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A COMMENT ON B. PETRONIJEVIĆ'S WORK "L'EVOLUTION UNIVERSELLE"

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Abstract. Petronijević's study "l'Evolution Universelle" (originally written in French) – a copy of which was presented by him to the Astronomical Observatory of Belgrade – considers various aspects of natural evolution, including astronomical topics. There is a chapter devoted to cosmology and another one analyzes the cosmogony of stars and of the Solar System; the evolution of our planet, the Earth, also has its own chapter. The authors discuss these aspects of Petronijević's work, with an emphasis on the contemporary European context of his evolutionism.

In the early XX century, Serbia continued the renaissance in education, culture and science which had been intensified during the last decades of the XIX century. In this context, the most important contribution was given by distinguished intellectuals educated in well-known European centres. Branislav Petronijević was one of them.

Although the biographical data about Branislav Petronijević are very well known, we can give here just a few of them. He was born on March 25, 1875 at Sovljak near Ub. He finished the primary school in Ub, the first part of gymnasium in Valjevo and the second part in Belgrade. In Vienna he attended the faculty of medicine for three semesters and afterwards the faculty of philosophy in Leipzig where he obtained his PhD in 1898. After his return to Serbia he began to teach philosophy at the Grand School which became Belgrade University in 1905. After his retirement in 1927 he began to teach again in 1935. He became a member of the Serbian Academy of Sciences in 1919.

Petronijević was not only a philosopher; instead, the wide sphere of his interests also comprised mathematics, geometry, physics, astronomy, biology, paleontology and other disciplines. His complete bibliography contains about 150 titles of published works.

Petronijević's work "l'Evolution Universelle" was published in 1921 in French (a Félix-Alcan edition, Paris) as a book of 212 pages. At that time, he taught at the University of Belgrade and also at the University of Geneva. He dedicated this work to the memory of Gaston Milhaud teaching scientific philosophy at Sorbonne. A copy of this book was given by its author in person, as a present to the Astronomical Observatory in Belgrade on occasion of his visit in 1941.

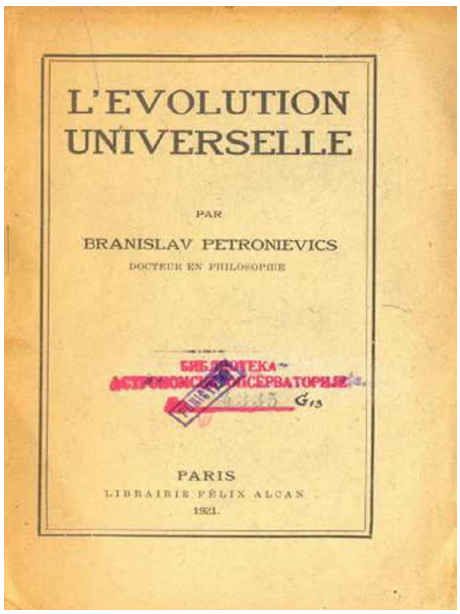

Figure 1: The view of the front page of Petronijević's book "l'Evolution Universelle".

This work was formed as a result of two circumstances:

- Petronijević's need to undertake more detailed studies in positive sciences in the course of work on the third volume of his "Principles of Metaphysics" in order to avoid disagreements between the metaphysical construction and scientific facts from the world of inorganic nature;

- during his stay in Paris he got a possibility to present a course on the universal evolution at the Sorbonne, so a part of the book resulted from these lectures.

"l'Evolution Universelle" contains a presentation of the proofs and laws concerning the evolution of the world as a whole, as well as special evolutions (inorganic, organic, intellectual and social), but it is also a work of scientific synthesis.

In the Preface Petronijević gave a brief description of his work, emphasizing that in it "an ordinary reader would find a clear presentation of the main facts following the universal evolution, a scientist a rigorous argumentation in favour of the truth in these facts, and a metaphysician a sharp criticism of this argumentation".

In philosophical considerations of the evolutionist doctrine he reserves an equal treatment for the question of general evolution of the universe (which has both metaphysical and hypothetical nature), as well as for the evolution in special domains of reality (being an empirical fact grounded in the scientific discourse). A consideration of the problem of universal evolution from the aspect of origin of evolutionary processes was put aside because the author – following his own words – thought this question as "too complicated and completely open". For the sake of a better un-

derstanding of the principles of evolution, Petronijević in the beginning presents a short history of the evolution concept, followed by his comments and critical reviews, according to his philosophical views. Then he proceeds to indicate the four main hypotheses concerning the origin of individual objects and of the world itself.

Assuming the evolution to be an empirical fact, Petronijević defines it as "a development of an entity in successive phases of variations" involving a time process, a sequence of successive states. According to him the evolution is given through variations and the evolutionary process is made of phases, i.e. the following state has a larger (progressive evolution) or a smaller content (regressive evolution) than the preceding one. If we want the universal evolution to be an evolutionary process, we should (according to Petronijević) define the world as a whole and the necessary prerequisite for this is that the space containing the material world is real and finite. To Petronijević, the world is complete if it is finite in space, otherwise there would be many stellar systems like the Milky Way at immense ethereal distances among themselves and, consequently, the material world would be no physical entity (therefore, there could be no universal evolution). The role of ether in the real infinite space is analogous to the one of empty distances in an infinite empty space and it is enough to examine the infiniteness of the real space.

