Zemplén's Monograph on "Electricity and its Practical Applications" from 1910

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ABSTRACT. A brief account is given of the life and career of the Hungarian physicist Gyozo Zemplén (17.10.1879–29.07.1916), who has lost his life in World War I. It is shown how his scientific activity started as a distinguished pupil of Roland Eötvös and how Eötvös made efforts to start Zemplén at the Technical University of Budapest. The important contributions made by Zemplén in the field of modern hydrodynamics are mentioned briefly. The main theme of this contribution is Zemplén's "Electricity and its Practical Application", a modern monograph published in 1910. When we compare the scope of this work with the important events of the developments of this new science, we may observe the following. Electrodynamics is carefully introduced from basic phenomena, leading to the modern achievements. The evolution of the theory is explained by its practical utilizations, which—naturally—is very good and more or less valid, and very impressive, even today. The monograph treats the basic facts, and, as applications, introduces us to the problems of electric lighting, electric transportation (railways), high tension electric transmission lines, but equally reaches the modern questions, as telephones, black body radiation, Röntgen radiation, or even the birth of radio. So the reader is introduced to the glorious modern world of electricity—the magnetic side of the picture seems to be a little fainter. (Not to mention the birth of atomic physics.) The unique problem this interesting book leaves with the reader may be summarized in the questions: In 1910, how could it happen that the new world picture offered by electrodynamics runs away blindly from Plank's (1900) and Einstein's (1905) fundamental results (the quantum problem and the photon), and Einstein's special relativity (1905)?

The first comprehensive account of the triumphant electricity was made available to the Hungarian intelligentsia reading circle in 1910. The author was a thirty-one year old physicist, at that time lecturer at the Palatine Joseph Technical University of Budapest (József Nádor Muegyetem). Before analyzing this magnificent volume, let us turn our attention towards the author.

The young Gyozo (Victor) Zemplén was born on 17th October, 1879. He studied physics and mathematics at the Budapest University under the well known professor Roland Eötvös. He began research in physics, followed Eötvös in the research of viscous properties of liquids and gases (1). But this work - which finally led him to obtain a doctor's degree in physics - was not so satisfactory to him. From certain signs we ourselves may judge that even Eötvös was willing to see that it is not worth-while to limit Zemplén to this activity. Eötvös tried to find a position for his pupil at the Technical High School which had been elevated to the rank of University at that time. Zemplén, during his university studies had become acquainted with the most modern branches of physics, especially hydrodynamics and electrodynamics, and not to forget a comparatively new branch, mathematical physics. During his first years at his new place, he began statistical mechanics, and published papers on its foundation. But very soon, on the occasion of his visit to France, he published his first papers on shock waves of hydrodynamics (2). In these papers he gives the first general treatment of shock relations in ideal fluid and announced a theorem, saying that only compressive shock waves do exist (rarefaction version may not exist, on the base of the Second Law of Thermodynamics). Later he gave a general mathematical study of general disruption phenomena (3) where one provides that not only the fundamental hydrodynamical quantities, but also their derivatives may be discontinuous, that is to say, they may have a jump. The relation which classifies the shock waves has thereafter been called Zemplén's theorem. He continued this research, even trying to find the shock waves in the newest continuum theory, the Maxwell electrodynamics (4), but this had not become so well received, since at that time electrodynamics was considered acting alone, not combined with other properties of the medium, as in our days, when different kinds of matter may manifest their properties in response to electrodynamics effects, e.g. magnetohydrodynamics.

Before analyzing Zemplén's work on electricity and magnetism, let us mention the basic data about his life. Quite sorrowful, his life was not long. He was mobilized in the First World War to the artillery of the Austro-Hungarian monarchy, went to the Italian front as a lieutenant of artillery, and on a seemingly quiet day he lost his life on 29th July 1916 due to an Italian artillery action.

As regards his volume on "Electricity and its Practical Applications" we must state that this work is the very first book on electrodynamics in Hungarian (5). It was published by the Royal Scientific Society enjoying the cooperation of the Hungarian Academy of Sciences. The Editors were busy to aid the author because they were convinced there was a great necessity to give a general account of the new science of electrical phenomena and its industrial benefits to the reading circle. The work was successful: we do confess, the book is quite interesting to read even nearly hundred years after its publication - admitting, that maybe now we would prefer a somewhat different thematic structure for it, but as a historical document, it is very interesting and thoughtful.

