

STEPAN POZNIAK*, NATALIA HAVRYSH**

SOILS IN THE MEMORY OF WORLD NATIONS

Received: 16.11.2018

Accepted: 22.01.2019

Abstract. The most important feature of the primary accumulation of different facts about the properties of soils, their fertility and ways of cultivation is the human awareness of soil as the environment of growth and development of plants, as well as the existence of a large variety of soils and the need for their differentiated use in the agriculture and different taxation systems. Monuments are important in the case of careful treatment and conservation of natural objects, including soils. Monuments to soils have been preserved in ancient writings – Egyptian papyri and steles, chronicles, maps, etc. Taking into account the importance of chernozem for nature and for humans as well, a number of monuments, scientific works, fiction, or poems are devoted to this particular type of soil. There are also announced “years of chernozem”, indicating it as the standard of excellence in the world soils. Analysis of the development of soil science has shown that it has a long history, from ancient times to the present day. The main idea is that soil plays an important role both for nature and humanity. An important task of modern society is a reasonable approach towards the soil and preservation of natural soil objects.

Keywords: soil, chernozem, natural monuments

* Ivan Franko National University of Lviv, Department of Soil Science and Soil Geography, Doroshenka St. 41, 79000, Lviv, Ukraine. Corresponding author’s e-mail: stepan.pozniak@lnu.edu.ua

** National University “Odessa Law Academy”, Department of Agricultural, Land and Environmental Law, Pionerska St. 2, 65009, Odessa, Ukraine. E-mail: natahavrysh@gmail.com

INTRODUCTION

The history of knowledge about soils is several thousand years old. It contains a lot of interesting and important information, as it is inextricably associated with the development of agriculture and humanity in general. Soil has always been and still remains the most important driving force of society's progress across the centuries.

The most important feature of the primary accumulation of different facts about the properties of soils, their fertility and ways of cultivation is the human awareness of soil as the environment of growth and development of plants, as well as the existence of a large variety of soils and the need for their differentiated use in the agriculture and different taxation systems.

RESULTS AND DISCUSSION

The most valuable monuments of writing system of ancient times include Egyptian papyri and steles, in which the qualitative characteristics of soils are presented. In another ancient document – the chronicle of the 25th century BC, carved on a diorite slab (Palermo Stone) which is held in the museum in Palermo (Italy) – various arable soils, “uncultivated soils”, “soils on the edge of the desert”, “soils for a large vineyard” are mentioned many times (Fig. 1). It is written on the papyrus of the Brooklyn Museum that the second person after Pharaoh in the state was responsible for cases “about arable lands” (Fig. 2).

In 1902, the French archaeological expedition found the basalt column, which is now stored in the Louvre. Laws of the king of Babylon Hammurabi (1792–1750 BC) are carved on this column (Fig. 3). One of the laws deals with the protection of irrigated soils. On the clay slabs there were preserved plans for land management and irrigation canals projects.

It is important to mention one of the seven wonders of the Ancient World, namely the legendary Hanging Gardens of Babylon of the Assyrian queen Sennacherib or Shammuramat (9th century BC). According to the legend, they were built on artificial terraces, where the shallow ground was placed, and then decorative and fruit trees were planted. The soil of the gardens was artificially irrigated. On the queen's tomb it is carved the following inscription: “I made the rivers flow around my possessions for fertilizing the lands that were previously uninhabited and infertile”.

With the development of Greco-Roman civilization (8th century BC – 3rd century AD), which was characterized by the intensive development of agriculture, sciences and arts, knowledge of soils acquired the form of some generalizations and concepts within the framework of philosophy and religion, as documented in the treatises of Greek (Hesiod, Theophrastus, Eratosthenes) and



Fig. 1. The Palermo Stone (reconstruction)



