LETTERS

Sergei Vavilov, Honored in Russia, Still Little Known in the West

For many reasons the history of science in the former Communist countries is not fully known in the West. In particular, we would like to draw attention to the serious lack of published information on Sergei Ivanovich Vavilov (1891–1951), an outstanding physicist and organizer of science.

Vavilov is known for his work in physical optics, especially luminescence. In his laboratory he and his collaborators investigated various luminescent substances and developed a procedure for determining their main parameters. This procedure has become classical. Vavilov formulated the basic laws of luminescence that are universally acknowledged. Under his tutelage a large school of scientists in the field of luminescence emerged, and they continue to do important work to the present day.

One of Vavilov's most notable achievements was the foundation of the Lebedev Physical Institute in the early 1930s. This institute, which has produced six Nobel Prize winners, is known all over the world. Vavilov was the director of the institute from the moment of its creation until his death.

Vavilov played a decisive role in the discovery and interpretation of Vavilov–Čerenkov radiation (known in the West simply as Čerenkov radiation). As is well known, this radiation has found numerous applications in the so-called Čerenkov counter—an important instrument used in high-energy physics and astrophysics.

Pavel Alekseevich Čerenkov was a postgraduate student working on his doctoral dissertation when he discovered this unusual radiation. Vavilov, his supervisor, not only suggested the subject of investigation and worked out the program and method but personally took part in the measurements. After the first experiments, Vavilov concluded—on the basis of the luminescence laws he had established—that the weak blue radiation of pure liquids discovered by Čerenkov was not luminescence.

Vavilov was the first to understand that the radiation in Čerenkov's experiments was initiated by Compton electrons knocked out from atoms under the action of radioactive sources. He involved in the discussion of this phenomenon two other scientists from his institute, Ilya M. Frank and Igor E. Tamm, who formulated a complete theory of this radiation. Their theory was completely confirmed in numerous experiments, and Čerenkov, Frank and Tamm were awarded the Nobel Prize in 1958.

As an organizer of science and president of the Soviet Academy of Sciences, Vavilov made a tremendous contribution to the growth of science throughout the Soviet Union during the difficult period soon after the end of World War II.

Thanks to his profound scholarship, he clearly detected the trends in the development of modern physics. Though himself a specialist in optics, he encouraged the growth of various branches of physics at the Lebedev Physical Institute. In particular, he considered the development of nuclear physics of great importance. He was an adviser to postgraduate students in that field and organized the first Soviet conferences on nuclear physics. With his active support a school of scientists in the field of cosmic-ray physics was founded at the Lebedev institute. It was headed by Dimitry V. Skobeltzyn, who had been invited to the institute by Vavilov.

Vavilov was a kind, responsive person. In his conduct he was motivated by the principles of Christian morality. He was the brother of Nicolai Ivanovich Vavilov (1887–1943), a distinguished biologist who perished in Stalin's prison and who was the father of one of the writers of this letter. The writer remembers with deep

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gratitude the loving care rendered to his family by his Uncle Sergei after his father's arrest and death. He helped the writer to get an education and become a physicist. He also helped the writer's older brother, Oleg—a talented physicist who died under unclear circumstances.

Sergei Vavilov wrote several fine scientific books on optics and relativity, and also an excellent scientific biography of Isaac Newton. That book appeared in many editions in the Soviet Union, but unfortunately it is virtually unknown in the West.

In the numerous encyclopedias and physics textbooks examined by one of the writers in US and British libraries and bookstores, Vavilov is rarely mentioned in connection with the discovery he and Čerenkov made together. A conspicuous exception is the short entry on Vavilov in volume 13 of the *Dictionary of Scientific Biography* (Scribner's, 1975), which not only mentions the discovery but refers to it as "the Vavilov–Čerenkov effect."

On the other hand, the *Compact Macmillan Encyclopedia*, published in London in 1993 carries an article on Čerenkov in which German-born physicist and Nobel Prize winner James Franck figures prominently, even though he had no connection to the discovery of the Vavilov–Čerenkov effect. Such injustices should be corrected.

When Tamm accepted the Nobel Prize in 1958, about seven years after Vavilov's death, he gently chided the Swedes on their choice of terminology, saying, "I must note that in the Soviet Union we call this radiation 'Vavilov–Čerenkov radiation,' not simply 'Čerenkov radiation,' in order to underline the decisive role of Sergei Vavilov in the discovery of this radiation."[1] Nevertheless, we realize that "Čerenkov effect" has been an established term in physics journals and monographs other than Soviet and Russian ones for many years, and it is not realistic to expect to change it in the world literature. However, we feel that Vavilov's important role in the discovery of Čerenkov radiation ought to be covered both more frequently and more fully in the West's textbooks and reference books. Taking such a corrective step would not diminish the role of Čerenkov, who himself wrote about Vavilov's outstanding role in the discovery of the effect.[2] Rather, it would stand as a belated act of justice for his teacher.

References

1. P. A. Čerenkov, I. E. Tamm, I. M. Frank, *Nobel Lectures*, Fizmatgiz, Moscow (1960).
2. P. A. Čerenkov, in *Sergei Ivanovich Vavilov: Sketches and Reminiscences*, Nauka, Moscow (1991), p. 220.

B. M. Bolotowsky
Yu. N. Vavilov
Lebedev Physical Institute
Moscow, Russia

Theory of Hadronic Watches Fielded

I read with interest "Where Does the Proton Really Get Its Spin?" by Robert L. Jaffe (September, page 24). The "tribulations of quantum chromodynamics" seem to be mostly due to the population explosion of virtual quarks and gluons ("gears") caused by the nonlinear nature of the theory. However, the physically observed hadrons ("Swiss watches") aren't as numerous. So, it might be useful to have a field theory of Swiss watches rather than gears. If the gears are never seen free in a laboratory, why should one take them so seriously?

The answer, of course, is that experiments do show the existence of a substructure of hadrons and hence a quantum field theory of hadrons as structureless particles will not work. However, in including constituent quarks, there is really no need to give them the status of full-blown second quantized fields. After all, it is the second quantization that causes their population explosion. The quarks could be considered as first quantized objects. However, creation and annihilation of whole hadrons is still necessary to explain experiments. So one may ponder the possibility of a second quantized field theory of composite objects (hadrons) that have first quantized constituents (quarks). Over the years, I have convinced at least myself that such an animal is mathematically possible.[1]

But this raises many new questions. Can QCD be constrained in some way to produce such a field theory? Is such a theory computationally any less troublesome than QCD? Can it explain presently known experimental results? What does it do with the color symmetry? Some of these questions can be answered right away but others need more work.

Going with the experimentally minimal nature of this theory, the color symmetry is included, but it is not "gauged." So the quark interactions are not gauge interactions. Hence there are no gluons. Such an approach has an interesting side effect. It is trivial to see in any theory that if hadrons are required to be color singlets, the quarks will be confined. But conversely, does quark