



## 112 Years Since the Foundation of Soil Science and 110 Years Since the Foundation of the Soil Institute in Bulgaria



**Prof. Dr. Metodi Teoharov**

*“N.Pushkarov” Institute of Soil Science, Agrotechnologies  
and Plant Protection,*

*7 Shosse Bankya Str., Sofia 1331, Bulgaria*

*Corresponding Author: Metodi Teoharov, e-mail: [mteoharov@abv.bg](mailto:mteoharov@abv.bg)*

*Received: 17 March 2022*

*Accepted: 7 April 2022*

### **Abstract**

Historical soil science is called to analyze and evaluate realistically and critically the role of important dates and discoveries that determine the further development of soil science. Of particular importance for soil science is the first scientific and fundamental work of N. Pushkarov "Formation of the soil", published 112 years ago.

With the present work an analysis of the natural and philosophical-dialectical interpretations of his work related to the genesis of the soil is made. Pushkarov applies the genetic approach to the study of soils and refutes the so-called. agro-geological (geological) approach, which dominated at that time in world soil science. He makes an accurate and objective general assessment of the factors and conditions of soil formation and proves new knowledge of methodical and fundamental nature, which is applied in further research in the country. At the same time, facts are presented about the soil science or agro-geological section established by him in 1911, which performs the tasks for soil-cartographic research formulated by him. All this gives grounds to conclude that in 1909 N. Pushkarov laid the foundations of soil science in Bulgaria, and in 1911 he established a scientific-administrative unit (scientific organization at the section level) and laid the foundations of the Institute of Soil Science. .

**Keywords:** Nikola Pushkarov, soil science, soil science section, genetic approach, genesis, agro-geological bias, analysis and evaluation

### **Introduction**

Two important scientific events in Bulgarian soil science, related to the name of the great Bulgarian natural scientist, soil scientist, public figure, patriot and revolutionary Nikola Pushkarov deserve to be objectively analyzed and evaluated due to the fact that they are extremely important for the development of soil science we have. There are scientific and literary sources and facts about both events, which are irrefutable proof that one event has a purely scientific and fundamental character, and the other - scientific and administrative. It is difficult to say which of them is more important, as both have their place in the development of Bulgarian soil science. In the order of the search for historical truth and the requirements of science, it is right to give priority to the first scientific event, which aims to prove the genetic nature of the origin of the soil. In fact, this is the first scientific work of N. Pushkarov,

published in the journal "Natural Science", book 8, pp. 481-489, 1909-1910, which applies Dokuchaev's approach and principles for scientific consideration of soil and soil formation. It is an indisputable fact that with this work the science of soils in our country was born and founded. No less important is the second event, which with the establishment at the suggestion of Pushkarov of a scientific-administrative organization in 1911 (soil or agrogeological section) at the State Agricultural Experimental Station in Sofia, laid the foundations of the Soil Institute in Bulgaria. With the comprehensively developed research program, he began to conduct the first soil surveys throughout the country. The distinction between these two events in role and significance is obligatory in the name of historical truth.

### **What are the goals and objectives of this study?**

In connection with the above, the present study has the task to ask two important questions: First: to clarify the beginning of the founding of soil science in Bulgaria by studying the pedogenesis of Pushkarov and second: to distinguish this beginning from the time of the first scientific administrative unit. soil-geographical, soil-cartographic and soil-agrochemical studies in the country in 1911, which is incorrectly considered to be the birthplace of Bulgarian soil science. For this purpose, a thorough analysis and evaluation of the natural-scientific and philosophical-dialectical interpretations of his work, related to important for soil science, unexplained issues, namely: definition of soil, establishing its genesis, factors and conditions of soil formation, of the main and most general circular processes that take place in it and last but not least - upholding the genetic approach to the study and formation of soil.

### **Historical period of writing the scientific work by Pushkarov**

Pushkarov's scientific article is still relevant today and is of lasting importance for both Bulgarian and world soil science. It was written when world soil science sets and determines the approaches, methods and directions of development of soil science. It is dominated by the influence of agro-cultural chemists and agro-geologists, who develop the agro-cultural and agro-geological bias in soil science. As a geologist-naturalist, Pushkarov began his first research as such and contributed to the petrography of the high Balkans between the peaks of Yildiz Tabia and Vezhen in 1902. As a soil scientist, however, he later became a successor to the soil genetic approach then unknown in us (until 1902) and founded in 1883 in Russia (Dokuchaev, 1883; Pushkarov, 1909). This is clearly evident in his first scientific work in the field of soil science and soil geological essays, which he later developed.