Fig. 3. The column with laws of the king of Babylon, Hammurabi

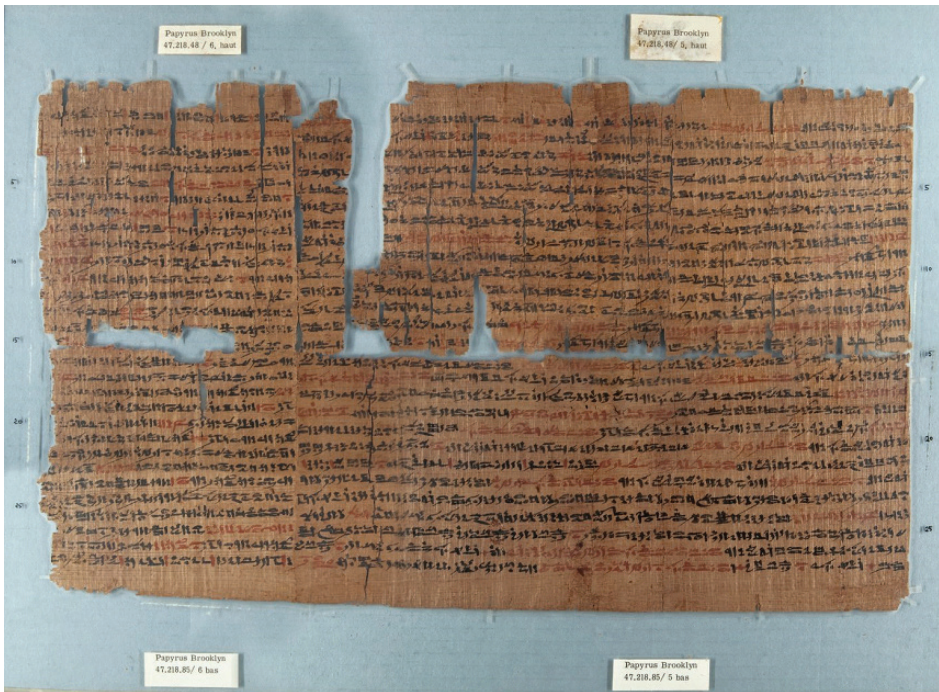


Fig. 2. The Brooklyn papyrus

Roman (Cato, Varro, Virgil, Columella) philosophers. In particular, a detailed description of the geography of soils of different territories and their peculiarities is given as a result of the application of various systems of agriculture (Herodotus, Strabo). There was also published the first classification of soils as to their properties and value (Columella). Recommendations on the use of various ore soils in agriculture were developed, and for the first time, methods of fertilizing the soil (Varro, Columella) were described (Krupenikov 1981).

16th–17th-century unification of official land cadastres – the *Geoponica* in the Byzantine Empire, *Pistsev Books* in Russia, land-valuation acts in the countries of Western Europe, as well as in Lithuania, Belarus, or Ukraine – indicate the intensive development of land cadastral works, which are original landmarks of soil use. Interest in the soil issue was prompted by the problems associated with the search of ways for improving agriculture, plant nutrition, or increasing agricultural yields.

At the end of the 15th century, the concept of black soil, or chernozem appeared. Ukrainians even developed a special “national view” on the origin of black soil. The soil is rich in organic matter, probably because of rotting remains of plants and animals.

The first mention about the dark soils on the territory of Ukraine (at that time, the south of Russia) is in the “Word on the Fertility of the Soil”, which was pronounced on September 6, 1756 in the St. Petersburg Academy of Sciences by professor of botany and natural history, J.H. Gebenstrattom, who made a journey to Ukraine and saw “(...) the soil naturally black, which was made of rotten parts of animals and plants”. He does not use the word *chernozhem*, but the concept of black soil is identical to it.

Extremely interesting and progressive for that time was a complex geological (geomorphological) soil map of the territory from the Baltic Sea to the Danube and the Dnieper rivers, made by Polish geologist S. Staszic in 1806. In the map legend, one may find such terms as: “chernozem – plant soil (Terres vegetables)”, “deserted steppes”, “marsh” and “marshland soils”. This map is a peculiar landmark of soils in general and chernozems in particular.

