



## Soil Science – Science of Past, Present and Future

**Metodi Teoharov**

*President of Bulgarian Soil Science Society  
1331 Sofia, 7 Shosse Bankya str.*

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



### **Abstract**

The present study includes a detailed analysis on the past, present and future of the soil science in the Bulgaria and over the world. Soil science entered in the cycle of scientific discipline serving practice when in 1883 the famous Russian scientist V.V.Dokuchaev established regularities of soil formation. Since then it has emerged as an important branch of biological science and it has become a science of undoubtedly great for public importance. There are different periods how it was developed in Bulgaria and it the rest of the world. In third period is examined Vernadski's concept of the Noosphere and relationship with soil science and how "the thoughtful layer of the planet" can repairs the consequences of the Technosphere and Anthropocentris.

**Key words:** Soil science, development, periods, world schools, FAO-classification, WRBSR, Noosphere, Technosphere and Anthropocentris.

### **The Beginning**

#### **Dokuchaev – Founder of the World Genetic Soil Science**



*V.V. Dokuchaev  
1846 - 1903*

The science of soils was founded under the name pedology by the world-famous Russian soil scientist V.V. Dokuchaev 133 years ago - after he wrote the major work "Russian Chernozem" in 1883. In it he proved the genetic origin of soils and the regularities of their distribution. Dokuchaev wrote that "the soils are the result of extremely complicated interaction of the local climate, the plant and animal organisms, the composition and structure of the parent rock and in the end the age of the country". His scientific ideas were very fast supported first in Europe and then in America. Thus the end of the 19th century and the beginning of the 20th century became an active period for the soil scientists in a number of countries. The first teams of scientists and national schools were created and



*N. Poushkarov*  
1874 - 1943

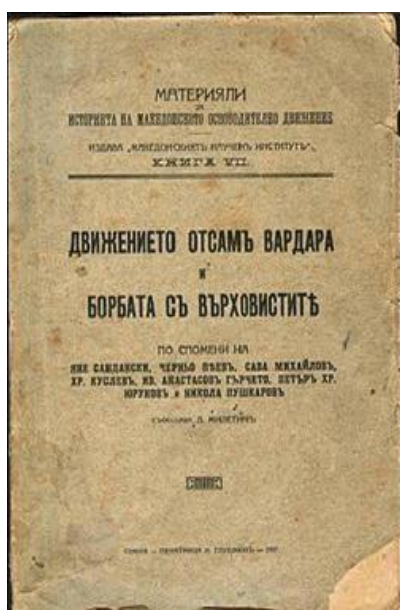
Revolutionary Committee of Skopje. His love to geology and soil science made him collect rock samples in his rucksack while he was hiking around the mountains, carrying bombs and bullets on him (Teoharov, 2011). Historical archives show that his revolutionary, cultural, educational, pedagogical, researching and publishing activities were really substantial. The top of his deals was his scientific works, in which he consigned a lot of labour, ideas, heart and talent, which are important for all generations to come.

they began to investigate the soil resources of their countries. Dokuchaev's study was later accepted by scientists from all over the world.

### **Pushkarov – Founder of Bulgarian Soil Science**

In our country the founder of soil science was the great public figure, patriot and enlightener Nikola Pushkarov. Before writing his fundamental work "Formation of Soils" in 1909 and creating a soil science (agro-geological) section to the State Agriculture Station in Sofia in 1911, his life was linked with that of the so called Macedonian Levski – Gotse Delchev and the struggle for liberation of

## **Development of Soil Science in the First Half of the 20th Century in Europe and America**



At the time when Puskarov was fighting for unification of the land of Bulgaria, a successful attempt for soil-grouping on a genetic principle was made in Germany. Nevertheless, the agro-geological soil science, which regards the soil as a purely geological formation was developed as an alternative of the genetic soil science. The soil scientists in France accepted a lot of the Dokuchaev's concepts, terms and ideas and published their first national soil map in 1838. In 1927 in America the first taxonomic grouping of the soils from Marbut was also made and it corresponded to the genetic soil types, introduced by Dokuchaev. The new doctrine quickly brought scientists in Europe together and soil science was acknowledged as an agronomical science. Scientists began organizing and conducting a number of scientific conferences and congresses in the countries of advanced economies and scientific activities.

