoubtedly strengthened the feeling of personal responsibility among the staff.

The fact that Vavilov appraised success not on the basis of formal implementation of plans but on the quality of results did not, however, mean that he totally rejected planned activity in science. Speaking before the War at a meeting of heads of laboratories at the State Optics Institute, he said, "The future plans of the laboratories have now been collected together and I have had to consider them. It is quite clear that, in most cases, they were completed only to satisfy the requirements of the planning department. To my surprise, I have found no statements of objectives, and have gained a distinct impression that the originators of these plans are not at all clear in their own minds as to what they are going to do. The absence of clarity in a plan of scientific activity, even when good intensions and discipline are taken for granted, can have an exceedingly bad effect on the success of such work. Scientific research proceeds successfully only when it is properly planned and it is clear what are the requirements for its successful completion. The most important aspect of scientific work is its purpose, its plan. In our case, this is conspicuous by its absence. The fault lies both in management and in execution."

During the War, when, on the face of it, planning might have become subordinate to constantly varying short-term demands, Vavilov regarded planning, even short-term planning, as an important source of reserves. At a meeting of an administrative committee of the State Optics Institute on October 19, 1942, he said, "We must now work even harder: in addition to carrying out productive work, we must also take care of management and administration. The question is—how can we achieve better fulfillment of the plan and still greater productivity? This is not only possible, but there is an exceedingly simple way of achieving this aim. It is to be systematic and orderly. However, this approach is not by far adopted throughout our Institute. Even now, despite the intensive work at the Institute, one can see, far too often, members of staff sitting about in the laboratory doing nothing. This is not because they are lazy but because they have not planned their work for each day." A local patriot, Vavilov, never missed a chance to praise the scientific achievements of the State Optics Institute, whether in a paper to the Academy, in a popular lecture, in a speech to inventors, in a newspaper article, or in a paper read to a meeting of the Italian Electrical Engineering Association in Florence.

The session of the USSR Academy of Sciences held in March of 1936 played an important role in strengthening the scientific authority of the State Optics Institute. This session considered papers by A. F. Ioffe, D. S. Rozhdestvenskiĭ, and Vavilov, who directed the two major physics institutes of the country at the time, namely, the Physicotechnical Institute and the Optics Institute. This session was essentially a review of Soviet physics. In clearly written and comprehensive reports, and in the printed materials appended thereto, D. S. Rozhdestvenskiĭ and Vavilov gave a detailed review of the activities of the State Optics Institute. The Institute was commended for the high level of its scientific work. The resolution of the March session noted particularly that "the Optics Institute is one of the few physics institutes in our country which, right from the beginning, established a permanent relationship with industry." Vavilov's paper, "Development of the Physics Institute" was illustrated by numerous results of studies of the nature of light, obtained by him and his collaborators at the State Optics Institute.

This work was carried out in the luminescence laboratory set up at the suggestion of D. S. Rozhdestvenskiĭ, to which Vavilov transferred his investigations from Moscow.

At the March session, D. S. Rozhdestvenskiĭ commended the work of this laboratory and noted that "the extension of optical phenomena from gases to liquids and solids is particularly complex" and pointed out that "these and similar questions are being tackled very successfully at the Optics Institute by the luminescence group implementing the ideas of Vavilov."

The luminescence laboratory at the State Optics Institute, like the Vavilov laboratory at the Physicomathematical Institute of the USSR Academy of Sciences which was in Leningrad up to 1934, was relatively small. In general, Vavilov was opposed to excessive expansion of the laboratory unless he had some specific scientific or technologic problem that could only be tackled by larger staff. For a long time, his laboratory team did not exceed 10—15 people. Being a man of enormous erudition and very broad scientific interests, Vavilov did not allow his collaborators to confine their attention to narrow "luminescence" interests and frequently and deliberately, but with remarkable tact, switched them round, transferring them to more promising projects. His laboratories, which were referred to as the "luminescence laboratories," carried out visual observations of quantum fluctuations and interference, developed ultraviolet microscopy, and investigated night-sky emission, the Kerr effect, and so on. This variety of topics, and the well-known lack of specialization in the laboratory, were regarded by Sergeĭ Ivanovich not only as admissible but frequently essential. The small size of the lab-

