References

- Feinberg E L *Epokha i Lichnost'. Fiziki. Ocherki i Vospominaniya* (Epoch and Personality. Physicists. Essays and Memoirs) (Moscow: Nauka, 1999) Two papers and a short article in this book are devoted to S I Vavilov (pp. 137–175)
- Solzhenitsyn A I Arkhipelag GULag Vol. 2, Part 4, Ch. 3 (The Gulag Archipelago) (Moscow: Tsentr 'Novyĭ Mir', 1990) p. 260 [Translated into English (New York: WestviewPress, 1991–1992)]
- 3. Gorelik G Andrei Sakharov: Nauka i Svoboda (Andrei Sakharov: Science and Freedom) (Izhevsk: RKhD, 2000)
- 4. Badash L Kapitza, Rutherford, and the Kremlin (New Haven: Yale Univ. Press, 1985)
- Kapitza P L *Pis'ma o Nauke* (Letters about Science) (Moscow: Moskovskiĭ Rabochiĭ, 1989)
- Ginzburg V L O Fizike i Astrofizike (Physics and Astrophysics: a Selection of Key Problems) (Moscow: Byuro Kvantum, 1995) [Translated into English: *The Physics of a Lifetime* (Berlin: Springer-Verlag, 2001)]
- Frish S É Skvoz' Prizmu Vremeni (Through the Prism of Time) (Moscow: Izd. Politicheskoĭ Literatury, 1992)
- Frank I M Izluchenie Vavilova-Cherenkova. Voprosy Teorii (Vavilov-Cherenkov Radiation. Theoretical Problems) (Moscow: Nauka, 1988)
- 9. Cherenkov P A Dokl. Akad. Nauk SSSR 2 451 (1934)
- 10. Vavilov S I Dokl. Akad. Nauk SSSR 2 457 (1934)
- 11. Tamm I E, Frank I M Dokl. Akad. Nauk SSSR 14 107 (1937)
- 12. Cerenkov P A Phys. Rev. 52 378 (1937)
- 13. Collins G B, Reiling V G Phys. Rev. 54 499 (1938)
- Zakharchenya B P "Nepovtorimyĭ Nikita Alekseevich" (The Inimitable Nikita Alekseevich) Avrora (11) 29 (1995)
- Vavilov S I *Isaac Newton* (1643–1727) 4th ed. (Moscow: Nauka, 1989) [Translated into English (Berlin: Akademie-Verlag, 1951)]
- Ginzburg V L Usp. Fiz. Nauk 151 119 (1987) [Sov. Phys. Usp. 30 42 (1987)] This article was also inserted in V L Ginzburg's book O Fizike i Astrofizike (see Ref. [6] above, p. 258)

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S I Vavilov — the founder of the P N Lebedev Physics Institute

O N Krokhin

When Sergeĭ Ivanovich Vavilov passed away on 25 January 1951, I was a 1st-year student of the Physics Department of Moscow State University. I bear firmly in mind the news of this grievous event, which came to us, students, from our teachers during our university hours. I remember the atmosphere which was perceived as the loss of an outstanding personality of a national scale. As many as 50 years have passed since then, an entire generation of people has been superseded, the life and the country have drastically changed, but I sometimes ask myself the question: how would Sergeĭ Ivanovich have acted now, in our time, and how would he have responded to the circumstances which have placed our science in a difficult situation?

That time was also hard, both as regards financial situation and a strong ideological oppression which sometimes resulted in moral and even physical destruction of scientists. Sergeĭ Ivanovich received all that in full measure. Vsevolod Vasil'evich Antonov-Romanovskiĭ recalls S I Vavilov's reply to his request, probably not quite appropriate: "Ah, Vsevolod Vasil'evich, I should now rescue Soviet physics!" [1]. This was said at the turn of 1948–1949 when, according to the directions of the Secretariat of the CPSU Central Committee, an All-Union Meeting of the heads of physics chairs of universities and higher schools was being planned with the purpose of an ideological pogrom. It is well known that S I Vavilov, together with I V Kurchatov, hampered the calling of this meeting in every possible way. In January 1949, he managed to achieve the cancellation of the meeting at the cost of making a proposal to establish the Scientific Secretariat of the Presidium of the USSR Academy of Sciences.

During his Academy presidency, Sergeĭ Ivanovich was presumably having a very hard time of his life. Yu N Vavilov, the son of N I Vavilov — Sergeĭ Ivanovich's brother, an outstanding biologist, who perished in the Saratov prison in 1943¹ — recalled that Sergeĭ Ivanovich said, supposedly at one such moment of his life: "The post of the President of the Academy of Sciences is a dog's post, and I would readily change it for a plumber's job".

