

Evolutionary education: an example from Russia

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The history of evolutionary theory development is a fascinating topic. Besides providing students with an array of historical information and personalities, it teaches them a scientific perception of the world. However, it is not always clear for them how to cope with a vast amount of information on the history of evolutionary thoughts provided in numerous textbooks. There should be a stamina, which would help them to arrange the information in a logical way as well to be ready for the perception of the new one. My practice of teaching the evolution at the university shows that the effective way to achieve good results is to go through the succeeding row of personalities and their theories by addressing three important questions. 1. What is the beginning of the Universe, and Life in particular? 2. Why is the Development going on? 3. How is the Development going on? Answers to these questions in Table format help students not only keep on following the thread of evolutionary theory development through the time. They also show the completeness and peculiarities of each particular theory, coupled with philosophical world perception of their authors. They also show, that a number of critique addresses to Darwin's theory do not have a substantial background. It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.
Ch. Darwin. 1859. "On the Origin of Species..." London: John Murray. Chapter XIV. P. 489-490.

Teaching the Evolutionary theory at the university is one of the necessary components in high education of Russian students. Earlier taught as rather dogmatic “Darwinism”, this class now provides a more creative and diverse material. Positive from one side, the pluralism gives an opportunity for some students to doubt the Darwinian Theory. Seeming freedom in expression of personal opinion often substitutes a real knowledge of the topic. Although the Evolutionary theory is usually taught among senior students, who already received a considerable amount of information in philosophy and natural sciences, it is essential to give them a right idea of structure and aim of the mentioned theory. This can be done using our original approach.

First of all, we travel through the history of Evolutionary theory. This is a fascinating topic. Besides providing students with an array of historical information and personalities, it teaches them a scientific perception of the world. However, it is not always clear to them how to cope with a vast amount of information on the history of evolutionary thoughts provided in numerous textbooks. There should be a stamina, which would help them to arrange the information in a logical way as well to be ready for the perception of the new one. Our practice of teaching the evolution at the university shows that the effective way to achieve good results is to go through the succeeding row of personalities and their theories by addressing three important questions. 1. What is the beginning of the Universe, and Life in particular? 2. Why is the Development going on? 3. How is the Development going on? Answers to these questions in table format help students keep on following the thread of evolutionary theory development through the time. They also show the completeness and peculiarities of each particular theory, coupled with philosophical world perception of their authors. The approach shows in particular, that a number of critique addresses to Darwin’s theory do not have a substantial

background. For example, certain authors criticize Darwin for not answering the second question, which was, for example, answered by Lamarck in his “Philosophie zoologique” (1809). The presence of so called “le pouvoir de la vie” (the complexifying force), which pushes organisms to become more complex, moving 'up' a ladder of progress, can not be scientifically proved, thus it was correctly abandoned by Darwin. The answer to the first question by Darwin is even more surprising. Often treated as atheist, he was not in reality such. The epigraph to this article shows his agnostic background, ideal for the scientist.

Going through evolutionary theories of the past, it is necessary to draw the students’ attention to the personalities of the authors. Their biographies can suitably be divided into three parts, according to the classification of Goethe: Schuljahre (years of study), Wanderjahre (years of traveling) and Meisterjahre (years of teaching). Only reaching the third stage in the life someone becomes able to formulate substantial philosophical theory, to which the Evolutionary theory belongs as a Philosophy of Life. Thus, someone, formulating something of the level of the Evolutionary theory must have a large amount of data coupled with the rich life experience. Students or even young scientists do not have both, in order to be good opponents in criticizing theories, produced by giants of the past. Even talented scientists, who made important contributions to the Evolutionary theory but did not have luck to live long enough to reach the third stage (f.i. famous Russian scientists C.F. Rouliev and V.O. Kovalevsky), did not leave anything of the level of Buffon, Lamarck, Cuvier, Darwin or Vernadsky. Therefore students must be first provided with as many facts as possible, which lie in the fundament of debated theory. Step-by-step study of Darwinian “On the Origin of Species...” helps to do that in relation to the Theory of Natural Selection, which reveals admirable logic and factual strength.

Surfing through the chapters of the book under the guidance of University teacher, students soon discover, that the secret of the astonishing success of the Theory resides on the literally gigantic amount of facts, surveyed by Darwin. He did not use dubious forces, such as the complexifying force of Lamarck, to explain the existing order of Nature. The strength of his theory is that it explains the diversity of life as the result of action of natural forces, which can be tested scientifically. The size of the book due to numerous incorporated facts often makes it hard for students to understand an amazing logic of the monograph. To show it is a main goal of the teacher (Zinoviev, 2005, 2009).

