

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 "Sovetskii 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

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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.

I do not intend to discuss in detail the history of nuclear physics at the Physics Institute of the Academy of Sciences. I merely want to describe very briefly the atmosphere established at the Institute by Sergeĭ Ivanovich.

Above all, Sergeĭ Ivanovich had the remarkable gift of combining benevolence, readiness to assist, and simply great humanity, on the one hand, and very exacting expectations and impatience with those shirking their duties, on the other. The most important characteristic he expected of his pupils was love for their work, a sense of duty, and a capacity for selfless hard work.

I well remember an episode at the very beginning of my studies under Sergeĭ Ivanovich. I had to familiarize myself with the experiments carried out with the Wilson cloud chamber in order to enable me to build similar apparatus. Sergeĭ Ivanovich recommended that I carefully read the paper by Auger in "Annales de Physique." I found the paper after considerable difficulty, and was greatly disappointed to find that it was written in French, which I did not understand. With some embarrassment, I reported this to Sergeĭ Ivanovich, hoping that he would recommend some other paper in German or even in English. But this was not to be. He insisted that I should take a dictionary and, if necessary, look up every single word. He was "not at all worried how much time you will waste on the first few pages (even if a day per page is necessary, but you must work on your own and you will work faster and faster)." Of course, I have remembered this lesson ever since. And this brings to mind another occasion when Sergeĭ Ivanovich bumped into me in the street and told me that I was "thoughtless" in not wearing sufficient clothing on a cold day.

During the initial stages of nuclear physics research at the Institute, Sergeĭ Ivanovich brought in Professor L. V. Mysovskii from the Radium Institute as a consultant. My experimental work on neutron-proton scattering was done at the Radium Institute, but I have always considered myself to be a post-graduate student of Sergeĭ Ivanovich, who kept an eye on all his young subordinates. However, he was then highly occupied. The scientific direction of the large Optics Institute, the direction and, in fact, the development of the new Physics Institute, and very active research work demanded great energy and all his time and effort. It seemed that post-graduates, especially those working in fields other than his own, would not have been given much of his time. But Sergeĭ Ivanovich found a solution.

He was very interested in the researches of his graduate student P. A. Cerenkov on the emission of radiation by solutions of uranium salts under the action of gamma rays (which, as is well known, eventually led to the discovery of the Vavilov-Cerenkov radiation).

The photometric measurements were carried out by the quenching method, using the threshold of vision, which was developed by Sergeĭ Ivanovich. This involved work with fully adapted eyes, i.e., one had to sit for an hour in darkness. Usually, Sergeĭ Ivanovich himself carried out the measurements once or twice a week. Actually, he suggested to his research students that they should use this hour of darkness to consider their weekly account and discuss with him their post-graduate work. I well remember the impatience with which I looked forward to this "meeting in the dark" with my supervisor. How many post-graduate students now have the chance regularly to meet and talk to their scientific

supervisor, a Director of the Institute, Academician, and an eminent scientist?

Later on, when nuclear physics research had established itself at the Institute, Sergeĭ Ivanovich invited Dmitriĭ Vladimirovich Skobel'tsyn to direct this work. At first, Dmitriĭ Vladimirovich came to Moscow from Leningrad for only a few days a month and acted as a consultant, but he eventually settled in Moscow and took permanent charge of this work. However, even then, Sergeĭ Ivanovich did not neglect his students and was always interested in our work. He frequently enquired of Dmitriĭ Vladimirovich, and of us directly, about the progress of our work, followed the literature on nuclear physics and cosmic rays, and was keenly interested in administrative problems.

I well remember how, in 1949, he organized the equatorial expedition on the ship "Vityaz'" which ran between Odessa and Vladivostok. Sergeĭ Ivanovich decided to use this time to investigate the properties of cosmic rays in the equatorial region. There were many difficulties, but Sergeĭ Ivanovich was very determined and persistent. The difficulties were overcome and the expedition was successful.

I also remember the day when I brought the manuscript of my first scientific article to Sergeĭ Ivanovich. It seemed to me that it was written clearly and convincingly. However, Sergeĭ Ivanovich did not like it. Practically all supervisors would, in such cases, simply give their comments and return the article to be rewritten. Sergeĭ Ivanovich, however, proceeded in a different way. He invited me to his office and, with only slight participation on my part, he himself rewrote the entire paper, demonstrating his brilliant facility for clear expression, taking care that the material should be understood by the reader and, most important, teaching a novice physicist how to edit a manuscript. I have always remembered these two hours spent by Sergeĭ Ivanovich on my article.

Sergeĭ Ivanovich supervised his young subordinates with unusual tact and delicacy. He always tried to emphasize the achievements of his pupils and to guide their work so as to give the appearance that they themselves found the solutions to problems which, in fact, were suggested by him. He himself always tried to remain in the background. This happened in my case, for example, during the transfer of my research from neutrons to cosmic rays. All his students can remember similar examples.

We were always astonished by the great erudition, knowledge, and capacity for hard work shown by Sergeĭ Ivanovich. A characteristic phrase of his was "You will find a paper of interest to you in 'such and such'—have you read it?" Frequently, one had to confess that one had not seen the paper, or had seen it but had not read it!

With all his enormous load of work, Sergeĭ Ivanovich always took a stack of journals home with him for the evening (and, in fact, for the night) and, for relaxation, systematically read through them.

I shall end these words about my Teacher with one of the most tragic recollections of my life.

Sergeĭ Ivanovich was to be sixty on March 25, 1951. Shortly before this, and at his suggestion, I was appointed one of the Joint Scientific Secretaries of the Presidium

of the Academy. In the course of preparations for Vavilov's anniversary, I was asked by the Presidium to write a draft of the speech to be given by Sergeĭ Ivanovich. On January 24, I worked on this speech right into the night. My head was full of memories of meetings with him, his advice, his admonitions. The more I thought about him, the clearer was the impression in my mind of this talented scientist, supervisor and, simply,

a remarkable man and teacher. I felt great pleasure in the fact that I could consider myself a pupil of Sergeĭ Ivanovich, that I could work under his direction, and that my life was closely linked with his. It was a shattering blow when, in the morning, I was told on the telephone that Sergeĭ Ivanovich had died.

Translated by S. Chomet