**TABLE 21.2 : Marbut's system of soil classification**

Soil order	Sub-order	Soil group
I. ZONAL SOIL	1. Arctic pedalfers 2. Temperate pealfers	1. Tundra soil 1. Podsol soils 2. Brown and grey podsollic soils
(a) Pedalfers	3. Tropical pedalfers	1. Yellow and red podsollic soils 2. Laterite soils
(b) Pedocals	4. Transition pedalfers 1. Temperate pedocals	1. Degraded chernozem soils 1. Chernozem soils 2. Chestnut soil
II. INTRAZONAL SOIL	2. Tropical pedocals	1. Brown soils 2. Desert soils
	1. Halomorphie 2. Hydromorphie	1. Saline and alkaline soils 1. Bog or marsh soil 2. Meadow soils
III. AZONAL SOIL	3. Calomorphie Or Calcimorphie	1. Rendizine soils 2. Brown forest soils 1. Lithosols 2. Regosols (dry sands) 1. Alluvial soils

### First International Conferences and Congresses

An international contact of soil scientists was first established in 1908, when Russian, Hungarian and Rumanian scientists got together and planned the organization of joint scientific excursions. They decided to hold the first international forum in Hungary. In 1909 the First International Agronomical Pedology Conference was held in Budapest. In 1910 in Stockholm at the Second International Pedology Conference a decision was made to publish an international soil science journal which was released in 1911. The First World War brought the international scientific activity to a stop and the Third International Pedology Conference was not held until 1922 in Prague, where 14 countries participated, including the USA. At this conference the soil science broke away from the geological trend and fully accepted Dokuchaev's genetic approach to soil studies. After a decision made by a commission of soil scientists in Zurich in 1923, at the Forth International Agronomical Conference in Rome, which turned into a Congress (1924), important decisions were made for the further development of soil science. The name pedology was abandoned and replaced by "soil science" (Stranski, 1946). The conference was attended by 340 delegates from different countries.



*Agronomical Pedology Conference held in Budapest 1911.*

## Foundation of the International Association of Soil Scientists

At the same time The Forth Congress founded the International Association of Soil Scientists, which is a predecessor of today's International Union of Soil Scientists. Until the Second World the Association held three congresses – in Washington (1927), where the first American soil classification was adopted under the presidency of the Russian soil scientist Glinka; in Leningrad (1930), where the Russian soil scientists suggested the sequential improved classification of the methods of soil research and some other organizational problems, as Association already included 1228 soil scientists. On the eve of the Second World War the International Association interrupted the scientific progress again.

## How Bulgarian Soil Science Had Developed until That Period



*Academician Georgy Bonchev  
1866 - 1955*

Academician Georgi Bonchev. Furthermore Pushkarov himself was a geologist, too. Nevertheless, it is seen in his works that in ideas and contents he was a convinced follower of Dokuchaev's genetic soil science, which makes him a scientist of world recognition and significance.

Bulgarian Soil Science School owes its development to a lot of talented soil scientists being influenced by leading national and international schools.

Our first soil scientist Nikola Pushkarov was a follower of the German school as he specialized with the German professor Raman for a year and a half. Raman was the creator of the first soil classification in Germany. Pushkarov adopted the ideas and contents of the genetic approach for soil research but until 1922 he formed the titles of his works by agro-geological terminology. (Soil-Geological Description of the Sofia Field (1913), Soil-Geological Sketch of the Pirdop Administrative District (1920). Naturally Pushkarov did not only experience the influence of the leading schools, but he was also influenced by his Bulgarian mentor – the famous geologist

