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DIGITISATION OF BOOK *COSMIC ENERGY AND MODERN PHYSICS* (*ВАСИОНСКА ЕНЕРГИЈА И МОДЕРНА ФИЗИКА*) BY ĐORĐE STANOJEVIĆ

Summary. In this paper one of the rare physics books written in Serbian in the second half of the XIX century, when technical literature in our country was almost non-existent, is presented. The subject is a book written by Prof. Đorđe Stanojević *Cosmic Energy and Modern Physics (Васионска енергија и модерна физика*) printed in 1887 in Belgrade. Though small in size, it is very concise, informative and with a very clear style. The book is the printed form of the *Invited Lecture* delivered at the beginning of his engagement at the Military Academy so that it gives a review of achievements in natural sciences and technology in the late XIX century. The present article contains a parallel consideration of the achievements in natural sciences and technology in the beginning of the XXI century. Đorđe Stanojević's *Cosmic Energy and Modern Physics* has been digitised and it is available at the Virtual Library of the National Digitisation Centre (Virtual library, http://elib.matf.bg.ac.yu:8080/virlib/). The digitisation of these books is a part of the project aimed at electronic archiving of Serbian books from the field of mathematics and natural sciences printed in the XVIII and XIX centuries.

Key words. Đorđe Stanojević, modern physics, molecular energy, book.

Introduction

Cosmic Energy and Modern Physics by Prof. Đorđe Stanojević appears as one of the rare books in physics printed in Serbian in the late XIX century. It was published by the Royal Serbian State Printing House in 1887 in Belgrade. The copy kept in the Library of the Serbian Academy of Sciences and Arts, signature 317/12, was digitised. The book is small in size, but its text is a long invited lecture delivered by Prof. Đorđe Stanojević on September 22, 1887 when he started his career at the Chair of Physics of the Military Academy in Belgrade. Đorđe Stanojević was educated at European centers, he knew foreign languages very well and in writing this lecture he used the most contemporary literature in foreign languages.

Data from Prof. Đorđe Stanojević's biography

Đorđe Stanojević was born in 1858 in Negotin, died in 1921 in Paris. He took degree from the Grand School in Belgrade. Afterwards he was assistant at the same institution working with Prof. Kosta Alković (1836–1909) and then taught in the First Gymnasium in Belgrade in 1883. As a fellow of Military Ministry he spent some time between 1883 and 1887 studying and working at the best known European astronomical and meteorological observatories (Potsdam, Hamburg, Meudon, Greenwich, Pulkovo). At that time and a little bit later he published a few scientific papers in the Editions of the Paris Academy of Sciences. These are the first scientific papers in astronomy and physics among Serbs. It can be concluded that his

interest in physics was significant, for instance, his lecture as the teacher of physics and mechanics at the Military academy, after returning to Serbia, he devoted to contemporary physics. Later on in science he devoted his activity mainly to physics and its applications. He taught applied physics at the Grand School and University. He was active in the building of the first hydroelectric plants in Serbia: Vučje, Negotin, Užice, Ivanjica… He was the author of the electrifying project for Belgrade.