The first complex investigations of chernozem were done by Kharkiv scientists, professors N.D. Borisyak and I.F. Levakovsky in the middle of the 19th century (Kanivets’ 2004). On August 30, 1852, Borisyak attended the meeting of the Imperial Kharkiv University with a report titled *About Chernozem*. Levakovsky in the work *Materials for Chernozem Investigation* published in 1852, justified the terrestrial and plant origin of chernozems, described their properties and methods of use, gave a classification of chernozems (into loams, clays, sandy loam, eluvium of thick carbonate rocks, solonets, and uranium), and already at that time he emphasized the need to protect chernozem (Kanivets’ 2004).

Levakovsky in the works *Materials for Studying Chernozems* (1871) and *Some Additions to Studies on Chernozem* (1888) described the geography and

origin of chernozems, justified the reasons of absence of chernozems in northern Russia, showed the influence of chernozems on the various elements of relief, analysis of methods used for determining the content of humus, and provided the classification of soils.

In the middle and second half of the 19th century, there was an active accumulation of new knowledge about chernozems. A. Schmidt explored the power of chernozems in the Kherson region. A. Grossul-Tolstoy described the soil and created a map of its distribution from the Prut to Ingul rivers, where four chernozem zones were identified (1856). K. Veselovskyi published the *Economic-Statistical Atlas of European Russia* with a soil map, in which 8 different soils were shown, among them was a chernozem (1851). What is more, there were discussions about the genesis of chernozem (E. Eversman, R. Murchison, A. Petzhold, E. Eichvald, N. Borisyak, F. Ruprecht, M. Bogdanov).

In 1883, on the basis of the works of his predecessors and his own studies, V.V. Dokuchaev published *Russian Chernozem*, which became the basis for the development of a new direction in soil science, namely genetic soil science. In this work, it is formulated the plant and terrestrial origin of soils, solution to the chernozem problem is proposed in the form of developed theory, foundations of completely new method of soil and geographical studies are laid, and some areas of the chernozem region are described. The above-mentioned publication is a peculiar landmark of chernozem and soils in general.

Chernozem is regarded as a nature phenomenon. Its distribution covers the combinations of plains and shallow of watershed spaces. It is characterized by rich organic matter. Chernozem is very fertile due to its high moisture storage capacity. The soil is called a “miracle of the biosphere”, its “wonderful creation”.

In Ukraine, chernozems in the virgin state have been preserved only in the nature reserves of Mikhailivska in the Sumy region (Fig. 4), the Khomut steppe in Donetsk, the Stril'tsivs'kyi steppe in the Luhansk and Kamyani graves in the



Fig. 4. The Nature Reserve “Mikhailivska Cilyna” (Sumy oblast)

Zaporizhia region, in the nature reserve of the Kasova Gora in Ivano-Frankivsk region. All these natural reserves are the national natural wealth of the country (Pozniak 2009).

In addition to nature reserves there are natural monuments on the territory of Ukraine. According to the classification of the International Union for the Conservation of Nature (IUCN), natural monuments belong to IUNC Category III, which is an intermediate between national parks and reserves, although their detailed legal status depends on a particular country. In Ukraine, on the territory of natural monuments, it is prohibited any activity which threatens their conservation or leads to degradation or alteration of their original state. Natural monuments, especially complex, botanical, as protected objects, also play an important role in preserving the natural properties of soils, including chernozems.

Bearing in mind the importance of nature protection, in particular the soil, people build monuments dedicated to various natural objects. The first famous soil monument was built in China, in the center of Beijing, in 1421 in the Imperial Garden (Fig. 5). It has the form of a raised square 6×6 m covered with a soil of different color and origin. In the center there is a circle filled with loess – typical for China soil-forming rocks. The rest of the square is divided into 4 sectors, directed at the main sides of the horizon. The northern sector is filled with chernozem, distributed in north-eastern China; the southern sector is filled with red soil of the southern part of the country; the western sector is filled with a light soil of desert origin; the eastern sector is filled with gley muddy soil, typical for rice fields which are found in the center of the country. One can find the following phrase: “This place was built in 1421 in the era of the Ming Dynasty. Inside there is a yellow soil, on the eastern side – blue, on the south – red, on the west – white and on the north – black soil. All these colors of soils belong to the emperor”.