## Pushkarov's Contribution to Soil Science



*House of N. Poushkarov*

Pushkarov developed the first program for large-scale soil research in Bulgaria and also the first soil classification and land evaluation by types. He revealed the regularities and geographical distribution of soils; he applied differentiated approach to the agronomical suitability of soils and the increase of their

fertility. Pushkarov also created the first National Soil Map (1931) in Scale 1:500000 in Bulgarian and German language at a time when even most developed countries did not have one. The map, which he published at his own



*Chernozem profile*

expense and which he had to pay for all his life, is a great achievement not only for our national science but also for the European one, as it was later used by Shtreme (1935) for the design of the first European Soil Map. It must definitely be pointed out that the period 1911-1943 (1943 being the year of Pushkarov death) is evaluated by world-famous scientists as a very successful stage for Bulgarian soil science.

## **Soil Science in the Second Half of the XXth Century**

After the Second World War the soil science in the world developed at a greater speed according to the status of the economies of the different countries. Although the world was separated into two political systems the soil scientists were united in the design and application of science-based methods and decisions, aiming at rational use and conservation of soil resources and solving the problem of supplies. Proofs of that fact are the constant business contacts and the development and execution of joint scientific projects and programs.

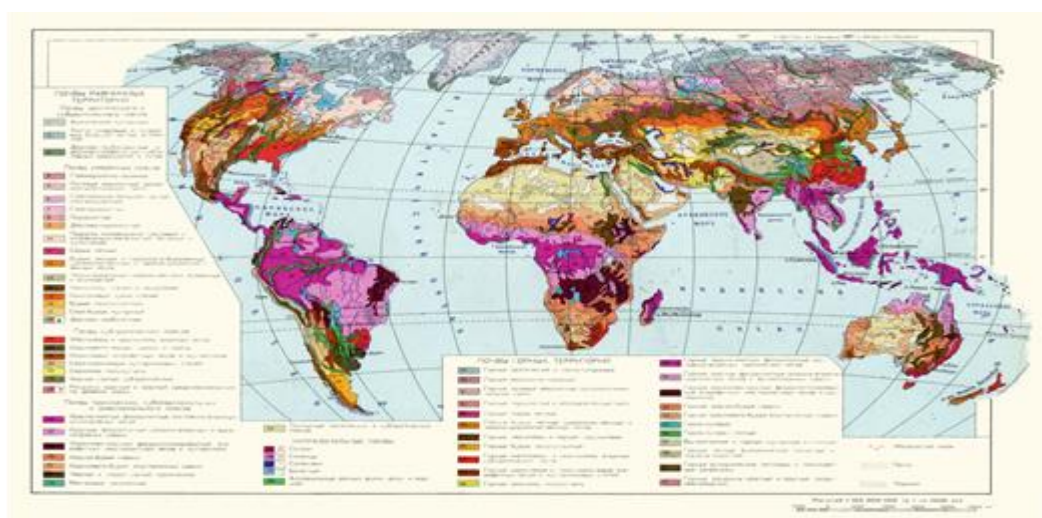


*Soil Science – The base of modern agriculture*

The most important thing is the appearance of the new concept of the noosphere and its influence on reasonable use of the natural resources, including the soils, which reflects the unobserved progress of the soil science in Europe and in the world. Dozens of international conferences and 20 congresses were held in different cities of the world. Their technical achievements were used in the adoption of a lot of inter-government, inter-state and international conventions and agreements for conservation of the soil and land resources and the biodiversity of the planet.

