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Victor Verhunov
National Scientific Agricultural Library of the National Academy of Agrarian Sciences of Ukraine
10, Heroiv Oborony Street, Kyiv, Ukraine, 03127
E-mail: dnsgb_uaan@ukr.net
https://orcid.org/0000-0002-5476-4845

Nataliia Shchebetiuk
National Scientific Agricultural Library of the National Academy of Agrarian Sciences of Ukraine
10, Heroiv Oborony Street, Kyiv, Ukraine, 03127
E-mail: Shchebetyuk@ukr.net
https://orcid.org/0000-0002-3332-1981

Development of natural knowledge as a basis for the organization of agricultural research in the forest-steppe zone of Ukraine (1st quarter of the 20th century)

Abstract. *The use of innovations and information technology approaches in the agricultural sphere of Ukraine under conditions of global influence has been based on the results of multifaceted long-term research. Our goal was to reveal the peculiarities of the formation of Ukrainian natural science knowledge in historical retrospect using problem-chronological and comparative-historical methods. The analysis of the development of agricultural zoning of the territory of Ukraine has been justified by its theoretical and methodological content, which has served as the scientific basis for the organization and formation of agricultural science and research in the first decades of the 20th century. Attention has been focused on the need for an in-depth study of the peculiarities of different territorial parts of the Russian Empire of the country in connection with the problem of geographical division and the growing demands of economic development. The first developments of geographers and soil scientists regarding the division and mapping of the soil cover of Ukraine on maps have been disclosed, among which is the work of V. V. Dokuchaev, as the author of the mapping technique and theoretical justification of the phenomenon of natural zoning. The work of his follower G. I. Tanfilieva became one of the first attempts at a comprehensive characterization of Ukrainian lands, taking into account zonal and provincial differences. The works of P. A. Tutkovskyi, K. G. Vobloh and other scientists, developers of agro-soil, agro-climatic, geobotanical, geomorphological and physical-geographical zoning of the territory of Ukraine. Based on the gathered sources, data*

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regarding the attempt to establish an agricultural experimentation structure during the first quarter of the 20th century in the Forest-Steppe zone of Ukraine, according to the regional principle, are provided. This initiative involved the operation of two regional agricultural research structures in slightly different areas of the Forest-Steppe. In the right-bank part, agricultural experimentation was carried out by the Kyiv Agricultural Research Station with a number of district institutions, while the left-bank part was served by the Kharkiv Agricultural Research Station, district and specialized research institutions. Accumulated in the first decades of the 20th century natural science experience contributed to the development of theoretical and methodological tools for the further development of agricultural science and research in Ukraine.

Keywords: *history of science; natural conditions of Ukraine; zonal division of the territory; natural and agricultural zoning; marginal principle; agricultural experimentation*

Introduction.

Natural conditions and regional natural-climatic features play a predominant role in the functioning and scientific-technical support of the agricultural sector in every country worldwide. Global changes in average temperatures, and consequently in the accumulation of heat, have a noticeable impact on established classification markers. According to some sources, a 1°C increase in temperature in Ukraine leads to a shift of the agro-climatic zone boundary towards the north by 100 km (Ivaniuta, Kolomiiets, Malynovska, & Yakushenko, 2020, p. 17). Further potential climate changes due to global warming by 1.5°C and their consequences for the world's ecosystems are outlined in the report of the Intergovernmental Panel on Climate Change (2018), the main conclusion of which emphasizes the urgent need for a global reduction in anthropogenic greenhouse gas emissions (Rogelj et al., 2018). In the absence of adaptation to the consequences of climate change, things like human health, access to water, and food security are becoming the most vulnerable. The agriculture of countries worldwide, including Ukraine, undergoes fundamental changes in the assortment of agricultural crops and, overall, in the innovation and technological processes of agricultural production. In this context, there is a need to refer to the historical roots of global experience and the modern mechanism of providing production processes in the agricultural sector of Ukraine with innovative technologies.

