# In Face to the Problems of the Century
## On the Occasion of a Century since the Birth of Assene Datzeff

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**Abstract.** The twentieth century was time of grandiose discoveries in atomic and nuclear physics. In the region of theory, it passes under the aegis of two fundamental theories – the theory of relativity and quantum mechanics. In the same time, the defects of the theoretical description of the microcosm have felt from the very appearance of the theories. All this united the efforts to solve the problems. Favourable conditions for development of physics and mathematics appeared after the World War Second in Bulgaria. An important role had the waste diffusion of Russian scienctific literature and the participation of our physicists in the investigations of Joint Institute for Nuclear Researches – Dubna. A leader of our science after the war was Assene Datzeff. We celebrate his century anniversary this (2011) year. He had a chance to study in the school of Louis de Broglie in France before the war where he defended a significant thesis. After the war, he directed his efforts to the preparation of young physicists-theorists being in the face to the great problems of the time. The results are evident. He published a monograph on heat conductivity and a detailed study on quantum mechanics. We have a powerful theoretical school in the both leading our physical institutes – Institute for Nuclear Research and Nuclear Energy and Institute of Solid State Physics.

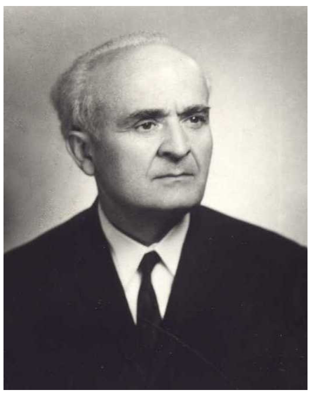
**Keywords:** Assene Datzeff, Theoretical physics, Quantum mechanics, Relativity, Heat conduction

The twentieth century was time of grandiose discoveries in the atomic and nuclear physics. In the region of theory, it passed under the aegis of two fundamental theories – the theory of relativity and the quantum mechanics. In the same time, there were imperfections of theoretical understanding the microcosm from the appearance of the theories. They stimulated the joined efforts of experimentalists and theoreticians to generate new data and their interpretation.

The successes of physics and mathematics in the 20th century [1-14] have been crowned with such technical achievements as the nuclear energy, space flight, automation and cybernetics, computers, nanotechnologies and quantum computers. There were interesting discussions around the theory of relativity and quantum mechanics [15-22].

Essential development of theory in Bulgaria before the World War Second was not observed. Literature and a large scientific base lacked. Number of scientists as well as number of the theoreticians grew up in parallel with the increase of general and university education after the War. Widely penetration of the Russian scientific literature in our country had favorable influence. It reflected not only to fill library but also to fill personal libraries of the curious young people with talent, enthusiasm and inspiration invaded in scientific institutes and universities. Wonderful practice during the first half of 20th century to send our university teachers to specialize in the West Europe (mainly Germany and France) had a favorable impact. They created a solid scientific base for the development of our university education after the War. Participation of our physicians in the Joint Institute for Nuclear Research in Dubna, USSR, gave a strong impetus to the development of physics in Bulgaria after the War.

One of our leading scientists after the war was the eminent Bulgarian physicist Assene Borisov Datzeff (04.02.1911 – 12.02.1994). We celebrate 100 years since his birth in 2011. Having the good fortune to fall into the school of Louis de Broglie in France, he defended a valuable thesis before the War. Assene Datzeff directed his efforts to preparation the young scientists in theoretical physics without to escape the great problems of the time. His monograph on the thermal conductivity and his study on quantum mechanics appeared as a result. Since my student years, when he was a dean of the Faculty of Physics and Mathematics, I know that he did not aim to have administrative duties to have more time for science. The results are available. We have vigorous theoretical schools in the Institute for Nuclear Research and Nuclear Energy, in the Institute of Solid State Physics, and in the Sofia University. I am personally indebted to my professor of quantum mechanics – Assene Datzeff – for the inspiration, criticism to the state of science and searching ways to overcome its defects. I was happy to enjoy of discoveries, which are reflected in my 150 publications in the area of theoretical physics [23-25].