### **Scientific analysis and evaluation of scientific labor**

The article, which is of fundamental importance for our science, begins with his famous thought "The ray gave life, and the earth - the material basis of this life." On this basis, he reveals some natural-genetic and his philosophical (dialectical) judgments about the identical nature of matter and motion, the vital motion of solar energy and earthly parts and the transformation of inanimate matter into living and vice versa. Describes the material (chemical) elements and compounds of living and non-living bodies - O, H, C, N, Fe, S, Ca, Mg, gases, oxides, acids and others that are the basis of soil formation of the earth's crust, respectively. soil and constantly enter into "new relationships" and "new groups".

What is Pushkarov's definition of soil? In metaphorical language, he gives a very interesting definition of the soil, namely, "The soil is the vast laboratory where the preparation

of dead matter takes place in order to enter the cycle of life. Soil is a living layer of the globe. Like a thin, delicate diaper, it covers the vast body of the earth and gradually spiritualizes that body. With this definition, Pushkarov approached the doctrine of the noosphere before Vernadsky (2009) created it. All these interpretations so far show that he considers the soil as a living biological system, as part of the biosphere, which is essentially a planetary phenomenon of a cosmic nature. Pushkarov gives a spiritual essence to the soil. Man, as part of the biosphere, is the one through whom every natural body on Earth can be spiritualized. Man is the thinking layer of the planet Earth and his role is to cultivate or destroy soils (Teoharov, 2017). It is noteworthy that Pushkarov emphasizes the role of chemistry and its thousands of evidences for studying the cycle of elements and substances and the eternal transition of living to inanimate matter and vice versa.

### **The role of conditions and factors in soil formation**

When describing the factors and conditions of soil formation, of course, as a geologist, he points out in the first place the importance of rocks in the course of soil formation processes, without defining them as a primary factor. For him, all factors and conditions are equally important in soil formation. Pushkarov believes that there is a constant exchange between the soil and the rock (hard crust) and the latter is the primary source of mineral composition and movement. He points out that the oxidation of minerals in nature is a process that takes place every minute. The result of this process are many metamorphic rocks and minerals. Therefore, the rocks form new rocks, and hence new modern soils. It takes into account the local nature of the rocks, which is still used as a diagnostic indicator at the generic taxonomic level in the classification of soils in almost all schools. According to Pushkarov, their local features may change under the influence of applied soils outside the location. As a representative example he gives the Cretaceous limestones covered with loess cover in the Danube plain. He considers the thick layers of rocks in the plain as former soil, which was carried away and deposited in the water basins gradually during the geological epochs. Later, our scientists confirmed the spread under the loess of the so-called. buried soils (Minkov, 1968). Considering the question in this way, it can be concluded that much earlier than other scientists, in practice, he indirectly came to the theory of large and small geological (biological) cycle of elements and substances. In his further work in soil-cartographic research, Pushkarov described in detail the influence of rocks on soil formation and linked geological processes with soil-forming. This is proof of the extensive training he achieved in the early years, thanks to the fact that he had the opportunity to be guided, scientifically and critically evaluated by his professor, Academician Georgi Bonchev - the first Bulgarian petrographer and mineralogist. Along with him and other geologists, he was one of the founders of the Bulgarian Geological Society (Kolarova, 1959). Even today, soil science cannot develop without the knowledge of petrography, mineralogy and geochemistry, and Pushkarov applied these sciences in soil science with great competence. He considers the flora and fauna as important sources and factors for the formation of the soil (after the rocks). He called animals in the soil "organized inhabitants", noting some living organisms that are an integral part of it, without which it loses much of its basic character - to serve as a link between dead and living matter. It also emphasizes the biochemical, physical and physico-chemical factors of soil and nature. Pushkarov connects organisms (lower, higher), the root system of plants, organic residues, water and temperature with weathering (rock breaking)