Fig. 5. The first soil monument in the world (the Imperial Garden of Beijing, China)

Thus, even in the days of feudalism, the Chinese had a rather wide knowledge of soil. The use and frequent updating of the land cadaster, which was mainly based on the peculiarities of soils, as well as the development of instruments for the application of fertilizers, which had a peculiar classification, should be perceived as the most significant achievements of Chinese of that time.

Chernozem is perceived as an ideal type of soil, a standard of perfection in the world of soils. As a symbol of natural wealth, a large cubic monolith of chernozem was demonstrated by V.V. Dokuchaev in 1900 at the World Exhibition in Paris. The arrangement and supervision for the collection was carried out by V.I. Vernadsky – later, a prominent Ukrainian scientist.

A detailed description of this monolithic sample – the standard of chernozem – was made by P.V. Ototskyi. It states that the sample of a typical steppe chernozem is taken from the Bobrovsky region of the Voronezh governorate, in the virgin steppe near the famous “Stone steppe”. This chernozem lies on the loess. Under the turf of feather grass and other herbs, horizon A is almost a homogeneous mass, colored with humus in black, especially in a wet state, and on the virgin soil it is always permeated with numerous alive and dead herbaceous roots. Separate components of the horizon, usually in the form of small grains, give it a large scale, fine-grained structure; thickness about 45 cm. Horizon B is transitive, by structure, color and composition; it occupies the middle position between A and C. The dark color here gradually becomes lighter and loses its solid nature; grit becomes less noticeable; the amount of humus, clay and zeolites decreases, whereas the number of carbonate salts increases. Underground parts of usual perennial herbs occur here in a much smaller number than in horizon A, but the most important feature of this horizon is the presence of a large number of individual molehills of different shapes.

The thickness of horizon B is about 45 cm. Horizon C is a subsoil, a regular loess, though poorer in the upper layers by charcoal; the molehills in it are located at a depth of three and more meters. The capacity of the loess often reaches several dozen meters. This is the most common subsoil of chernozem.

As regards the monolith of this chernozem, after the Paris exhibition, there were plans to place it at the International Bureau of Weights and Measures (IBWM) in Sèvres near Paris and stored there under a glass cover. However, reliable data from France have shown that there had never been a sample of chernozem in the IBWM. It was found out that after the World Exhibition various institutions and scientific societies asked to cut the chernozem monolith into pieces and pass them for use in various museums and exhibitions. However, it did not happen. It was decided to keep the monolith untouched. It was delivered to the Sorbonne (which was chosen randomly), where it stayed until the 1968 students riots during which the university building was taken over, the protective glass walls of the monolith were broken, and the exhibit

was destroyed. Some of its large parts were sent to the National Agronomy Institute, where they are saved to this day (Dobrovol'skiy 2010).

It is important to notice that a sample of chernozem from the Dobrovolechivskiy district of the Kirovohrad region is in the Laboratory of Land Resources of Europe where it is described as a "standard of chernozem".

The monument to chernozem was opened on June 27, 2013 in the Panins'kiy district of the Voronezh region, at the 130th anniversary of the publication of the book by Dokuchaev, *Russian Chernozem* (Fig. 6). It is made of marble and metal, it consists of two elements: a black marble cube with a side of 1.1 m, which symbolizes a "black diamond", and the planet above it, framed with golden ears. On the front side of the cube, the most famous statement of Dokuchaev is written: "There are no such figures that could be used to estimate the strength and power of the King of Soils, our Russian chernozem. It has been and will remain the breadwinner of Russia". The cost of the monument was about 1 million rubles.



Fig. 6. The monument to chernozem in the Panins'kiy district (Russia)

Taking into account the importance of chernozem, people estimate it in different ways. Numerous scientific monographs on chernozem have been written, in particular: F.N. Ruprecht, *Geobotanical Study of Chernozem* (1866); I.F. Levakovskiy, *Materials on the Study of Chernozem* (1871), *Some Additions to Studies about Chernozem* (1888); N.M. Sibirtsev, *Chernozem in Different Countries* (1897); L. Boubert, *Galitsko-Podilskiy Chernozems. Their Formation and Natural Structure, and Also Modern Agricultural Conditions of Exploitation*

