



## **Study of Physical Phenomena in the Written Heritage of Nayden Gerov**

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**Abstract.** Since the creation of the first Bulgarian independent schools in Bulgaria - Koprivshitsa and Plovdiv, Nayden Gerov introduces physics in them as a separate subject and begins teaching it in Bulgarian. Nayden Gerov also starts to deal with an extremely difficult and complicated task of writing the first physics textbook in Bulgarian (spoken at that time), with the desire to protect Bulgarian language from the entrance of unnecessary foreign words. In 1849 he prints "Some Extracts from Physics", Part One, where he deals only with questions of mechanics and acoustics. One year later, he finishes the second part, which, however, for unknown reasons, remains unpublished. In this section he explores the phenomena related to heat, light, electricity and magnetism.

When Nayden Gerov began writing his textbook, a "one-color" picture of the world spread in front of him, i.e. the mechanical, claiming universality. He adopts and recreates it, along with mechanical patterns that explain the thermal, electrical and magnetic phenomena. In the textbook he introduces the concept of "heat matter" (as a synonym of the quantity of heat), concepts of the electric and magnetic fluids, which he calls "moist".

**Keywords:** First Bulgarian Textbook on Physics; physical phenomena; laws.

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## 1. THE BEGINNING OF THE NEW PHYSICS

Thanks to Galileo Galilei's and Newton's research, expanded and validated by their followers, in the eighteenth and nineteenth centuries, the first physical picture of the world - the mechanical one - was conceived. In it, nature is seen as a giant machine, all the actions of which submit to classical mechanics. Inspired by this picture and delighted by the courage of its creators, Nayden Gerov will call one of them "The eminent physicist Galileo" (glorious, famous) (Balabanov, 2014).

## 2. NAIDEN GEROV - AUTHOR OF THE FIRST BULGARIAN STUDY OF PHYSICS

Nayden Gerov (1823 - 1900) prepares and begins to write his Physics textbook in the 1840s when still the mechanical concepts and models dominate. It is natural, his textbook to reflect those achievements of physics which he has learned through the academic literature he used (Balabanov, 2014).

In 1849, after overcoming a number of financial, domestic and methodological difficulties, the textbook "Some Extracts from Physics" - Part I was printed in Belgrade. This is the first Bulgarian textbook in Physics written in Old Bulgarian letters and with attached drawings, engraved on stone at the KS Stone-Cutting workshop in Belgrade (Metev, 1963).

## 3. GENERAL INFORMATION FOR THE TEXTBOOK

"Some Extracts from Physics" - Part One covers: Preface, Introduction and Three Books on 216 pages and 4 large sheets with 117 drawings. This textbook only discusses questions of mechanics and acoustics (Shturelova, 1974).

In the preface of his textbook, N. Gerov writes that he has drawn from some writings in "foreign languages, initial knowledge of physics". This explains the meaning of the title he puts on the textbook: "Some Extracts from

Physics". This title is an expression of the modesty of the author (Balabanov, 2014).

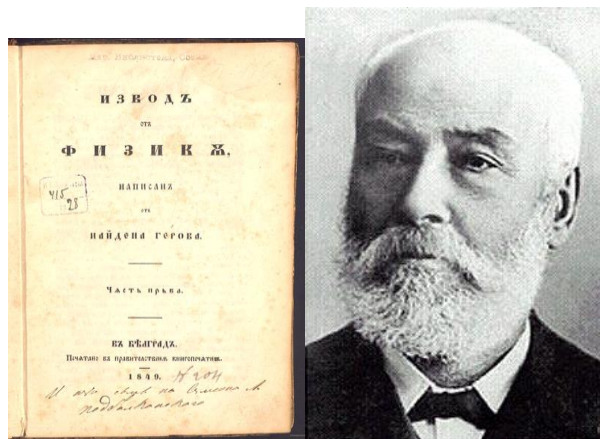


Fig. 1 Initial page of the textbook of Nayden Gerov and his portrait.

Drawings N. Gerov borrows from Claude Pouillet, simplifies them and uses his own technique in arranging them. So that they are not scattered throughout the physics textbook but collected on four sheets at the end of the textbook (Metev, 1963).

After the Preface the Introduction follows.

The introduction of the textbook consists of three chapters. There he gives a definition of physics and the main categories included in its foundations.

N. Gerov gives a definition of the atom as a stretching and indivisible particle. According to him, everybody has mass and volume, and can be found in three different states: solid, liquid (water) or gaseous. He defines mass as a set of particles that make up the body, and volume - as the space they occupy.

Other basic concepts of classical mechanics introduced by Gerov are movement, quiescence, and inertia. Movement of bodies is defined as movement into infinite space. The relative nature of movement is pointed out, whereas the principle of inertia is referred to as the property of "self-passiveness" of bodies - that property, by virtue of which without a reason the bodies cannot change their own condition themselves.



The changes in the states, properties and positions of the bodies in nature, N. Gerov calls “phenomena”.