oratories enabled Vavilov to keep an eye on all these projects. As the Scientific Chief of the Institute as a whole, he daily visited each member of his laboratory with the familiar question, "Well, what is new? Later, when his scientific, administrative, and public duties at the Academy grew enormously and restricted his visits to Leningrad, each such visit to the laboratories was transformed into a characteristically productive conference in which each member of staff, in turn, reported in detail on his work during the two weeks or month since the last visit by Vavilov. If there was nothing to boast about, the sarcasm of Sergeĭ Ivanovich's response was sufficient to ensure that the particular researcher really did try to report by the next visit either some new discovery or at least some new series of measurements. This taught the younger researchers to maintain a high level of discipline and responsibility in the projects entrusted to them. Vavilov always expected persistent effort from his collaborators and actively encouraged all scientific initiative. He was very displeased by mere conscientiousness in the performance of one's duties. "You work as if you were a bureaucrat and not a scientist" was his response in such cases.

The seminars which were held in both his laboratories with characteristic punctuality were really memorable. These seminars frequently heard contributions from Sergeĭ Ivanovich himself and provided an excellent training ground for the younger scientists. His contributions, whether in the form of a review or an original communication, were always interesting, acutely relevant, and frequently sharply critical. His erudition and powers of recall were impressive. Whenever he discussed a particular report, he reviewed the entire history of the problem, frequently covering several decades. His recall of dates, names, and details was quite remarkable. Vavilov's seminars in the luminescence laboratory of the State Optics Institute, which were by no means confined to luminescence, usually attracted a considerable audience drawn from the various laboratories at the Institute.

Vavilov's authority at the State Optics Institute was exceedingly great. His advice was sought by researchers from all the laboratories, and they always left enriched either by acquiring new information on their particular topic, or with direct recommendation for future work, including instructions on whom to approach, or simply with encouraging words.

Nor were these requests confined to scientific problems. His support was sought by people with various difficult personal problems. They approached Vavilov with problems both great and small, knowing that he would help them by counsel or some specific action. The archival collection of Vavilov's papers at the State Optics Institute[3)] contains copies of many letters to very different people and institutions with requests for help on behalf of various members of the Institute in all kinds of matters.

But Vavilov was not simply a 'do-gooder.' One recalls seminars in which he literally demolished both his collaborators and contributors from other laboratories and institutes who dared to report an incomplete or inadequately considered work, or simply doubtful speculations. However, this strictly critical approach was always unbiased, i.e., objective, and benevolent. Above all, S. I. Vavilov was motivated by genuine desire to help each person find his own place in science and, occasionally, elsewhere. These exacting standards were combined with great tact and an exceedingly precise realization of what could be expected of any particular person.

On the other hand, Vavilov was very impatient with personal indiscipline and intellectual laziness. Being a highly organized person himself (otherwise he would not have been able to achieve as much as he did!), he was always very surprised when he found that some particular collaborator could not complete some project entrusted to him and offered lack of time as an excuse. Vavilov would respond with the words, "How do you imagine I manage to do all my work? And I have much more to worry about than you!" He was very angry with delays in the writing of articles on finished pieces of research, in completion of dissertations, and so on. His favorite expression in such cases was "You want to be forced into Paradise, do you?" And he frequently added, "Remember ars longa, vita brevis." Being an excellent linguist (he spoke German, English, French, Italian, Polish, and Latin), he liked to introduce such foreign phrases into his "genuinely Russian" expressions. This gave an unusual coloration to his conversations.