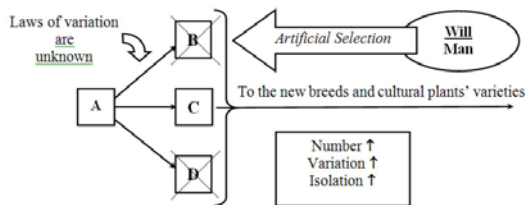


Fig. 1. Darwin's theory in relation to domestic animals and cultivated plants.

Trying to get an idea on patterns of changing and coadaptations of organisms, Darwin starts his analysis from domestic animals and cultivated plants. This is a very productive approach. First of all, humankind had already possessed a considerable amount of facts on this subject, which extended over many centuries. Many facts of selective work have been documented, thus having scientific value. Most of the audience, to which the Darwinian book has been addressed, has definitely had a better knowledge of domestic animals and cultivated plants. Therefore, something proved with facts from well-known field can be later transferred to the less-known subject according to the laws of logic and analogy. In Chapter 1, entitled "Variation under Domestication", Darwin, in fact, provides us with a full scheme of his theory, although applicable so far to domestic organisms. If drawn, it appears like that shown on the figure 1: descendants of individual A differ from each other due to the variation, causes of which were not known to Darwin.

Individual C, possessing certain useful characters, has been selected by men for further breeding. The higher number and variability of selected individuals along with isolation speed up the process of Artificial Selection.

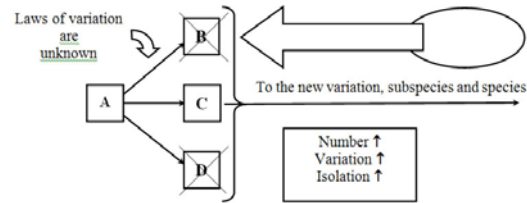


Fig. 2. Darwin's theory in relation to wild species (as shown in Chapter 2).

Following the same logic as in Chapter 1, Darwin then finds components of the similar scheme in nature. In Chapter 2 he proves the presence of variation in nature; the higher number and variability of individuals along with isolation is often linked with higher subspecific and specific diversity. The scheme is almost complete (fig. 2); only oval and arrow must be filled. What stands for the Human Will in nature? Struggle of Life or Struggle for Existence, shows Darwin in Chapter 3. Here he "...have called [the] principle, by which each slight variation, if useful, is preserved, by the term of Natural Selection, in order to mark its relation to man's power of selection". And finally, he finds the cause of Struggle for Existence – Geometrical Ratio of Increase. Thus, already in Chapter 3 Darwin fills all the positions of his logic scheme.

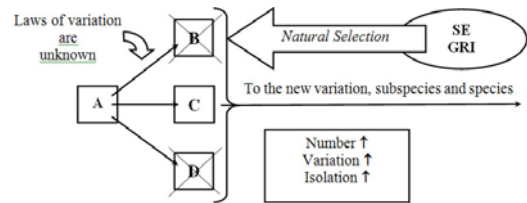


Fig. 3. The complete scheme of Darwin's theory in relation to wild species (as shown in Chapter 3): SE – struggle for existence, GRI – geometrical ratio of increase.

This logic in figural representation helps students to understand the rest of the book, which is quite voluminous. Explaining to the readers the term Natural Selection in Chapter 4, discussing laws of variation in

Chapter 5 and difficulties of theory in the following chapter (in later editions in two chapters, 6 and 7), Darwin convincingly shows, that most of the criticism against his theory arises due to either unprofessional readers (seeming difficulties) or absence of contemporaneous scientific data (actual, but not fatal difficulties). The rest of the book is simply a test of theory by different categories of facts (behavioral – Chapter 7; hybridizational – Chapter 8; paleontological – Chapters 9 and 10; geographical – Chapters 11 and 12; morphological and embryological – Chapter 13).

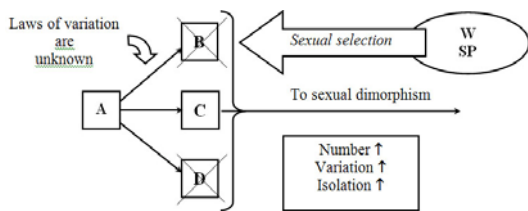


Fig. 4. Darwin's theory in relation to sexual dimorphism: SP – sexual partner, W – will.

The visualized logical scheme of Darwinian theory helps students to explain various categories of facts by action of natural forces. For example, the easily drawn scheme of Sexual Selection (fig. 4) explains the appearance and evolution of sexual dimorphism.

An amazing logic of Darwin's book makes the study of natural history more attractive. Knowing it, students do not see any more a number of unrelated facts, connected by dubious rules. They start reading them, like chapters of the book, in which in addition to heading the content appeared. No other theory gives such a simple instrument for understanding the organization and structure of life on the Earth.

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