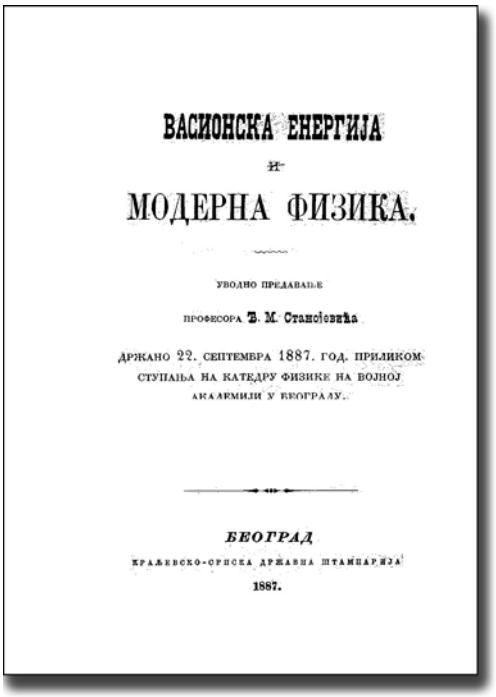
◄ **A photograph of Đorđe Stanojević**

Contents of the Book

Cosmic Energy and Modern Physics contains 68 pages. Since the book is the text of an invited lecture on the occasion of entering the Military Academy, it contains no figures, no chapters, just a few formulae. The lecture is devoted to the achievements in natural sciences and technology, especially physics, realised by that time. In this way it is possible to hear that during the XIX century epochal inventions were: steam engine, telegraph, telephone, microphone, telescope, spectroscope, photographic plate, electric current, electric railway. In a little bit more than one century natural sciences and technology achieved an improbable progress: internet, mobile telephony, Earth's artificial satellites, man on the Moon, Hubble space telescope, nuclear bombs, DNA analysis, cloning... So, as Đorđe Stanojević wrote for the XIX century at the beginning of his book quoting Njegoš: *Let this century be proud when compared to all others,* we are proud to say the same for the XX century.

Let us mention an example of Đorđe Stanojević on p. 21 where he gives a description of the historical development of physics. This description covering the time from Aristotle till the end of the XIX century is presented in the Cartesian orthogonal coordinate system. To the first part of this development beginning with Aristotle and ending with Galileo corresponds a straight line parallel to the X axis, whereas to the second part from Galileo towards the beginning of the XIX century, after an abrupt leap, corresponds a straight line with a large slope followed by short pauses. During the first period the development was influenced by Aristotle's strong authority, in the second one the most influential person is Newton nothing less than Aristotle in the first one. Both authorities among the followers led later to a stagnation of science development. After the stagnation followed after Newton in the early XIX century an intensive development of physics takes place. To this third period corresponds an oblique straight line with a steep slope. It is of interest to mention here also the fourth period, that of the XX century where the achievements can be represented by using an exponential curve.

We want specially to emphasize the classification of Đorđe Stanojević's cosmic energy recognising the four basic types: body energy, molecular energy, atomic energy and cell energy on p. 41.

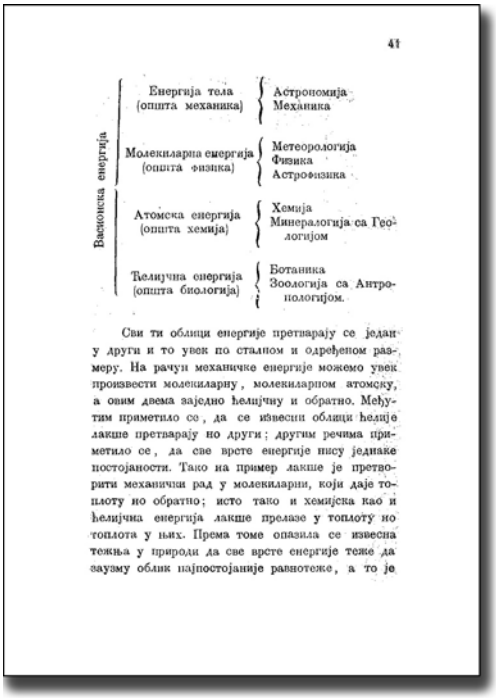


ВАСИОНСКА ЕНЕРГИЈА
И
МОДЕРНА ФИЗИКА.

УВОДНО ПРЕДАВАЊЕ
ПРОФЕСОРА Ђ. М. Станојевића
ДРЖАНО 22. СЕПТЕМБРА 1887. ГОД. ПРИЛИКОМ СТУПАЊА НА КАТЕДРУ ФИЗИКЕ НА ВОЈНОЈ АКАДЕМИЈИ У БЕОГРАДУ.

БЕОГРАД
КРАЉЕВСКО-СРПСКА ДРЖАВНА ШТАМПАРИЈА
1887.

Scan of front cover page



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Васионска енергија

Енергија тела (општа механика)	Астрономија, Механика
Молекиларна енергија (општа физика)	Метеорологија, Физика, Астрофизика
Атомска енергија (општа хемија)	Хемија, Минералогија са Геологијом
Ћелијична енергија (општа биологија)	Ботаника, Зоологија са Антропологијом.