The establishment of agricultural science and research in leading countries occurred several decades earlier than in Ukrainian territories. The emergence of research institutions networks in the USA and Europe was primarily facilitated by agronomic needs based on centuries-old practical experience with soils and plants. The application of agronomic techniques depending on natural conditions was first mentioned in ancient Roman works by Marcus Varro, Lucius Columella, and others. The main impetus for the development of natural sciences, including soil science and plant science, came from the fundamental research of German chemist Justus von Liebig, Swiss botanist Jean Senebier, French scientist Jean-Baptiste Boussingault, and others (Mykhailychenko, 2013). According to the natural-climatic conditions of a particular country, specialization in agricultural production and its scientific support

was formed through private initiative based on private property. By the end of the 19th century, agricultural research had emerged from higher sectoral education and become an integral part of natural sciences.

The development of agricultural science in the USA and Europe had a significant impact on the emergence of agricultural experimentation in Ukraine. At the end of the 19th and the beginning of the 20th century, research institutions established on Ukrainian territory received equipment and scientific literature from European countries, seed materials from the USA and Canada, and talented youth, upon completing university education, were sent abroad to deepen their knowledge and enrich their experience. Overall, until the 1920s, Ukraine did not face issues regarding the compatibility of methodological approaches and statistical data processing in research with global scientific standards. Therefore, by 1914, through the efforts of scientists, the gap had been bridged, overcoming several decades of lagging behind.

The system of scientific support for the development of the agricultural sector of Ukraine has undergone a complex path of transformations, overcoming political, socio-economic barriers at various stages of its development, with the transient influence of external and internal factors. In different periods of the formation of the theoretical-methodological and scientific-organizational foundations of this system, various natural factors or components of the process that exerted a generating influence on its development played a leading role (Zubets, 2004). Modern researchers argue that in the first decades of the 20th century, which marked a stage of formation for most of its natural science directions, including agricultural science and research in Ukrainian territories, considerable attention was paid to studying the issues of natural-historical and natural-agricultural zoning of the territory (Verhunov, 2021; Shchebetiuk, 2017). The materials collected at that time and their analysis contributed in many aspects to the construction or even laid the groundwork for agricultural experimentation in Ukraine, subsequently influencing the creation of new technologies, innovative models, and more.

The problem of territorial zoning in Ukraine has an interdisciplinary nature, and therefore, the current state of its scientific development is characterized by a diversity of expertise. Specifically, the analysis conducted by modern researchers of publications during Ukraine's independence era indicates the absence of a unified and widely accepted scheme of economic zoning, which is constantly evolving and improving, like other types of zoning (Chmyrova & Fediai, 2013). Primarily, the analysis and priorities of the scientific foundations of agro-industrial production in Ukraine are conducted within the framework of three zones (Polissia, Forest-Steppe, Steppe) corresponding to the natural-climatic conditions (Zubets, 2004). Generally, natural-agricultural zoning based on agro-climatic features in the form of taxonomic units (belts, zones, regions, districts, etc.) is applied (Martyn, Osypchuk, Chumachenko, 2015). Among the scientific works on this issue in the context of historical perspectives, in addition to those mentioned, there are also studies by researchers (Demuz & Borodai, 2022) with partial coverage of specific theoretical-methodological and scientific-organizational aspects of the establishment and activities of scientific institutions in the

first decades of the 20th century in Ukrainian territories and specifically in the Forest-Steppe zone.

The aim is to highlight the peculiarities of the initiation and further development of natural-agricultural zoning of Ukrainian territories through the contributions of prominent scientists. Additionally, to elucidate the regional principle of organizing agricultural experimentation in accordance with the contemporary zoning system, using the Forest-Steppe zone of Ukraine as an example.

Research Methods.