Having assumed matter as “self-passive” he logically concludes that these changes are caused by some reason that he calls “force or actor” (Balabanov, 2014).

Forces are divided into “periodic” (acting for a certain period of time) and “continuous” (i. e. continuously acting) and the main elements of force are given: point of application, direction and magnitude (Borisov, 1988).

He examines in detail different cases of force summing and decomposition, of a pair of equal and opposite parallel forces; explains the action of various levers and reels and their applications.

N. Gerov gives a notion of the Laws on conservation of the quantity of movement, and the equality of action and the opposite action. They are illustrated with the classic example of a gunshot kick; formulates in words the laws of speed and the path under “evenly modifiable movement”, etc. (Borisov, 1988).

In this way the introduction of the science in the textbook ends and its essential part begins.

In Book One, some phenomena caused by the force of gravity (which are subject to further study) are listed, two experimental methods of finding the centre of gravity of flat bodies (“a board”) and “a sharp stick like a knife” explains that, depending on the mutual position of the centre of gravity and the fulcrum of a body, it can be found in three kinds of equilibrium: “indifferent”, “constant” (persistent) and “in-constant” (non-persistent).

A separate chapter is devoted to the pendulum called the “swing”. Gerov gives a description of the clock pendulum and later specifies the concepts of mathematical (“simple swing - a tough stick without weight”) and a physical pendulum (“a complex swing - a heavy stick and a very large body attached at the end”), and presents at how they

can be used to measure the force of gravity, to measure time, as well as the influence the temperature on the accuracy of watches, and some ways by which this influence can be avoided.

Next, N. Gerov gives the concept of ideal fluid, clarifies the basic hydrostatics law through experiments with a vessel filled with liquid and pistons of the same and different area, placed at different places in the vessel; he describes the equilibrium of liquids in communicating vessels.

After the Chapter “Equilibrium of water bodies (Hydrostatics)”, naturally follows the Chapter “Equilibrium of gaseous bodies”, in which N. Gerov points out the similarity between gases and fluids in terms of the mobility of their particles, and their difference in their compressibility. A considerable attention is devoted to the atmosphere by using simple and interesting experiments to illustrate the great pressure the atmosphere has on all bodies on the Earth’s surface. He captivatingly narrates about how Torricelli’s famous experience has been achieved, and about the creation of a “barometer with cup and barometer siphons”. To measure the tenths of a millimetre, a nonius is used (its use is described at the end of the textbook – “a tool that measures ten portions of very thin divisions”).

Gerov formulates with words Marriote’s law and describes how to test experimentally Archimedes’ law and the so-called “hydrostatic scales” (scales) used to check the Archimedes’ law and determine the relative weight of the bodies.

Book Two is devoted to the forces of attraction between the building particles of bodies, called by the author “particle attraction”. This attraction is manifested in various phenomena and, according to them, it is called: “cohesion”, “affinity” and “conglutination”. Moreover, Gerov gives a definition of the term “elasticity” and the elastic deformations through which it is demonstrated and measured.

In the last “Third Book” some phenomena are discussed related to the sound and its characteristics - sound loudness, intensity, frequency of oscillation, noise, as well as its distribution in gases, liquids and solids.

The textbook provides extensive information on the use of the basic laws of nature in technology and everyday life. The author describes in detail various physical instruments and measuring instruments: scales, barometers, thermometers, areometers, aerostats, water and air pumps, calorimeters, galvanometers, etc. The author tries to present the practical aspect of the knowledge in physics so that it can be applied in life.

In some sections of the textbook, N. Gerov describes and recommends experiments that students can do at home and develop the skills and abilities needed for life (Balabanov, 2014).

The phenomena related to heat, light, electricity, and magnetism are discussed in the second part of “Some Extracts from Physics”, which unfortunately remains on a manuscript and has not been published.

#### **4. IMPORTANCE OF THE FIRST BULGARIAN STUDY OF PHYSICS**

When Nayden Gerov began writing his textbook, a “one-color” picture of the world spread in front of him, i.e. the mechanical, claiming universality. He adopts and recreates it, along with mechanical patterns that explain the thermal, electrical and magnetic phenomena. In the textbook he introduces the concept of “heat matter” (as a synonym of the quantity of heat), concepts of the electric and magnetic fluids, which he calls “moist”.

In general, the content of the Gerov’s textbook follows the traditional way of presenting classical physics. It can be said that he has achieved his goal of presenting physics as a “supreme and vast science”. From a scientific and methodological point of view, “Some Extracts from Physics” can be considered as an original work that has played its role in the dissemination of physical concepts in our country (Balabanov, 2014).

N. Gerov has written his textbook because he has seen farther than his contemporaries and believed in the necessity of knowledge in physics for the progress of society. That is why we should consider Nayden Gerov as a true founder of the education in Physics in Bulgaria and as our first physicist (Balabanov, 2014).

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