Сви ти облици енергије претварају се један у други и то увек по сталном и одређеном размеру. На рачун механичке енергије можемо увек произвести молекиларну, молекиларном атомску, а овим двема заједно ћелијчну и обратно. Међутим примећено је, да се извесни облици ћелије лакше претварају но други; другим речима примећено је, да све врсте енергије нису једнаке постојаности. Тако на пример лакше је претворити механички рад у молекиларни, који даје топлоту но обратно; исто тако и хемијска као и ћелијчна енергија лакше прелазе у топлоту но топлота у њих. Према томе опазила се извесна тежња у природи да све врсте енергије теже да заузму облик најпостојаније равнотеже, а то је

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We see that according to this classification the subject of physics is the molecular energy only, whereas the body energy belongs to *mechanics*, the atomic one belongs to chemistry and the cell one to biology. Further on Stanojević writes that it is much easier for mechanical, atomic and cell energies to be converted into the molecular one (heat) than vice versa. Hence he reaches a conclusion concerning the fate of the universe as a whole. Since in nature there is a tendency of all kinds of energy to be converted into heat, as the most stable kind, it follows that all living creatures in the universe can die, the Sun can cool, when temperatures become equal everywhere, the planets must stop, in other words a general death comes, *deadness*. However, today we know about several cosmological models of *open* and *closed* universe (Friedmann-Lemaître) and *flat* universe (Einstein-de Sitter). Regardless to the final fate of the universe to astronomers the most acceptable concept is that the universe was formed in the *Big-Bang*. The Big-Bang model of the expanding universe in its modern form is due to Gamow in 1948. The cooling of the universe is due to its expansion, whereas the temperature determined the kind of thermonuclear reactions for creation of chemical elements.

Since molecular energy belongs to physics and the atomic one to chemistry, to physics a molecule would be the smallest particle and atom to chemistry. In order to present the size of a molecule in a water drop Stanojević makes an interesting comparison. If a water drop were augmented to the size of the Earth, a water molecule with the same magnification would reach the size of a bee. The entire Earth would be a moving swarm of bees, whereas every bee in addition to the common motion would have its own motion, upwards, downwards, to the left, to the right, forward, backward. This comparison is a nice and illustrative way to understand what takes place inside a water drop.

In the XIX century chemistry Dalton's postulate was generally accepted - an atom is indivisible and undestroyable. That electrons exist within an atom became known only in the late XIX century. In the beginning of the XX century proton was discovered which was followed by the neutron discovery after some twenty years. But, a real revolution in physics took place in the seventies of the XX century. A model was formed capable to explain all kinds of matter and all kinds of forces, except gravitation, with 24 particles and 24

antiparticles. The particles are *quarks* (6+6), *leptons* (6+6) *and bosons* (12+12). In the common matter in protons and neutrons there are only two kinds of quarks: "down" quark and "up" quark, among leptons in the common matter only electron and neutrino are stable, whereas bosons are interaction carriers (*photons* are carriers of electromagnetic force, three particles are carriers of the weak interaction and eight massive particles called *gluons* are carriers of strong interactions).

In this book Đ. Stanojević says that the subject of physics is molecular energy and the forms of this energy can be: heat, light, electricity and magnetism. In modern physics all these kinds of molecular energy correspond to the electromagnetic interactions. In addition to the electromagnetic interactions in modern physics one also defines gravitation, weak and strong interactions. For more than half a century modern physics has tried to unify all the four into a single one. The problem of gravitation is still open. The search for a "*divine particle"* which would unify all kinds of forces is still actual.

It is of interest to say something about the terminology. There are some Serbian words used in the XIX century, but out of use now, or they have changed. Examples are: Europe, spelled "Yeurope" at that time, multiple was spelled differently (*višegubo*, now *višestruko*), "jestost" a word not existing now, meaning all existing including matter and motion, molecule was spelled then differently, cell energy has also changed, for moving Stanojević says "u srednju ruku" (means in mean hand) instead of mean or moderate speed.

Conclusion

The book ***Cosmic Energy and Modern Physics*** by Đorđe Stanojević was written in a clear and interesting way, almost without formulae or equations, to be suitable for reading by general public. On the other hand it is a review of the achievements of contemporary physics and its applications. Taking into account that except physics the book deals with the achievements in astronomy, chemistry, biology, electrical engineering and military technology it is possible to see how wide the scope of Stanojević's education, knowledge and interest was. Since it is among the rare books from the XIX century and it is now easily available at the Internet site of the Faculty of Mathematics of the Belgrade University in its Virtual Library at the address of http://elib.matf.bg.ac.yu:8080/virlib/, we want to recommend it to professors and students.

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