Sergeĭ Ivanovich was also impatient with idle talk and imprecise language which was frequently used, especially by beginners, to cover up lack of substance. He expected real content and precision. I recall how, at the beginning of my graduate work, I assembled a simple apparatus to investigate polarization of the luminescence of quenched solutions of dyes. Sergeĭ Ivanovich unexpectedly entered the room and asked how things were going. I replied that I would soon complete the system and begin to investigate transfert d'activation (this was the Perrin terminology used in the laboratory at the time to describe the transfer of excitation energy). Sergeĭ Ivanovich smiled and, ignoring all pronunciation, said, "What transfer? You will simply be measuring the change in concentrational depolarization during quenching, and we shall see, when you have completed your series of measurements, what this will produce." I have remembered this lesson all my life.

It was quite clear that Vavilov was a highly disciplined and organized person. All the staff members at the Institute remembered the punctuality with which his easily-recognizable figure appeared at the Institute, exactly at the appointed hour. He made no allowances for his health, age, or position. It is difficult to recall a single case when he was responsible for delay at the beginning of a seminar or conference.

We have already mentioned the seminars in Vavilov's laboratory. He was equally active in the course of interdepartmental seminars. His familiarity with very different scientific problems was stunning. He regarded seminars as one of the principal forms of scientific activity at the Institute, and attended them without fail, setting an example for all his collaborators.

Vavilov was particularly interested in the scientific library of the Institute. He was associated with the printed word throughout his life. He was a great expert in rare editions, and was always well informed about new scientific publications. He was always anxious to ensure that these new publications found their way into the library of the State Optics Institute.

[3)]This collection was saved by O. V. Sokolova, who was, for many years, S. I. Vavilov's secretary at the State Optics Institute.

He regarded it as his duty to be aware of all the details of the scientific life of the Institute and found time to participate in the various meetings and other activities, frequently well removed from his main scientific interests. Many such meetings were opened with his introduction, in which he clearly formulated the leading problems, and this often predetermined the course of the conference and its success.

The war years proved to be an astringent test of the vitality of the Institute and of its organization. Vavilov's qualities as a director became particularly clear during this period. His contribution to the reorganization of the work of the Institute in support of the war effort was very great. His personal example of selfless service to the country, and his great patriotism, inspired both scientists and workers at the Institute.

In an article entitled "A New Stage" in "Sovetskiy Optik", the house organ of the State Optics Institute, Vavilov wrote soon after evacuation to Ioshkar-Ola: "We have been given full facilities under the new conditions to continue our work, and there is no need for proofs or explanations of the fact that this work must be totally devoted to assist the Red Army and the war effort, generally. We have reviewed our working plan and will continue to review it in the light of circumstances, trying to satisfy as much as possible the urgent demands of the Front Line. However, it is not enough simply to review the plan. We all have a duty to restart our work under the new conditions as soon as possible and to increase its volume, intensity, and quality. The circumstances are such that we shall have to work as loaders, carpenters, and fitters, and everyone must understand that this is honorable work, that it will bring forward the time when the entire Institute will again become fully operational, and will therefore assist the Front Line... Our country has many highly qualified scientists and technologists. Their duty now is to use their knowledge, their talents, their inventiveness to the full in supporting the war effort. This must be constantly borne in mind, every day, whatever the adopted plans."

The State prizes given to members of the State Optics Institute during the war years show that this call evoked a response. Vavilov himself was awarded the Order of Lenin in 1943.

In a paper entitled "Twenty-Five Years of the State Optics Institute," the then Director of the State Optics Institute, D. P. Chekhmataev, wrote "There is hardly a period throughout the history of the Institute in which its work was so intensive and so productive as during the War. This would not have been possible had the Institute not had at its disposal the qualified staff brought up within these walls, devoted to their work and showing exceptional affection for their Institute."

In a speech delivered after the War (on December 30, 1945) before a meeting of electors at the Kozitskiĭ plant in Leningrad, Vavilov justifiably claimed (in all modesty) that "I was one of an enormous army of our scientists whose activity was very helpful to our Red Army in its fight for victory."