of the Northeast Zone of Galicia (1930); H. Mahiv, *Soils of Ukraine* (1930); L.I. Prasolov, *Chernozems as a Type of Soil Formation* (1939); N.D. Borisyak, *About Chernozem* (1851); I.A. Krupenikov, *Chernozem Is Our Richness* (1978), *Chernozems of the USSR (Ukraine)*, (1981), *Russian Chernozem – 100 Years after Dokuchaev* (1983); V.V. Medvedev, *Optimization of Agrophysical Properties of Chernozems* (1988), *Russian Chernozem Is More Expensive Than Gold* (ed. H.V. Dobrovolsky, 1994); S.P. Pozniak, *Irrigated Chernozems of Southwestern Ukraine* (1997), *Chernozems: The State and Problems of Rational Use* (2000); *Anthropogenic Evolution of Chernozems* (ed. A.P. Shcherbakova, I.I. Vaseneva, 2000); B.S. Nosko, *Anthropogenic Evolution of Chernozems* (2006); I.A. Krupenikov, *Chernozems. Origin, Perfection, the Tragedy of Degradation, the Path of Protection and Recovery* (2008), and others.

Poems and novels were also dedicated to chernozems, for example, two-volume novel by G.N. Troypolsky. In the novel written by O.Honchar, entitled *Flag Bearers*, it is noted with pain: “They freighted the chernozem. Chernozem already became for them a captive! Till this time they seized and sent people to the odious *Reich* and this summer they started to graze chernozem from the fields”.

In some countries of the world, in particular in Austria and Germany, in order to solve the food problem they create high-yielding soils artificially, taking as a model the natural chernozem. In these countries, 2005 was proclaimed the Year of Chernozem. On this occasion, a post stamp with the image of chernozem was issued in Austria (Fig. 7). Some museums and institutions of Ukraine have collections of monoliths of virgin chernozems, in particular, at the Odessa Agricultural University (selected by Prof. O.G. Nabokikh), Kharkiv National University of Agriculture named after Dokuchaev, Ivan Franko National University of Lviv, Poltava Local History Museum, and others. A large collection of monoliths of chernozem is stored in the Central Museum of Soil Science named after Dokuchaev in St. Petersburg (Russia) (Fig. 8).

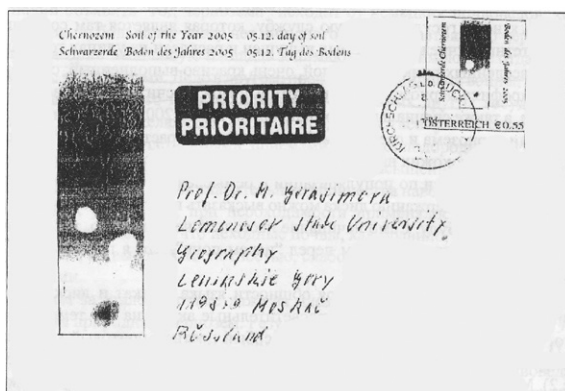


Fig. 7. The post stamp with the image of chernozem (Austria, 2005)



Fig. 8. The monolith of chernozem in St. Petersburg (Russia)

People's anxiety over the state of soils, and in particular of chernozems, appeared in the proclamation of 2015 as the United Nations International Year of Soils.

CONCLUSIONS

Analysis of the development of soil science has shown that it has a long history – from ancient times to the present day. The main idea is that the soil plays an important role both for nature and humanity. An important task of modern society is taking a reasonable approach towards the soil and preservation of natural soil objects.

REFERENCES

- [1] Dobrovolsky, H.V., 2010. *On the history of the Russian chernozems standard at the 1900 World's Fair*. Soil Science, 10(9): 1135–1136 (in Russian).
- [2] Kanivets', V.I., 2004. *Once more about the origins of the Kharkiv School of soil science*. Visnyk KhNUU, 1: 9–13 (in Russian).
- [3] Krupenikov, I.A., 1981. *History of soil science (from its inception to the present day)*. Science, 328 (in Russian).
- [4] Pozniak, S.P., 2009. *From the history of studying chernozems in Ukraine*. Scientific Herald of Chernivtsi University. Geography, 450: 40–43 (in Russian).