VALENTIN ALEKSANDROVICH FABRIKANT

(On his Sixtieth Birthday)

L. M. BIBERMAN

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OCTOBER 1967 marked the sixtieth birthday of Professor Doctor of Physical and Mathematical Sciences Valentin Aleksandrovich Fabrikant, one of the greatest specialists in the field of physical optics and gas discharge.

Fabrikant began his scientific activity while still a student of the Physical and Mathematical Department of the Moscow University. In 1929 he performed, under the guidance of G. S. Landsberg, an experimental verification of the quantum theory of the Raman scattering of light, as a result of which a new method was proposed for determining Planck's constant. In 1930, after being graduated from the University, Fabrikant started to work at the All-union Electrotechnical Institute, (VÉI), where he soon took charge of the laboratory. The first years of his activity at the VEI were devoted to different problems of photometry and applied optics. Special mention should be made of the very complicated investigation of luminescence, as a result of which he obtained a direct proof of S. I. Vavilov's law (proportionality of the luminescence yield to the wavelength of the exciting light). At approximately the same time, a very interesting investigation was performed of light scattering in a turbid medium.

Since 1932, Fabrikant concentrated his attention on problems of gas-discharge optics. He published a series of articles under the general title "Optical Investigations of Discharges," in which data are presented on the spectral composition and emission intensity of a discharge in a wide range of variation of currents and pressures. At the same time, a thorough analysis was made of the elementary processes connected with the occurrence and disintegration of excited atoms in the discharge. In particular, he obtained essentially the first quantitative data on collisions of the second kind between excited atoms and electrons.

As a result of a series of investigations, he established a connection between elementary processes and the macroscopic optical characteristics of a gas-discharge plasma. The results of these investigations are just as valuable now, and are universally recognized. Special mention should be made of an investigation of the establishment of a Boltzmann distribution over the excited states. Whereas in the earlier investigations the Boltzmann concentrations were regarded as the limiting values, as early as in 1939 the question was raised of the possibility of obtaining populations exceeding the Boltzmann values. This led to an analysis of the optical properties under such conditions, in which inverted population is produced. It was indicated for the first time that when radiation passes through a layer of medium with inverted population, the result is not attenuation but amplification, due to stimulated emission processes.

It is most important that in this case Fabrikant was the first to call attention to the possibility, in principle, of obtaining inversion and indicated concrete experimental ways of realizing this state (discharge in a gas mixture using resonance in collisions of the second kind).

These results were incorporated in his doctoral dissertation, which he defended in 1939, and were published in 1940.

During that time, Fabrikant's interest in this group of questions was connected with an evaluation of the feasibility of a direct experimental proof of the existence of stimulated emission. However, subsequently the formulation of the question was broadened, and in 1951 Fabrikant and his co-workers registered a claim

for an invention of a new method of light amplification. In this disclosure, the indicated ideas were further developed and expressed in more concrete form. It was shown that the passage of radiation through a medium with inverted population leads to an exponential growth of the intensity. The amplification principle was extended to the ultraviolet, infrared, and radio bands. It is most important that besides the previously indicated method of obtaining inverted population by resonance in collisions of the second kind, the following were also proposed: pumping (three-level scheme) and the use of a pulsed discharge.

An author's certificate (patent) was granted for this discovery in 1959, and an inventor's diploma in 1964. Related to this topic is an investigation made in 1957, in which a number of problems in the theory of optical quantum amplifiers was considered, particularly a discussion of the specific nonlinear effects that arise in devices of this type, and also an investigation of 1962, where an analysis was performed of the conditions for the occurrence of inversion in gas-discharge optical lasers.

Thus, Fabrikant was the first to point out the possibility of obtaining inverted population of the energy levels, proposed a number of concrete experimental methods that have become realized at present, and formulated the principle of amplification of electromagnetic radiation by passage through media with inverted populations. As is well known, this principle is the basis of the entire fruitful and promising trend of modern physics called quantum electronics.

Fabrikant's experimental investigations are distinguished for their purposefulness, completeness, and originality of the methods. By way of an example, we mention the very clever method of investigating the radiation field in an absorbing moving and scattering medium.

It is known that, owing to the absorption, radiation emerging from such a medium does not yield, direct data on the radiation field in the internal regions. Fabrikant employed a movable probe coated with a luminescent composition, which tansformed the radiation absorbed by the medium into radiation at different wavelengths, which freely emerged from the boundaries of the investigated gas volume. This method was used to investigate the propagation of resonant radiation in a low pressure discharge in mercury vapor and in inert gases. In the latter case, the investigations were performed in the vacuum ultraviolet, i.e., in the spectral region which is the most difficult for optical investigations.

We mention also an experimental investigation of the diffraction of electrons moving in sequence, the results of which was a direct proof that an individual particle has wave properties. Fabrikant's physical research is always closely related to practical problems. Thus, systematic investigations of discharge in mercury vapor and of the propertiesof luminors have allowed him to make a very appreciable contribution to the development and manufacture of Soviet fluorescent lamps and won him a State Prize.

Fabrikant's scientific activity was highly valued by the Academy of Sciences, which awarded him in 1965 the S. I. Vavilov Gold Medal "for work in the optics of gas discharge, in which the phenomena connected with negative absorption were investigated for the first time, and in which the use of this absorption was proposed for light amplification."

Altogether Fabrikant published more than sixty scientific papers. One cannot fail to note the unusual breadth of his interests, his articles on the history of physics, his popular-science papers, his articles in encyclopedias and dictionaries, a large number of reviews and critical remarks, etc. Professor Fabrikant is also the author of the Optics Section in Putilov's Course of General Physics.

Fabrikant began his pedagogical work in 1930 at the Moscow Power Engineering Institute, where he has been in charge of the Physics Department since 1944. He possesses the secret of exceedingly lucid exposition of very complicated problems of physics. Fabrikant regards lectures as very responsible task and yet as a labor of love.

He has devoted much time and effort to youth. As a result, approximately twenty of his students and coworkers defended doctoral and candidate's dissertations.

Typical of Fabrikant is his activity in the science community. At present he is deputy chairman of the administration and chairman of the Science-methods council for Physical-mathematical Sciences of the All-union Society "Znanie" (Knowledge).

We wish the celebrant further creative success.

Translated by J. G. Adashko
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