## First Soil Map of the World

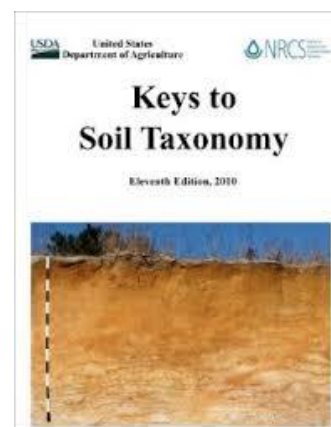
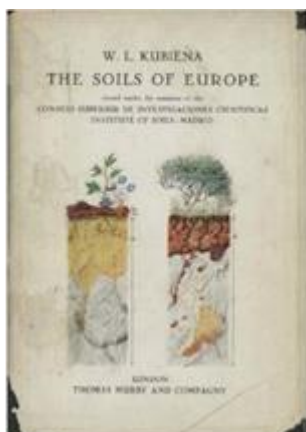
The First World Soil Map was published in the Soviet Union in 1954 and it was successively improved in 1955 and 1974. It was used for the development of the next two maps of soil grouping of FAO. In more recent times the scientists in Europe have developed the European and World Charter of Soil. At this moment soil scientists are conducting a European petition (People 4 Soil) for adoption European Charter. The UN declared 5th December as a World Day of Soil and 2015 as an International Year of Soil, which is a great achievement for the UN, accomplished thanks to the enormous work of the national societies and the International Council of Soil Science.



*Soil Map of the world*

## The Leading Role of the World Schools

The soil systematic and classifications of Shtreme (1950) and of Kubiena (1950) include plenty of interesting and valuable research of the genesis, composition, properties and geographic distribution of European soils. The French soil scientists under the leadership of Prof. Duchaufour (1965) and Prof. Aubert (1967) successively improved the soil systematics and later, in 1988 they published the French Referential Base of Soils, which comprised the latest achievements of Russian, European and world soil science. In 1977 under the methodical leadership of Academician Kovda and Academician Gerasimov the new and improved Russian classification was published. In the USA Prof. Guy Smith and Prof. Arnold continued to improve the soil taxonomy and it underwent several editions (Soil Taxonomy, 1990). After 1990 Prof. Arnold, who is a respected scientist in Southeast Europe, was admitted as member of the Editorial board of the international Russian journal.



Soil Science. Soil scientists from leading schools (including Bulgaria) conduct research of soils on all continents.

### FAO Classification – Great World Scientific Achievement



The results of the conducted research throughout the world are the basis of the successively designed and improved world soil maps and the grouping of soils in so called FAO Legend (1964). In this first version of the FAO soil system 37 soil groups are includes, 24 of which were taken from the Russian classification. This version underwent several editions until the World Referential Base of Soil Resources was developed and after several successive congresses it was

adopted and published in 1998 by the XVI congress in Montpellier, France. New two actualized versions are published in 2006 and 2014.

### Bulgarian Soil Scientists – Co-organizers and Participants in the Development of the World Referential Base of Soils



Academician Ivan Stranski  
1886 - 1959

Bulgarian soil scientists had a serious contribution in its development. They had the chance and opportunity to unite the efforts of the international soil science community by a decision of the FAO, UNESCO, UNEP and the International Organization of Soil Scientists. FAO authorized Prof. Fridland as their representative and coordinator to organize workshops in Bulgaria. Thus the basic principal concepts of the FAO classification were set and developed at three successive workshops in Pushkarov Institute in 1980, 1981, and 1983. To deserve such trust Pushkarov Institute under the leadership of



Prof. Ivan Garbuchev turned into a research and educational centre of rich material and technical base and hundreds of talented scientists – both Bulgarian and foreign, so Bulgarian soil science was recognized as one of the best developed in the world. It was working in favor of the national and world soil science and it was a basic factor for the progress in agriculture. So as to reach this appreciation a great research activity was conducted in Bulgaria and dozens of international science events were held here. Bulgarian soil scientists had a very successful cooperation with Russian, French, German, Dutch, Czech, Slovakian, Hungarian, Polish and Belgian soil scientists.

*Soil Expedition by* prof. V. Koinov, prof. N. Ninov, prof. G. Gurov, prof. Hr. Trashliev

### **Bulgarian-Soviet Soil Expedition. Nationally Important Scientific Achievements of Bulgarian Soil Science**



Academician  
I. P. Gerasimov  
1905 - 1985

In 1947 a Bulgarian-Soviet soil expedition under the leadership of the academicians I.N.Antipov-Karataev and I.P.Gerasimov was conducted. Modern diagnostics and classification of soils was developed and “Soils in Bulgaria” (1960) - the first modern and comprehensive academic work in the area of soil science was published. It played a significant role in the science-based agro-productive zoning of agricultural crops in Bulgaria.