Of course, this phrase by no means reflects what we know from the history of the Academy of those years. It was Sergeĭ Ivanovich who lay the foundation of the present-day Academy of Sciences. The Academy strengthened and expanded; a start was made on the solution, in the depths of the Academy, of those problems which foster scientific and technical progress; during the post-war years, the Academy stood at the forefront of scientific and engineering revolution.

I am convinced: should Sergeĭ Ivanovich find himself with us, he would decisively stand up for the interests of science and would be ready to accept this, as he put it, 'dog's post'.

Professionally, Sergeĭ Ivanovich was an optical scientist and, in particular, devoted much time to the problems of luminescence. In this regard he had the opportunity to work within the circle of the most prominent optical physicists of our country: during his youth — in the laboratory of P N Lebedev who discovered the pressure of light, and later on with L I Mandel'shtam, G S Landsberg, I E Tamm, I M Frank, and P A Cherenkov — in FIAN. The works of these scientists amounted to three Nobel prizes, of which only one was actually awarded — that which should rightfully bear the name of Vavilov for the discovery of the Vavilov – Cherenkov effect. The scientific school and the style of work inculcated by S I Vavilov in FIAN undoubtedly contributed to the discovery of masers and later of lasers by N G Basov and A M Prokhorov — one more Nobel prize.

S I Vavilov succeeded D S Rozhdestvenskiĭ as the scientific supervisor of the State Optical Institute in Leningrad. In the post-war years, S I Vavilov initiated the establishment of the Institute of Applied Physics (nowadays this is a big enterprise — the 'Orion' Scientific-Production Association), whose research field covered the development of infrared technology and optoelectronics.

Therefore, it is valid to say that S I Vavilov was the soul and organization engine of our optical science throughout these pre-war, war, and post-war years.

The P N Lebedev Physics Institute in its present-day form was established by S I Vavilov in March of 1934 [2]. Genetically, it traces its origin from the Physics Study of the Cabinet of Curiosities in Petersburg in the distant past. The

¹ V F Sennikov, a staff member of FIAN, discovered S I Vavilov's letter addressed to I V Stalin, which was dated 1949, requesting the exoneration of N I Vavilov. S I Vavilov denied categorically the inimical actions ascribed to N I Vavilov and emphasized his openness and the straightforwardness of his judgement. S I Vavilov wrote that these accusations were slanderous. This letter bears L P Beriya's resolution: "To be rejected".

Physics Study was presumably incorporated into the Academy of Sciences in 1724, in accordance with the Ordinance of the Senate to establish the Academy². In 1921, this Physics Study (renamed the Physics Laboratory in 1912) was united with the Mathematical Study into a Physicomathematical Institute under the supervision of Vladimir Andreevich Steklov. In the past, the Physics Study saw the work of Euler, Bernoulli, Kraft, Lomonosov, Lenz, Jacobi, Petrov, Golitsyn, and Lazarev. After the decease of Academician V A Steklov in 1926, the Physicomathematical Institute was headed by Academicians A F Ioffe and A N Krylov.

As noted by S I Vavilov in his well-known book on the history of FIAN, by 1932 the Physics Department of the Physicomathematical Institute actually fell into decay, numbering only four staff members. It is likely that the Academy leaders did not give proper attention to the development of physics within the precincts of the Academy. This is very strange, because physics occupied a prominent place in the Academy of Sciences at its inception. This circumstance worried several prominent Academy physics scientists, who raised the question of the establishment of a big physics institute in the Academy of Sciences. S I Vavilov, who had just been elected a Full Member of the Academy and was the Head of the Physics Chair in Moscow State University, received an offer to take charge of the Physics Department of the Physicomathematical Institute. It was not long before he turned the Department into an actively working research center. As early as 1933, research was pursued along several lines: the study of neutron properties, investigations into radiation-induced glow of liquids, the study of colored crystals, the investigation of gas breakdown, electron diffraction and X-ray analysis of catalysts.

We can see that the foundation of the future polyphysical FIAN was laid in those years. This idea entirely belongs to S I Vavilov and, as the future showed, proved to be quite fruitful. It is precisely this approach that underlay the outstanding accomplishments in various realms of research in FIAN. The Vavilov-Cherenkov effect was discovered (which dates back to the Physics Department of the Physicomathematical Institute); the propagation of radio waves was studied; the foundations of nonlinear vibration theory were laid; ferroelectrics and semiconductors were investigated; the USSR's first transistor and injection laser were made; superlattices were proposed; the principle of phase stability in the acceleration of elementary particles was formulated; a start was made on cosmic ray and neutron physics research; radio astronomy, masers and lasers, and the phase conjugation effect were discovered; the principles of a thermonuclear weapon, controlled nuclear fusion with magnetic insulation, and inertial confinement fusion were established. First-rate results in the fields of optics, spectroscopy, and luminescence were obtained in FIAN. S I Vavilov is invisibly present in all our investigations and accomplishments. The style of work and the attitude to science and colleagues which he imparted have been retained in the institute for many years after his decease and will hopefully be retained for the future generations.