and soil formation processes. He points out the role of water (atmospheric, rain, flowing, local, erosional) on weathering and soil formation, its composition and movement, mechanical and physical impact on minerals, rocks and organic matter. Some of his thoughts on its significance for the pedosphere, flora and fauna deserve attention. "The soil is the upper layer of the earth's crust, where the roots of plants are located and where animals find shelter and food. Soil that does not contain water is dead soil. It is the only solvent from which plants can draw mineral salts for their growth. Pushkarov describes its role in the formation of various geomorphological forms, and thus changes in the earth's surface, in general relief and topography. His example from the Balkans is remarkable, where he points out that "with its centuries-old work the water has cut the Balkan Mountains". He pays special attention to the movement of winds, emphasizing that it is the strong winds that polish and give different shapes to the rocks. As typical examples he points out the Belogradchik rocks, those along the Iskar gorge, the Stone forest near Gebedje and others. In this way he indirectly defends the "Aeolian hypothesis" for the formation of the most fertile fields in Europe - the Danube, Rhine, Yellow River and others. Pushkarov, albeit briefly, addresses the issue of anthropogenic activity and changes in its soil. Using folk memory, he gives a concrete example of the degradation of soil by man. He writes: "Old people claim that the Slivnitsa and Dragoman heights were covered with forests and after the destruction of the latter nothing can grow on the bare rock." Later, Acad. Ivan Stranski confirmed the same processes of deforestation and anthropogenic transformation of soils that took place after the felling of oak forests in the Sofia field.

The analysis of the scientific work shows that Pushkarov strictly methodically and consistently applies the genetic approach in the study of genesis (soil origin). Almost all of his views are further embedded as an alphabetical truth in a number of works, textbooks and manuals.

### **How does the agrogeological field of soil science study the genesis of soils at the same time?**

This work appears to be fundamental in the science of soils in Bulgaria. We will take advantage of additional facts proving its scientific and fundamental importance. To this end, we will make a brief comparative analysis of the approaches applied at the same time by some other soil schools. We will not dwell on the Dokuchaev doctrine, which, as we know, applies the genetic approach to the study of soils and its influence, albeit at a later stage, on world soil science. When Pushkarov published his work, the agro-cultural and agro-geological direction of studying the genesis of soils developed in Germany, which spread to a number of countries in Europe and America (Gerasimov, 1985). At the beginning of the twentieth century, some scientists in our country adhered to these approaches, without having in-depth developments (P. Berov - agronomist and G. Bonchev - geologist). It is important to know that agrogeology considers the soil as a geological formation, inert body, weathering material, which contains nutrients obtained from weathering of rocks. According to agrogeologists, the soil is considered as a weathering crust, and the process of soil formation - as a process of weathering (Gyurov, Kolcheva, 1969). In 1922, the Third International Conference on Pedology was held in Prague, attended by 14 countries, incl. and USA. It decided to detach soil science from the agrogeological slope and adopted the Dokuchaev approach to the study of soils (Stranski, 1946; Teoharov, 2016). Thus, the genetic approach to the study of

pedogenesis began to dominate in world soil science and factor-process, profile-evolutionary, horizon-profile, profile-specific (process) and evolutionary diagnostics of soils gradually became established; Clayden B. and JMHollis, 1984; Aubert G., 1988; Shishov et al., 2004; FAO, 2014). All this is proof of the relevance of Pushkarov's scientific work and its enduring significance. Through it he proves new knowledge of a fundamental nature, making an objective assessment of the main factors and conditions of soil formation that determine the genesis of soils and thus refutes in theory and practice the agrogeological approach in soil science. Thus Pushkarov, through this work, appeared as the founder of soil science in Bulgaria in 1909. Without making a detailed analysis, a similar opinion was expressed by Prof. E. Kolarova (1959). She writes: "In our opinion, this is the first article that scientifically examines the issues of soil and soil formation in our special literature. Moreover, this scientific article was written at the level of science not only at that time, but also of modern science - soil science. It is inexplicable why no one pays attention to this scientific assessment of Pushkarov's work, and all soil scientists point to 1911 as the "birth" of Bulgarian soil science. Another cardinal question arises from the exposition made - What was then the year of birth of Bulgarian soil science - 1909 or 1911? The annual report for 1910-1911 of the State Agricultural Experimental Station - Sofia reads as follows: "Ministry of Trade and Agriculture, aware of the great need for comprehensive study of soils in the country opened a new section at the station, very important for our agriculture agrogeological, appointing on 17.09. the same year and a person with the appropriate preparation for its filing "(Naidenov, 1913). This person is Nikola Pushkarov, who makes a proposal to the Minister to open a section on soil science. In practice, the section headed by Pushkarov is a scientific-administrative unit with an independent plan and tasks. In the reports on its activity he develops and sets for implementation the following program tasks: 1. Systematic study of soils by regions, for which purpose geological, biological and climatic data are collected and the collected samples are analyzed chemically and physically. 2. Finding out the reasons for the change of the properties of the soils in a given place and indicating as much as possible the means for elimination of the adverse phenomena. 3. Making maps for the studied areas. With their general formulation, these program tasks are still relevant today. These tasks give us reason to believe that they are strictly fundamental and applied. These are well-formulated tasks with a visible perspective for obtaining new knowledge and solutions for practice. They were adopted by the Ministry of Trade and Agriculture and their implementation began immediately. In 1913 the first soil-geological sketch with agrogeological map in M 1: 26000 for the Sofia field was printed, developed independently by Pushkarov. According to Acad. Gerasimov (1985), the essay "is a valuable scientific monograph". In this work the opinion about the soil as a product of the combined influence of a number of natural factors is developed, which he clarifies in his work "Soil formation". Acad. Gerasimov also notes that this opinion is much broader and correct than previous agrogeological ideas in soil science.