Let us summarize the thematics of the book. It is divided into eleven chapters - the whole volume reaches about 683 pages. It starts with the concept of work and energy, and soon considers the energy resources available to mankind. Then it introduces us to the steady electric currents, its effects, networks, electromagnetism and the energy of electric currents. Next chapter considers alternating currents, the induction phenomena, treats the self induction and capacity, and discusses resonance phenomena. The fourth chapter treats the electromagnetic waves, Hertz's experiences with the propagation of the electromagnetic waves, the electromagnetic theory of light, enumerates the experiments on propagation, determines the propagation velocity, treats refraction and diffraction phenomena, discusses the - at that time - available spectra of waves (the interval of the frequency of oscillations between and Hz) concludes to the electromagnetic theory of light. The applications are discussed in the following seven chapters. This begins with the sources of electric currents, steady or alternating ones. A relatively long chapter is devoted to the energy transport realized by electricity; this involves batteries, transformers, switchboards, transmission lines, lightning phenomena, electric networks, and discusses the transportation problem of electric energy to great distances (the capacity of long wires, telephone lines in intercontinental connection). A separate chapter is devoted to explain the problems of work transmission (different kinds of electromotors). Next point is electric lighting. (The black-body radiation is discussed from Kirchhoff's law to Stefan-Boltzmann law, including the Wien relation; however, Planck's name is not mentioned). The heating and different industrial application of electric currents to melt substances like steel; and aluminum production, and the problem of the production of nitrogen from the air are discussed. Following that, the chemical effects of electric steady currents are discussed (electrolysis, galvanoplastics, ozoneproduction). The most interesting chapter of the time might be this one which discusses the transmission of human thoughts by means of electric currents (telephony) and electromagnetic waves (with our modern vocabulary: by means of radio, though this review really mentions Guglielmo Marconi, but it actually refers to the wireless telephony rather than to the modern radio). The last chapter treats the cathode-rays, Lenard's experience, the exploration of Röntgen-rays, their properties and utilization. This theme is the last one of the volume.

The book—naturally an original Hungarian volume—is quite easily readable even now, a hundred years after its preparation. To tell the truth, the book appeared also in 1927, sixteen years after the original publication, but this volume has been elaborated by two actual professors of the Technical University (6), Béla Pogány and Imre Selmeczi Pöschl. The result is somewhat surprising: the elaborated version is of 664 pages (the original one is of 683), the elaboration takes care mainly of some problems arising from the evolution of the Hungarian language, and the new volume contains more figures than the original one (+150) and as a matter of fact, the radio is discussed in more detail, the first appearance of the radio tubes in Hungarian literature is here in this book.

The triumph of electricity and magnetism is - so to speak - glorified in this volume. We must stress, that the electric traction used to underground railway was realized first on earth in Budapest, for the commemoration (1896) of the thousand years of Hungarian statehood. It is interesting, however, how the problems of the appearance of quantum effects (Plank's constant and atomic physics), the relativity (the Lorentz transformation property of Maxwell's equations) and the very basic fundamental equations of electrodynamics, the Maxwell's equations fall aside to both volumes!

One may say that this volume had been taken to be a textbook on electrodynamics for the first years of the Technical High School, or even it was meant to be an information giving manual for those interested in propagating the practical use of electrodynamics for the use of already diplomed engineers. Anyhow, Zemplén himself had been quite well informed on the basic laws of electrodynamics, Maxwell's equations. One can easily demonstrate it by referring to an article by Zemplén, in which he tried to investigate the disruption phenomena of the Maxwell's equations (4). As regards Planck's conception on black-body radiation (the action-quantum and its role) and on the beginning of the relativity theory we find nothing. We draw the conclusion: Zemplén's original book is an interesting document of the practical importance of electrodynamics of the early 1900 years. It does not risk going into details of the modern branches of electrodynamics which are more connected with the structure of matter. This is not a sign of the world picture of Zemplén - who some years before this volume gave the Hungarian translation of Henry Becquerel's and Mme Curie's work on radioactivity. This is only the sign of opening a new gate of reality before the Hungarian readers, introducing them to a magnificent and almost omnipotent new scientific branch. We can only suggest the young Hungarian colleagues to get acquainted with this original volume of Gyozo Zemplén even now.

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