Assene Datzeff was born in the village of Kamenar, district Razgrad. He graduated at the Sofia University in 1933. During 1934 – 1939 he specialized at the University of Paris, where he defended the thesis "*On the problem of potential barriers and the solution of Schrödinger equation*" for the scientific degree *"Docteur es sciences physiques*". The examination commission included Professor Garnier as a president together with Lois de Broglie and F. Perrin as examiners. Professors in the University then were Jean Perrin, Eli Cartan, Marie Curie, Irene Joliot-Curie and other celebrities. After his return in Bulgaria, in 1939, Assene Datzeff became assistant in physics at the Sofia University. During the World War Second, he participated in a national resistance but was revealed and arrested. He returned in the Faculty of Physics and Mathematics in September 1944, where he was elected to associate professor from 1947 and professor in theoretical physics from 1950. He received the highest state award for science – Dimitrov Prize – for a work on the heat conduction in 1951. He was elected a corresponding member of the Bulgarian Academy of Sciences in 1952 and a full member of BAS in 1961. He was dean of the Faculty of Physics and Mathematics from 1950 to 1955. He was head of the Department of theoretical physics from 1955 to 1984. He was the Secretary of the scientific Section on physics and mathematics of the Bulgarian Academy of Sciences from 1962 to 1968. He died after a heavy illness in 1994 [26-29; 4, p. 99].

Creative work of Assene Datzeff began with his dissertation [30], realized under the direction of Louis de Broglie and defended in June 1938. It containes 93 pages and based on two publications in Comptes Rendus de l'Academie des Sciences [31, 32]. It makes impression with its perfection and elegance. Assene Datzeff shows that he is a mature scientist, able to consider and to solve detailed and versatile problems. His dissertation was dedicated to the author's parents and to Louis de Broglie.

The problem of potential barrier penetration Assene Datzeff solved for the barrier in the one-dimensional case like a sequence of rectangular barriers. With the diminution of thickness of the barriers, the solution becomes more and more exact and in the limit case of infinitely thin layers of the barriers it is given in integral form. He obtained formulae about passed and reflected waves and respectively for coefficients of penetration and reflection. He applied a second method in the case of triangular barrier.

Then applied the method for the general solution of the wave equation. Finally he gave an application for the relativistic case.

Today the method of rectangles and triangles has significance for the numerical methods of mathematical physics.

Returning in Bulgaria before the War, Assene Datzeff published two papers, which merit a special attention. In the first one [33], he considers a model of plane motion of three material points, two of which are nearby. Using the Hamilton-Jakobi method he obtains a condition for stability of the orbits. The analogy with the corresponding formulae of Bohr concerning stability of motion in the case of hydrogen atom is remarkable. That is why he supposes that the relation between stability and periodicity is the result of internal motions of the electron. The attached electron wave is interpreted as a mathematical expression, which gives the condition for periodicity by the Jakobi function and the influence of a perturbing article.

Assene Datzeff applied method used in dissertation to solve the light wave equation in his second work [34]. The potential barrier in it corresponds to area of higher refractive index. Finally, he remarked that in addition to a light wave traveling in a transparent medium, the wave function could describe acoustical, electrical or any other wave. It is a wave function, complying the Schrödinger equation for amplitude. The problem is summarized in the case of two and three dimensions field. Meticulous calculations lead to an accurate final result.

Assene Datzeff expressed his attitude to quantum problems also in his inaugural lecture on the popular problem about indeterminism in physics on 17 February 1949 [35]. In it, he expressed his viewpoint that quantum mechanics and theory of relativity in all their contemporary forms anywhere and at any point did not warrant idealistic conclusions. Quantum theory is only one step but not the last one in the development of physics. There is no doubt that causal relationships exist between the motion of an electron and the reason, which generates its consecutive positions in the space. Whatever the forms to get the development of physics, it will always lead to objective consequential relationship between material objects constituting the Universe.