The Physics Institute gave rise to several scientific institutions in our country. The Seismology Institute (later the Institute of the Physics of the Earth) evolved out of the Physics Laboratory during the formation period of the Physicomathematical Institute. The Acoustic Laboratory turned into the Acoustic Institute. The Laboratory of Standards gave rise to the High-Energy Laboratory of the Joint Institute for Nuclear Research (JINR), where the then biggest proton accelerator was constructed after the FIAN project and under V I Veksler's supervision. In recent years, this laboratory in the JINR was headed by A M Baldin — a staff member of our institute. The Laboratory of Standards later gave also rise to the very big Radiotechnical Institute directed by A L Mints. The Neutron Laboratory of the JINR headed by I M Frank had its origin in the Atomic Nuclear Laboratory. The Spectroscopic Laboratory established the Institute of Spectroscopy supervised by S L Mandel'shtam. Three FIAN laboratories laid the foundation for the Institute of Nuclear Research of the Russian Academy of Sciences in Troitsk, where M A Markov passed to work. Finally, the FIAN Laboratory of Oscillations was transformed into the Institute of General Physics under A M Prokhorov's supervision.

The outstanding physicists whose names I have listed here had been working with S I Vavilov for many years (with the exception maybe of A L Mints). Many of them regarded themselves as his disciples and left their memoirs of him published at different times. During the recent meeting of the FIAN Scientific Council in commemoration of A M Baldin's jubilee, one of the speakers, B B Govorkov, resorted to a figurative expression when recalling the history of discoveries made in the institute: "It looks as if 'genius' has settled somewhere in the FIAN building, which dawns upon scientists of the institute from time to time". If this is the case, it is valid to say that this 'genius' was settled in FIAN by its founder and director Sergeï Ivanovich Vavilov.

The pre-war years were filled with investigations into atomic nuclei and the physics of nuclear reactions. The year of 1939 saw the discovery of neutron-induced fission of uranium nuclei, and during the next year the emission of secondary neutrons was reported to occur in this case. These discoveries predetermined the advent of a new era - that of harnessing nuclear energy. As the Director of FIAN and a member of the Mathematical and Natural Sciences Division of the Academy, S I Vavilov participated most actively in the development of this field of physics in the institutes of the USSR Academy of Sciences and primarily in FIAN — at that time the only Academy physics center in Moscow. It was proposed to construct several cyclotrons in our country: at the Radium Institute, at the Physicotechnical Institute in Leningrad, and in FIAN.

On 25 November 1938, the Presidium of the Academy of Sciences set up a Commission on the Atomic Nucleus, which was headed by S I Vavilov. Recently, collected documents were published, which elucidate the history of works related to the USSR atomic project [3]. The book contains records of proceedings, verbatim reports, and other documents which throw light on the work of this commission. Perhaps this was the place where viewpoints were concentrated and organizational matters were discussed: upon the entry of the Physicotechnical Institute (Leningrad) — at that time the most advanced institute in nuclear physics — into the Academy, the USSR Academy of Sciences assumed full

 $^{^2}$ This is testified by the order of the first Academy President issued on 3 December 1726, which directed the delivery of physics lectures to the Academy students in the Physics Study taking advantage of its instruments. At that time, the Physics Study was located in the Academy building.

responsibility for the investigations in this branch of physics. Particularly intense scientific discussions commenced after the discovery of uranium fission in 1939. When reading these materials, one is involuntarily surprised by two circumstances: the vast flow of specific results, and the fact that even then, in the pre-war years, very much was well understood. Namely, that uranium-235 possesses good fission characteristics, that to accomplish the chain reaction in natural uranium requires neutron moderation, and even the indication that the element with a mass number of 239 may possess better fission characteristics than uranium-235. S I Vavilov was among those who clearly realized the exceptional significance of these facts established by the physical science. In the year of 1939 alone, the Commission on the Atomic Nucleus held at least 14 meetings entered into the records, which were included in the collection of selected documents.