Vavilov's life was made difficult by the War. Frequent journeys to Kazan', to which the Physics Institute of the Academy was evacuated, bordered on the adventurous and presented a real hazard to life and limb. Academician A. A. Lebedev has given a very accurate account of these visits in his recollections.[4)]

In 1943, Vavilov was appointed a representative of the State Defence Committee and, in this capacity, had to travel to Moscow. "These journeys were very difficult," wrote A. A. Lebedev, who frequently traveled together with Sergeĭ Ivanovich. "It was difficult to move about Moscow at the time, and Vavilov frequently returned home quite exhausted."

I recall one characteristic episode. In 1944, I was sent from Ioshkar-Ola to Moscow and, at the suggestion of Sergeĭ Ivanovich, lived together with M. M. Gurevich (in his empty apartment) in Spiridonovka. Some days later, Sergeĭ Ivanovich himself arrived and invited me to go with him to the Elektrozavod Factory, where major preparations were being made for the mass production of fluorescent lamps—a pet project of Sergeĭ Ivanovich. The mode of transport was very democratic, i.e. by tramcar, although, undoubtedly, Vavilov would have had no difficulty in obtaining an automobile by virtue of his position. Having arrived, we were imprudent enough to enter through the back and found ourselves facing a militiaman, who demanded to see our documents (security was quite strict at the time). At this point, Sergeĭ Ivanovich (Academician, delegate to the Supreme Soviet, and a representative of the State Defence Committee!) meekly showed his passport with the Ioshkar-Ola endorsement and humbly explained that we had "arrived from the provinces, were uneducated people, unfamiliar with the ways of the Capital." The militiaman let us through and Sergeĭ Ivanovich was greatly amused and for long recounted this story.

Despite the wartime difficulties, Vavilov remained optimistic and his output continued to increase beyond all reasonable limits. Even if we ignore his direct responsibilities during these stringent years, there was his work on the theory of concentration phenomena in luminescence, the monograph about Newton, the translations of Newton's "Lectiones Opticae", and the articles about Galileo.

The War eventually approached its victorious conclusion, and our thoughts turned to the immediate future, to the return of the Institute to Leningrad, and to its fate in the post-war period. At a meeting of the Science Council of the State Optics Institute on April 11, 1944, Vavilov said, "The State Optics Institute is a major institution and will be even greater than it is now, but its growth must be carefully planned. A scientific-research institute must function in a coordinated fashion, otherwise there is danger of hypertrophy. Industrial laboratories improve from year to year and the Optics Institute must collaborate with these laboratories in a number of areas. This will strengthen the role of the Institute and provide a link with industry."

He gave much thought to the internal structure of the State Optics Institute and concluded that its strength lay in its complexity and its ability to solve problems through the combined effort of specialists in different laboratories. He rejected the isolation of laboratories and their narrow specialization. "It is difficult to divide laboratories accurately and clearly. Laboratories must be regarded as living bodies with all the attendant features. They cannot be judged by the nameplate outside. Con-

[4)]Usp. Fiz. Nauk 114, 547 (1974) [Sov. Phys.-Uspekhi 17, 958 (1975)].

trary to the general tendency in other fields, I would say that, for practical reasons, it is impossible to separate the subject area of some laboratories from the subject area of other laboratories. The subject area should, in many cases, extend beyond the framework of the official designation of a laboratory" (from a speech to the Scientific Council of the State Optics Institute on April 25, 1944).