Assene Datzeff continued and summarized his investigations on quantum mechanics in the monograph "*Quantum mechanics and physical reality*" [36]. Based on the statistical description of the phenomena in microworld he gives possibility to preserve the primary causality in it by the influence of the surrounding medium (vacuum). It is exclusively difficult mission to make models of the vacuum, about which we do not know anything and could make only speculative conclusions. Datzeff makes several fundamental suppositions, which lead to the goal. He assumed that atoms of the substance of vacuum exist, the Planck law of energy is valid, and quanta exchange on submicroscopic level. This possibility is considered comprehencive and profoundly. All diversity of quantum mechanics he explained by the action of one primary factor, as a vacuum. The apotheosis is the proposed non-linear generalization of the Schrödinger equation in the case of large particle density.

His fundamental results are published in Bulgarian and Franch articles (mainly in Comptes Rendus) [37-44].

The idea of substance of vacuum is used also in the proposed by Assene Datzeff interpretation of special theory of relativity [45-46].

At the same time, Assene Datzeff directed his attention to the problems of thermal conductivity, where he applied the method of stitching. Series publications in the Proceedings of the Russian Academy of Sciences (1947 – 1950) and the Sofia University Annual he collected in the monograph "*On the problem of heat propagation in solids*" [47]. The first part contains the cases of a rod consisting of two homogeneous unlimited parts, then rods composed of two limited homogeneous parts or $n$ homogeneous parts and an inhomogeneous rod. The second part is a summary in two-dimensional and three-dimensional cases.

The monograph began with a preface written by Louis de Broglie where he saied: "*Mr. Datzeff is a valuable physicist theoretician. He manifested always alive sympathy to France. He left an excellent and pleasant remembrance in those who knew him from his visits to Paris*".

These investigations of Assene Datzeff were awarded with a Dimitrov Prize.

Another outstanding investigation of Assene Datzeff is devoted to the linear problem of Stefan [48]. The problem of Stefan treated the temperature field in the space, occupied by two phases of a given body, usually in solid and liquid phase, for example water and ice. The functions, presenting the regions of different phases, comply with the corresponding heat equations, while the separating surface of the phases, which rests at constant temperature, is unknown. It is related with an equation called calorimetric condition.

The problem of Stefan belongs to the problems, leading to solution of systems partial differential equations or integrals with boundary conditions, some of which are changeable and have to be determined in any particular case.

The problem of Stefan has different important practical regions of application, for example hydrodynamics, aviation, freezing and ice thawing, internal Earth motions, crystal growth, metal melting, and rockets.

The book contains the results of author's investigations on the linear problem of Stefan, published in Bulgaria and USSR mainly during 1947 – 1956. They are exposed in several lectures in the Institute of Mathematics at the Florence University in May 1967.

Datzeff considered in the first part of the book different cases of one-dimensional problem, beginning with two unlimited phases and passing consecutively to the cases of limited phases, changeable phases and different boundary conditions.

In the second and third parts of the book, the results are generalized for two and three dimensional cases, including anisotropic bodies.

The key of the method here is also the method of stitched solutions.

Besides as a scientist, Assene Datzeff has a trace as a lecturer and promoter of science. His lectures and textbooks on theoretical physics [49] and quantum mechanics [50] set a solid base of our understanding of physics and the strangeness of the modern concept of the atomic world. His participation in the course of post-graduate qualification of teachers [51] is outstanding. Datzeff outlined the role of such creators of scientific revolutions like Newton, de Broglie and Schrödinger in several popular expositions [52-54]. The participation of eminent our scientists in the popularization of science is a part of the necessary transmission between the discovery and the production, the gap between which is a serious obstacle to the progress.

Datzeff was happy to be one of the motors of this progress.

Finally, I wish to express my cordial gratitude to Lady Vera Datzeva for the possibility to study creative richness of Assene Datzeff. I thank as well to the Organizing Committee for the invitation to take part in this nice Balkan Symposium, dedicated to the 115$^{th}$ anniversary of the birth of our teacher on physics – Georgi Nadjakov.

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