Valentin Aleksandrovich Fabrikant (Obituary)

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The well-known physicist, Full Member of the Academy of Pedagogical Sciences of the USSR, Professor Valentin Aleksandrovich Fabrikant died on 3 March 1991 in the 84th year of his life.

V. A. Fabrikant began his scientific activity while being still a student of the Physics-Mathematics Faculty of Moscow University. In 1929 he carried out under the guidance of G. S. Landsberg some work on an experimental test of the quantum theory of Raman scattering of light, as a result of which a new method of determining the Planck constant was proposed. In 1930 on graduating from the university V. A. Fabrikant began working in the All-Union Electrotechnical Institute, where he soon headed a laboratory. The first years of his activity at the All-Union Electrotechnical Institute were devoted to various problems in photometry, applied optics, and scattering of light in turbid media.

Since 1932 Fabrikant's attention has been concentrated on problems of optics of a gas discharge. A series of articles with the overall title "Optical investigations of a discharge" was published in which data are given concerning the spectral composition and intensity of the radiation from a discharge over a wide range of changes of currents and pressures. Simultaneously a thorough analysis is carried out of the elementary processes associated with the appearance and destruction of excited atoms. In particular, essentially the first quantitative data were obtained concerning collisions of the second kind between excited atoms and electrons. As a result of a series of investigations a connection was established between elementary processes and macroscopic optical characteristics of a gas discharge plasma. The results of these investigations have completely retained their validity and are generally accepted.

We should dwell for a moment on a study which established the Boltzmann distribution over the excited states. In the earlier papers the Boltzmann concentrations were regarded as limiting ones, but already in 1939 the problem was examined concerning the possibility of obtaining populations in excess of Boltzmann populations. This led to an analysis of the optical properties under such conditions when inverted population occurs. Fabrikant was the first to state in print that when radiation passes through a medium in which an inverted population of energy levels has been realized amplification of the passing radiation rather than a weakening of it will be observed; he also proposed a method of experimentally realizing an inverted population of levels in a discharge in a mixture of gases using resonance in collisions of the second kind. These results became a part of the doctoral dissertation of V. A. Fabrikant (defended in 1939) and were published in 1940.

At the time Fabrikant's interest in this set of problems was associated with the discussion of the possibility of a direct experimental proof of the existence of stimulated emission. However later the problem was posed more broadly, and in 1951 Fabrikant with collaborators filed a patent application on an invention of a new method of light amplification. In the application the above mentioned ideas were developed further and were cast in a more concrete form. It was shown that the passage of radiation through a medium with an inverted population leads to an exponential increase of intensity. The amplification principle was extended to the ultraviolet, infrared, and radio frequency ranges. In addition to the earlier indicated method of obtaining an inverted population by using resonance in collisions of the second kind proposals were made of optical pumping (three-level system) and the use of a pulsed discharge.

VALENTIN ALEKSANDROVICH FABRIKANT
(1907–1991)

In 1959 as a result of the above application an author's certificate was issued, and in 1964 a diploma concerning the discovery was issued. The paper of 1957 where a number of problems in the theory of optical quantum amplifiers was examined also belongs to this line of investigations. In particular, the first discussion was given of specifically nonlinear effects arising in devices of this type. Also the investigation of 1962 in which an analysis was made of the conditions under which population inversion could arise in optical lasers based on gas discharge belongs to the same line of investigations.

Thus, Fabrikant not only pointed out the possibility of obtaining an inverted population of energy levels, but proposed a number of concrete experimental methods for producing it, realized at present, and formulated the principle of amplification of electromagnetic radiation in passage through media with an inverted population. As is well known, this principle also serves as the basis for quantum electronics.

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In 1965 the Academy of Sciences of the USSR awarded to Fabrikant the S. I. Vavilov Gold Medal "For outstanding work in the optics of gas discharges", in which for the first time phenomena were investigated associated with negative absorption, and a proposal was made of utilizing this phenomenon for light amplification.

The experimental work of V. A. Fabrikant was distinguished by its goal-orientation and originality of methods. As an example one should mention a very ingenious method of investigating a radiation field in an absorbing and scattering medium. It is well known that radiation leaving such a medium as a result of reabsorption does not give direct data concerning the radiation field in the interior regions. Fabrikant used a moveable probe covered with a luminescing compound which transformed the radiation absorbed by the medium into radiation of wave lengths that could freely leave the gas volume being investigated. This method was used to investigate the propagation of resonance radiation in a low pressure discharge in mercury vapor and in inert gases.

The experimental investigation of electron diffraction under conditions when at each instant of time only one electron passed through the apparatus deserves attention. This experiment was a direct confirmation of the wave properties of individual particles.

Physics research of V. A. Fabrikant was always very closely associated with practical problems. Thus, the systematic investigations of the discharge in mercury vapour and of the properties of luminophors enabled Fabrikant to make a very significant contribution to the development and production of Soviet luminescent lamps. For this he was awarded the USSR State Prize.

V. A. Fabrikant was a born teacher. He began teaching already in 1930 in the Moscow Power Institute, where he was in charge of the chair of physics from 1941 to 1977. Fabrikant's lectures were distinguished by their depth and at the same time by their exceptional clarity. They attracted inquisitive students from all faculties and served as an instructional medium and example for many young lecturers. More than twenty of his students and colleagues have defended candidate's and doctoral dissertations.

V. A. Fabrikant exhibited a constant interest in the teaching of physics at secondary school level, and many teachers were in close contact with him. He was one of the initiators in publishing the journal "Kvant", a member of the editorial board of the "Physics in School", and of the "Encyclopedia for a Young Physicist". For many years he was a member of the Presidium of the "Znanie" Society.

The activity of V. A. Fabrikant—a scientist, a pedagogue, a source of enlightenment—was highly recognized in 1968 when he was elected a Full Member of the Academy of Pedagogical Sciences of the USSR.

V. A. Fabrikant was distinguished by an unusual breadth of interests. Valentin Aleksandrovich had a lively interest in the history of natural science and published a number of articles on the history of physics. He was a connoisseur of literature, and loved music and art.

A man of the highest culture, and of great charm, and a true intellectual, V. A. Fabrikant commanded respect and love of all those who knew him.

Translated by G. M. Volkoff