

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

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confinement imply the experimentally observed color singlet nature of hadrons? This converse can actually be proved within this theory.²

This theory also allows exactly relativistic phenomenology in a natural way to explain observed hadron mass spectra with some success.³

References

1. T. Biswas, *Nuovo Cimento A*, **107**, 863 (1994)
2. T. Biswas, *Nuovo Cimento A*, **104**, 995 (1991).
3. T. Biswas, *Nuovo Cimento A*, **88**, 145 (1985).

TARUN BISWAS

*State University of
New York at New Paltz
New Paltz, New York*

Drell Clarifies Nuclear Stance

I wish to correct Irwin Goodwin's "Washington Reports" story on nuclear testing (October, page 51), which discusses the Jason panel that I chaired. At issue is Goodwin's assertion that "As recently as 1990 Drell had advocated low-yield underground tests, but he now says his views have been affected. . . ."

In my 1990 congressional testimony, when I presented the results of my report on nuclear weapons safety to the House Armed Services Committee, I testified that the US arsenal meets the official US safety requirements. But I also said certain safety improvements could be achieved and should be considered, most notably by replacing the high explosive now used in the Trident warhead with an insensitive high explosive used in most of the other modern US nuclear warheads. Replacement, though, could be undertaken only after a limited series of underground tests at full primary yield or higher—that is, not low-yield tests. The importance of the resulting improvement in safety, I testified, would have to be weighed against a political judgment as to the importance of a comprehensive test ban in achieving an effective worldwide nonproliferation regime (which I support, now as then), with the highest priority going to the effort to reduce nuclear danger.

The US is now committed to negotiating a comprehensive test ban treaty (CTBT) by the end of 1996. This commitment was made in order to gain the support of 175 nations for the indefinite extension of the nonproliferation treaty this past May at the United Nations in New York.

The remaining issue addressed by

this year's Jason study on nuclear testing was the importance of retaining the option of low-yield (subkiloton) tests as permitted activities under a CTBT. Based on our technical analysis, we concluded that such low-yield tests were less important than the other actions we described, as reported in Goodwin's story. Our conclusions support President Clinton's decision to call for a true zero-yield CTBT. I fully endorse that decision.

SIDNEY D. DRELL

*Stanford Linear Accelerator Center
Stanford, California*

Eugene Wigner Remembered

I would like to mention three chance encounters I had with Eugene Wigner that have led me to rank him among the great "true gentlemen" of the world and to lament his leaving us. [See the articles on pages 40 and 46.]

After receiving my PhD in physics from the University of Nebraska, where I worked with Joseph Macek on an extension of some of Wigner's work, I received a postdoctoral appointment to Louisiana State University. There I discovered that the office next to mine was occupied by Wigner. We met briefly one day when he was standing next to my car, talking with my wife and two daughters, who were waiting for me. He said, "Ah, so these are your charming daughters, Dr. Wooten," and walked off after politely shaking my hand. I had seen him in the hall but had never actually been introduced to him and was amazed that he would even be aware of me. This was the first Nobel laureate I had met; I thought them to be gods and I the dust at their feet.

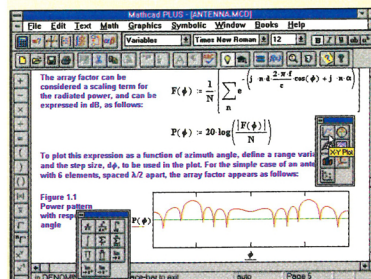
Later in the semester, during an atomic physics seminar on the effects of temperature and pressure in solids, I became confused at what seemed to be a discrepancy between the effect pressure would have on a substance and what the speaker's equation seemed to imply. When I explained that I was confused and asked him to clarify one point of his work, the speaker haughtily replied that it should be obvious to anyone and began to move ahead in his talk. At that point Wigner raised his hand and, upon being recognized, stated very quietly and politely, "I'm sorry, but like Dr. Wooten, I too do not understand." This, of course, produced an immediate, if somewhat nervous, detailed and satisfactory explanation.

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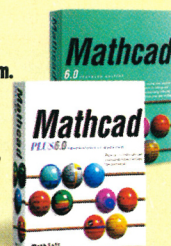
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