This historical research is grounded in the application of overarching scientific principles such as objectivity, systematicity, historicism, comprehensiveness, and others. Pursuing the goal of impartially generalizing the results of studying the peculiarities of creating agricultural zoning in Ukraine, the works of scientists from the Soviet period were analyzed, avoiding political expediency and ideological bias. Additionally, the study involves incorporating the scientific contributions of scholars from the Russian Empire who made contributions to the development of physical-geographical zoning of Ukrainian territories within the empire during its initial stages. The accumulated natural science knowledge facilitated the theoretical justification of the relationships between various components of climatic and natural zonality and the directions of agricultural production. Working in related fields, scientists designed a system of scientific support for agricultural management based on zonal division.

The most weight is given to the subject-chronological and comparative-historical methods that we have applied. Their synthesizing role in reflecting the progressive development of natural knowledge has contributed to understanding individual phenomena, events, and processes in dynamics. The use of the problem-chronological method has allowed studying phenomena in temporal spatiality, highlighting finer aspects in chronological order according to historical background, as well as generalizing the whole picture and its individual components. By tracing the process from the theoretical substantiation of zonality to the identification of natural zones, we come to conclusions about specific soil-climatic conditions that interact with zonal soil types, and ultimately with the directions and forms of agricultural research and production.

The comparative-historical method allows us to identify or clarify the essence of little-studied phenomena, particularly those not yet confirmed. Therefore, its application by us is evident and has allowed us to delineate and characterize the features of accumulating natural knowledge, their development within the framework of a scientific-organizational approach to agricultural experimentation in the first decade of the last century in the territories of Ukraine, particularly in the Forest-Steppe zone.

Tracing the development of natural knowledge through the analysis of scientists' scientific contributions allowed the application of the principle of personification and the biographical method. The identification of creative achievements and scientific heritage confirms the step-by-step overcoming of scientific problems, the

implementation of new scientific developments into practice, and the acquired scientific knowledge gains signs of individuality, uniqueness.

Results and Discussion.

In the second half of the 19th century, conditions for the initiation of agricultural research were historically established on the territory of modern Ukraine. Among these, we note private initiative through the activities of societies and subsequent state support in the form of various legislative initiatives. There were many interacting factors contributing to the emergence of theoretical-methodological factors in the development of agricultural science and research. The formation of scientific-organizational foundations occurred almost simultaneously with the accumulation of natural knowledge. At the beginning of the 20th century, in Soviet Ukraine, an attempt was made to create a structure for agricultural research based on the so-called regional principle, which was based on the natural-historical zoning of the territory. It is noteworthy that the latter has always served as the basis for the structured placement of agricultural production, assessment, and rational use of land resources, etc.

Natural-agricultural zoning is based on agroecological principles, reflecting all the bioclimatic natural resources of specific territories with a prioritized interpretation of land resource utilization in the agricultural sector. Its characteristic features are filled with a unified content, which lies in the absorption of solar energy by various agricultural crops. Scientific knowledge about natural conditions and available resources complements natural-agricultural zoning, considering the need for scientific support in managing the agricultural sector. Therefore, this zoning combines administrative-territorial boundaries with natural-climatic regions, administrative formations according to local natural conditions, etc.

For over a century, scientists have been studying the issue of natural-agricultural zoning, the prerequisites for which began to emerge after the abolition of serfdom in 1861. Increasing demands for economic development and a pressing need for clear administrative management brought to the fore the problem of geographical division of the territory of the Russian Empire. The already accumulated scientific knowledge and experience were actively supplemented by a deepened understanding of the characteristics of various territorial parts. The initial schemes of agricultural zoning in the European part of the Russian Empire delineated the chernozem, southern non-chernozem, and northern non-chernozem latitudinal agricultural belts. Soil maps by geographers-economists such as K. S. Veselovsky (1819–1901) (1851) and V. I. Chaslavsky (1834–1878) (1879) reflected the soil cover of Ukraine with predominance of chernozems (Dokuchaev, 1879). The characteristic sandy soils, loams, and sandy loams for the north, and loamy, loamy chernozems for the south of Ukraine were also noted. The theoretical-methodological content for the aforementioned maps was developed by renowned soil scientists such as V. V. Dokuchaev (1846–1903), G. I. Tanfilyev (1857–1928), M. M. Sibirtsev (1860–1900), and others.