It is also interesting to recall Vavilov's ideas about the so-called "large" and "small" science, put forward at roughly the same time. In the course of a polemical argument with a distinguished Soviet physicist who, in one of his speeches, defined a particular kind of science, namely, "large" science, and claimed the privilege of studying it for academic institutes, Vavilov wrote in "Sovetskiĭ Optik", published on the 25th anniversary of the Institute on December 15, 1943: "Above all, science can be divided into "large" and "small" only post factum and not ante factum. A modest and specially planned piece of research may frequently turn out post factum to give rise to a revolution in science; the reverse may also occur, i.e., a project based on grandiose ideas will yield nothing. On the other hand, to expect "large" science from some establishments and "small" science from others would be a profound tactical error and, at the same time, an error of principle. The Optics Institute has never divided its work into large and small sciences and, from this point of view, provides clear experimental evidence that the proposed classification is erroneous. The Institute has occupied itself both with the structure of atoms and with the development of polishing paste without prescribing which will become part of "large" science. Post factum, we know that both kinds of science were involved." Having given an extensive review of the achievements of the State Optics Institute, "put together hastily and without order from memory," Vavilov concludes that "much of this work has, in fact, yielded very substantial results even though, in many cases, this was not foreseen at the beginning. If I am asked whether instances of 'small' science occurred in the State Optics Institute, then the answer undoubtedly must be that any laboratory can produce an ordered list of factual although minor achievements. 'Small' projects cannot be avoided but the development of an institute must aim to reduce gradually their relative number."

Vavilov was elected President of the USSR Academy of Sciences soon after the return of the Institute to Leningrad, and had to transfer to Moscow. However, his connection with the State Optics Institute did not cease. He retained his laboratory at the Institute, and once or twice a month spent a few days in Leningrad to find out about progress in the laboratory and to attend seminars. He was keenly interested in the fate of the Institute and many members of staff, of all levels of seniority, frequently waited impatiently for his arrival in order to share with him their successes, to listen to his criticism, and to receive advice. Vavilov gladly received all those wishing to meet him. The general impression was that his visits to Leningrad, to his old "hunting grounds" at the Institute, and his encounters with old friends, colleagues, and pupils, provided a welcome relief for him from his complex and highly responsible duties in Moscow.

Memories of a teacher

N. A. Dobrotin

Usp. Fiz. Nauk **117**, 176–179 (September 1975)

PACS numbers: 01.60.+q

It so happened that I was fortunate enough to work for almost twenty years under the immediate direction of Sergeĭ Ivanovich Vavilov.

In 1932, the Physics Department of the Physico-mathematical Institute of the USSR Academy of Sciences (in Leningrad) consisted of a small group of scientists, mainly theoreticians, with very different interests. The Institute had practically no experimental basis, and its members had only the building and the official designation in common. A youthful group, taken on for post-graduate work at the Institute, we were in fact totally neglected.

Sergeĭ Ivanovich appeared on the scene at this point. He immediately examined the possibility of setting up a modern physics institute with a broad profile and its own scientific identity, occupying a distinguished position among other physics institutes of the country. In view of the existence of the Physicotechnical Institute, the Optics Institute, the Radium Institute, the Physics Institute of Moscow University, and other research physics institutes, the realization of this idea was not simple. It required not only strong support from Party and Government, not only a resolution from the Soviet of National Commissars transferring the Academy of Sciences from Leningrad to Moscow, but also the unusual energy, far-sightedness, and administrative talents of Sergeĭ Ivanovich.

His first task was to select and prepare the staff for the new institute. He personally directed young post-graduate students, bringing them up to become future physicists. And this seems to me to be particularly interesting and characteristic of Sergeĭ Ivanovich. By then, he had already had his own scientific school and was an acknowledged leader in the field of luminescence in the country. Most others would in his position have guided the development of the new institute in the direction of "their own subject." Sergeĭ Ivanovich, on the other hand, with characteristic perspicacity, foresaw even then a great future for the newly emerging physics of the atomic nucleus. Despite the fact that not all by far leading physicists shared this view, Sergeĭ Ivanovich started by assembling and preparing the staff for nuclear physics research at the Institute. Even before the Institute was transferred to Moscow, he invited I. M. Frank and L. V. Groshev to undertake research into nuclear physics. He assigned to P. A. Cerenkov a project in an area intermediate between luminescence and nuclear physics, and only A. V. Sevchenko was assigned to luminescence. I was asked to investigate the properties of neutrons which had only just been discovered. I was joined a little later by S. N. Vernov.