### Conclusion

"Soil formation" is the first scientific work in Bulgaria, in which Pushkarov clarifies the genesis and nature of soils, sets the principles of the genetic approach to their study and refutes the agrogeological (geological) direction in soil science. He makes an accurate and objective assessment of the conditions and factors of soil formation and proves new



knowledge of a methodical and fundamental nature, which still has its current relevance. With the developed program tasks and the soil science section created on his proposal, he applies this approach and the new knowledge in science and practice. All this is proof that Pushkarov founded soil science in 1909, and through the scientific and administrative organization he created at the section level in 1911, he laid the foundations of the Institute of Soil Science.

## References

- Vernadsky V.I. (2009). *Scientific thought as a planetary phenomenon*. Ed. Acad. S. Ganovski, S., 246 p.
- Gerasimov, I. (1985). *Fundamental scientific problems of modern Dokuchaev soil science*. Zemizdat, S., 92 p. (in Bulgarian)
- Gurov G., Kolcheva, B. (1969). *Soil science*. Ed. Hr. G. Danov, Plovdiv, 368 p. (in Bulgarian)
- Dokuchaev, V.V. (2008). *Russian chernozem*. Ed. Russian Collection, St. Petersburg, 473 p. (in Russian)
- Kolarova, E. (1959). Essay on the life and scientific activity of NP Pushkarov. In: *Nikola Petkov Pushkarov*, Izd.BAN, S., 11-26. (in Bulgarian)
- Minkov, M. (1968). The fate of Northern Bulgaria. Ed. BAS, 2020 p. (in Bulgarian)
- Naidenov, V. (1913). Annual report of the station for 1910 and 1911. G. Gavazov Printing House, Sofia, 57 p. (in Bulgarian)
- Pushkarov, N. (1909-1910). Soil formation. *Mr. Natural Science*, Book 8, 481-489 (in Bulgarian)
- Stranski, Iv. (1946). *Soil Science*. University Printing House, Sofia, 585 p. (in Bulgarian)
- Stranski, Iv. (1974). The Black Soils of Sofia. In: Ivan Stranski - *Selected works*, ed. BAS, S., 11-59. (in Bulgarian)
- Teoharov, M. (2017). Soil science - the science of the past, present and future. In: *World Soil Day, December 5, 2016*. Ed. BPD, S., 18-34 (in Bulgarian)
- Shishov, L.L., Tonkonogov V.D., Lebedeva I.I., Gerasimova, M.I. (2004). *Classification of soils in Russia*. Smolensk, Oikumena, 343 p. (in Russian)
- Aubert G. (1988). *Referentiel Pedologique Francais*. Orleans, 2nd Proposition, INRA, 251p.
- Clayden, B. and Hollis, J.M. (1984). *Criteria for differentiating soil series*. Technical monograph, N 17, Harpenden, 159 p.
- FAO, (2014). *World reference base for soil resources*. By: IUSS-ISRIC-FAO, World soil resources reports, N 103, Rome, 203 p.