The country was covered by large-scale soil research in Scale 1: 25000 и 1:10000. Soil-climatic and agro-chemical characteristics with cartograms and specific technological solutions for agriculture were developed for every land area in the country. New methods for categorization of agricultural land were adopted and land evaluation of the total soil and land resource was performed. The first agro-ecological map was created and the first agricultural zoning of Bulgaria was done. Two national maps in Scale 1:500000 и 1:200000 (Tanov, 1956), (Koinov, et al., 1968) were designed. Three versions of the Bulgarian classification were successively updated by Koinov, et al. (1964), Yolevski, et al. (1983) and Penkov, et al. (1992). Harmonization of the diagnostics and correlations of Bulgarian soils with leading international and world



Academician  
Antipov – Karataev  
1888 - 1965





The rich scientific information accumulated by 1998 is constantly used under the current economic conditions but it must necessarily be updated. Why? Over the last three decades the ecological and agrarian culture has been developing in some aspects and degrading in others. Soils have been degrading, too.

### **Soils in Bulgaria and world - under Anthropogenic and Technogenic Pressure**



Soils and land in areas of intensive agricultural and industrial production are mostly subjected to a great anthropogenic and technogenic pressure – a phenomenon, which is characteristic not only of Bulgaria but of the entire world. That is why in Bulgarian and in FAO classifications new soils appeared – Anthropogenic and Technogenic ones (WRBSB, 2006). A new era, called Anthropocentris, was introduced into the geological science. These are serious indicators above all of Man's influence on the changes in soils and land, which include the reduction of the organic carbon on the planet, acceleration of the processes of dehumification, contamination and degradation of soils, disturbance of their natural status, structure, properties, qualities and nutrition balance. The erroneous systems of cultivation, ameliorations and plant protection methods accelerate those unfavorable processes.

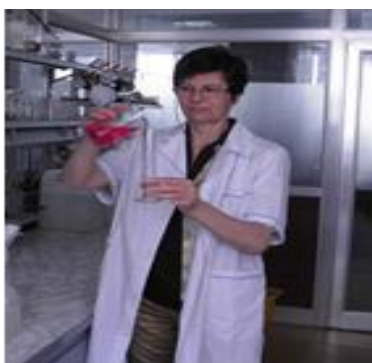
*Technogenic profile*

### **Necessity of the Application of Agro-chemical and Agro-ecological Control**



*ISSAPP "N. Poushkarov"*

The necessity of restoration and application of the agro-chemical and agro-ecological control requiring state support is more than obligatory because of the fact that traditional principles and norms of the agricultural production and the use of soil resources are broken.



The state must trust the soil science, which, in spite of the crisis it is in, still has the necessary potential to suggest modern methods and to limit the unfavorable trends. To that purpose the scientific and above all managerial and state subject do need a new way of thinking, new ideas and a new approach for application of the scientific achievements.