A precise solution of this requirement, according to Petronijević, is that there are two different kinds of spatial infiniteness: one for finite distances and another one for infinite distances. To Petronijević the latter case is not logically possible and to prove this he uses a mathematical method illustrated in vertical sequences of squares corresponding to finite and infinite numbers; otherwise, Petronijević states, an abrupt transition would take place at the point of the common straight line (mathematically impossible!) where we have the end of finite numbers increasing from the left to the right and where the infinite numbers begin decreasing from the right to the left. After proving mathematically the condition of the universal evolution, Petronijević poses the question of existence of an initial state of the universe in the past (whether time is finite or infinite towards the past). He reaches the following conclusions:

a) that the time interval from the present to the moment at which a change started is fixed and cannot be shifted;

b) what precedes the moment of the absolute beginning of change and what comes after the future of successive variations, which is always finite, is the timeless eternity which never began and never will end.

With respect to this eternity the total evolution of the universe can be considered in four ways:

- as a unique process with no beginning and no end;
- as a sequence of universal successive evolutions with no beginning and no end;
- as a unique process having had an absolute beginning in the past, but will have no end in the future;
- as a unique process having had an absolute beginning in the past and will have an end in the future.

The first two alternatives were rejected by Petronijević, whereas the latter two were used by him to conclude that the total evolution of the universe "is likely, but uncertain (hypothetical)". In order to make this a firm truth one should prove by

deduction that, due to the initial state of matter, it is necessary for the world to evolve as a single whole. This is, in Petronijević's opinion, very difficult, even impossible. However, this shows that, in contrast to most of his contemporaries (including Einstein and Eddington), he clearly preferred a finite origin of matter in the past, the solution which, as is well known, won the day in the end.

As for the Solar-System evolution, Petronijević prefers the hypothesis of Kant and Laplace about the common formation and, in its favour, he offers five proofs based on properties of the motion within the Solar System. However, he indicates hypotheses according to which some bodies from beyond the system (the outer space) were attracted by the gravitational force of the Sun, so that the hypothesis of a common Solar-System evolution is, according to him, very likely, but still not quite certain. In the case of stellar systems a common origin is more likely and there is no doubt that individual stars evolve. Different phases observed at the same time, as well as the physical structure of stars, appear as successive phases of their individual evolution. With respect to these successive phases Petronijević distinguishes seven groups of celestial bodies and also thinks that the individual evolution of every star is characterised by five crucial phases: of being nebulous, of being a star, of being Sun-like, planet-like and moon-like.

His explanation for the heat emission from the Sun is based on the gravitational contraction where the mechanical work, being a consequence of gravitation, is converted into heat. This approach originated with Lord Kelvin, and remained predominant in physical science until the advent of understanding of nuclear reactions.

For the evolution of chemical elements Petronijević says that there are three proofs only:

1. spectra of celestial bodies; 2. nebular hypothesis 3. coexistence of kindred elements in the Earth's crust.

According to Petronijević the evolutions of matter (substance), of force, and energy has a dubious basis. As for the evolution of the Earth, there are phases of cosmic, geologic, and climatic transformations.

In this book there is an example of an evolutional classification given by N. Lockyer whose field was, especially, the evolution of chemical elements based on stellar spectra. Following his philosophical views, as well as well-known scientific facts known at the time, Petronijević's cautious position is that Lockyer's point of view is very speculative.

To summarize, through his original and multifaceted creative studies in science and philosophy, Branislav Petronijević contributed immensely to the development of scientific thought in Serbia and Yugoslavia of his time. His works contain research in paleontology, evolutionary biology, psychology, mathematics, and philosophy, as well as various brief excursions in various other exact and descriptive sciences. In particular, his studies in mathematics and biology make a portrait of him as a polymath of the highest caliber. His "The Universal Evolution" presents a significant contribution to the philosophy of science, along the lines set by his distinguished precursors, Auguste Comte, Herbert Spencer, Thomas Henry Huxley, and, to a certain degree, Henri Bergson. In it, Petronijević strongly argues for a synthetic view of evolution encompassing both inorganic and organic worlds. In this, he was entirely on the track

of the most progressive thinking of his time (e.g. Bowler, 2003), which is not surprising, when his personal contacts and friendship with such distinguished evolutionary biologists of his time like Louis Dollo, Henry Fairfield Osborne, or Arthur Smith Woodward, are taken into account. For a modern view similar to Petronijević's in its scope and boldness, see for instance Chaisson (2001). Petronijević's uncompromising evolutionism is not only important in its historical context. Today, when the odious spectre of creationism (and anti-science in general) is rising again in the modern world (e.g. Pennock, 2003), we would do very well to return to the main lessons of his work, his deep understanding and trust in science, naturalism and rationalism, as well as his conviction - predating by some decades the famous phrase of Theodosius Dobzhansky - that nothing in the universe makes sense except in the light of evolution.

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