In 1940, S I Vavilov initiated the establishment of the USSR's first Nuclear Physics Chair in the Physics Department of Moscow State University, and D V Skobel'tsyn became the Head of this chair. This chair subsequently turned into a big Material Structure Division and gave rise to the Institute of Nuclear Physics of Moscow State University. Together with the Physics and Technology Department of Moscow State University, set up in 1946, these organizations gave our country a huge army of firstrank experts in different branches of physics. The Commission on the Atomic Nucleus fulfilled the principal coordination role until the State Defense Committee's Resolution of 28 September 1942 was issued. This resolution, in particular, charged the Academy of Sciences with setting up, on the basis of the Physicotechnical Institute (Leningrad) at that time stationed in evacuation in Kazan', an Atomic Nuclear Laboratory under I V Kurchatov's supervision. In 1948, in accordance with the governmental resolution presumably following S I Vavilov's proposal, a scientific group was set up in the Theoretical Department of FIAN under I E Tamm's supervision, which was entrusted with the development of the physical principles of a hydrogen bomb. The participation of S I Vavilov as FIAN Director is testified by his letter of 18 November 1948 addressed to general A S Aleksandrov of the First Main Directorate (PGU). This letter is currently stored in the institute's archive. Vavilov wrote that significant results were obtained in I E Tamm's group and asked for their urgent consideration at the meeting of the Scientific and Technical Councils of the PGU. I E Tamm delivered his report on 10 December 1948, in which he outlined the results obtained by himself, A D Sakharov, V L Ginzburg, and other participants of the work in the FIAN group. In 1953, this work was completed in Arzamas-16 to which I E Tamm, A D Sakharov, V I Ritus, and Yu A Romanov had moved from FIAN.

S I Vavilov passed away early, not having reached a full 60 years. He left the P N Lebedev Physics Institute, RAS to Soviet and Russian physical science, which he wanted to see at the forefront of science. Five Nobel Prize winners in physics, among whom he could have been himself, were largely a result of his labor, of his comprehension that science is made by talented people, and that the director's task is to be able to listen, apprehend, and set the stage for development. D V Skobel'tsyn, who succeeded S I Vavilov as Director of FIAN, once said that the director's task is "to favor that which blossoms". S I Vavilov's primary concern was the quest and the care for what can lead to a good result.

It only remains for us to try to retain this tradition in FIAN for as long in the future as possible.

References

- Bolotovskiĭ B M, Vavilov Yu N, Kirkin A N Sergeĭ Ivanovich Vavilov — Uchenyĭ i Chelovek: Vzglyad s Poroga XXI Veka (Sergei Ivanovich Vavilov — the Man and the Scientist: a View from the Threshold of the 21st Century) (Moscow: Izd. FIAN, 1998); Usp. Fiz. Nauk 168 551 (1998) [Phys. Usp. 41 487 (1998)]
- Vavilov S I Fizicheskiĭ Kabinet, Fizicheskaya Laboratoriya, Fizicheskiĭ Institut Akademii Nauk SSSR za 220 Let (Physics Study, Physics Laboratory, Physics Institute of the USSR Academy of Sciences over 220 Years) (Moscow: Izd. Akad. Nauk SSSR, 1945); Usp. Fiz. Nauk 28 (1) 1 (1946)
- Ryabev L D (Ed.) Atomnyi Proekt SSSR. Dokumenty i Materialy (USSR Atomic Project. Documents and Materials) (Moscow: Nauka – Fizmatlit, 1998)

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Sergeĭ Ivanovich Vavilov and his time

E L Feinberg

Sergeĭ Ivanovich Vavilov, like his elder brother Nikolaĭ Ivanovich (the brothers resembled each other in many respects), was more than a remarkable personality. His fate, his rise as an outstanding scientist and a public figure, his extraordinary erudition in the realms of natural-science and humanitarian knowledge, and his genuine intelligence (I would even make recourse to the word 'gentleman') deserve special attention. And every period of his life, the changes in his activity and behavior were strikingly closely related to the deep transformations experienced by his country and its people.

For even his grandfather was a serf, and his father came to Moscow on foot from the Volokolamsk region in the 1870s to become a merchant's errand-boy, to start with. Being, according to Sergei Ivanovich, in full measure a selfeducated person, in less than 20 years (by the time of S I's birth) he became a big self-dependent merchant, "used to read and write much, and was undoubtedly quite an intelligent person". He was elected twice to the Moscow City Council, where he played an active part. He was in charge of charitable institutions, and was one of the initiators and sponsors of the construction of Moscow tramlines. Moreover, he was closely related to the governing body of the biggest (for those times) Prokhorov Trekhgornaya Manufaktura in Presnya and was engaged in its trade relations with the East — the biggest consumer of its textile products.

How could this all come about?

Sergeĭ Ivanovich was born in 1891 — 30 years after the fall of serfdom, when the 20 years of the epoch of genuinely great reforms of the emperor Alexander II had already profoundly affected the life of the country. These reforms were made so well internally consistent that, despite certain 'counterreforms' initiated rather soon afterwards, even the stubbornly conservative stands taken by his successors Alexander III and Nicholas II, unable to recognize the necessity to extend the reformative transformations, failed to halt the rapid development of the country driven by these reforms. The conservatism only gave rise to revolutionary outbursts