*Agro-chemical and agroecological analysis – chemist R. Sechkova*

## The Future

### Academician Vernadski's Concept of the Noosphere and Its Relationship with Soil Science



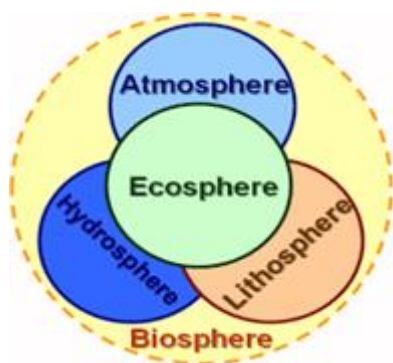
Academician V. Vernadski  
1863 - 1945

The future belongs to the study of the noosphere, which is unbreakably linked with soil science. The creation of this new science by Acad. Vernadski, who is a follower and student of Dokuchaev's and the application of the noogenetic approach of management of every natural and human resource lies at the basis of every useful decision. This is a study for the sense and conscience of Man and also for his well-designed, reasonable and conscious ideas and actions and also of his badly-designed, unreasonable, thoughtless and destructive ones, which change the biosphere, mankind and the Earth. According to Vernadski "we live in an unprecedentedly new geological epoch, the man with his work and his conscious attitude to life remodels the Earth cover, the geological area of life, the biosphere. He turns the Earth into a new geological status. Through his labour and conscience the biosphere becomes noosphere. Noosphere is not fiction, it is not creating belief, and it is empiric generalization". These thoughts of his - namely that Man as a part of the biosphere using his intelligent activity can save and prevent the Earth of destruction and cataclysms, are adopted by Bulgarian scientists, too (Nikolov, 2013; Kostov, 2013).

### The Noosphere Repairs the Consequences of the Technosphere and the Anthropocentris



Defending Vernadski's study the French scientist Teilhard de Chardin (1994) wrote in his book "Human Phenomenon" that "Man is not centre of the Universe, he is the thoughtful layer of the planet." These two humanistic scientists and their followers believed that „our counteraction to the regularities of the noosphere must not be expressed by despair but by reconsideration of ourselves" (Nikolov, 2013). All this obliges us to do research not only in the genesis of soils, but also in the noogenesis of Man and his role in conservation or destruction of soil resources. In the last decade soils have continuously and intensively been subjected to the impact of human activity. "Human activity changes the climate and nature, it converts soils, and for good or evil – it changes us." (Teoharov, 2011). Soil is the basic and major component of the Earth's ecosystem and the biosphere and as well as climate does, it changes very fast, but



not without Man' participation. The unreasonable and irresponsible statements and actions of some factors have recently attributed a political profile of the degraded and contaminated soils.

*Planet Earth - call for reason, harmony and fertility.*

## **Modern Man and the Consequences of the Technosphere and the Anthropocentris**



*International Soil Expedition*



*Food security problem - the main priority for the humanity*

Modern Man builds up, contaminates and disturbs the integrity and basic functions of soil. However, it is a living system with a life-giving power – a unique natural resource, which creates and preserves material goods and spiritual values for the Man himself. Soil preserves the historical memory of civilizations. A proof of that is the archeological excavations in the country and the center of Sofia, where antique objects, Roman and Thracian gold treasures, etc., are found at depth of only 2-3 meters. The lack of knowledge of the functions and essence of soils removes Man not only from the habitat where soil is formed and lives on, but from Man's own habitat.

Soils are a part of the biosphere and Man should evaluate his actions towards them. We share the opinion that it is time for the noosphere to conquer the minds of modern societies and the conservative rationality to take control of the soil and human resources. The indulgent, non-scientific and liberal attitude to these resources is disastrous. The intensive development of agriculture and industry, which soils cannot bear any longer, will lead to an ecological catastrophe of the planet.

***The nature of Man becomes a problem not only for soil and nature itself but also and for the man himself.*** Noosphere is a study, which may compensate for the consequences of human activity, the technosphere and the anthropocentris, if only the words of the first soil

scientists, said as early as 1909, are never forgotten: “Soil is that huge laboratory, where the preparation of the dead matter takes place, so that it can enter the blood circulation of life; soil is, so to speak, the living layer of the Earth’s globe. As a thin gentle diaper it covers the enormous body of the Earth and gradually spiritualizes this body”. Are these thoughts not the first signs for the appearance of the science of the noosphere in Bulgaria even before Vernadski himself created it? It is necessary for all Bulgarian scientists to continue the discussion with Academician Vernadski’s followers and to consider and take care of soil as if it were a little baby, covered in diaper and embraced by Mother Land.

***The thoughtful layer of the Earth planet is summoned to protect and preserve the living layer of the globe.***

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