V. V. Dokuchaev not only developed a methodology for mapping soil cover based on field research but also theoretically substantiated the phenomena of natural zonality

by generalizing existing materials at that time (Dokuchaev, 1879, 1892). Publishing the results of research on the close relationships between "climate, soils, animal and plant organisms" and nature zones, the scientist initiated the process of zonal study and division of the natural space of Ukraine (Fig. 1, a, b). Subsequently, researchers such as G. N. Vysockij, O. I. Voieikov, and others continued to investigate and develop Dokuchaev's zonal approach, adhering to a single indicator (the ratio of heat and moisture) in assessing biological productivity. The establishment of natural-agricultural zoning of Ukraine was facilitated by organized expeditions of the Poltava, Chernihiv, and Podillia zemstvo expeditions from 1882 to 1916. The results obtained during that time laid the groundwork for the development of soil science and other directions, including landscape studies, physiographic zoning, and so on.

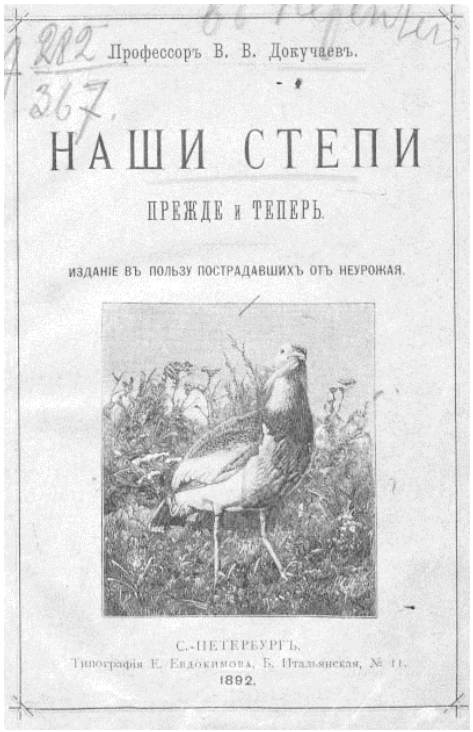
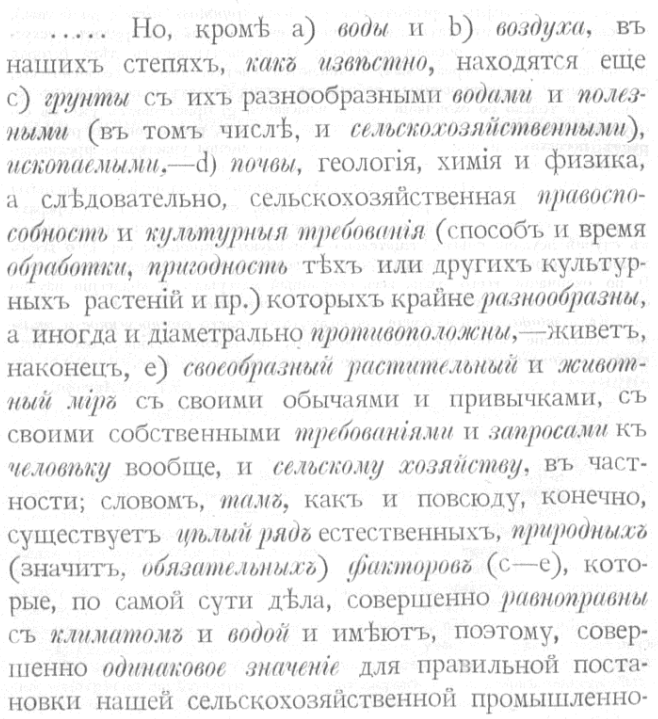


Figure 1, a. The work of V. V. Dokuchaev, 1892.

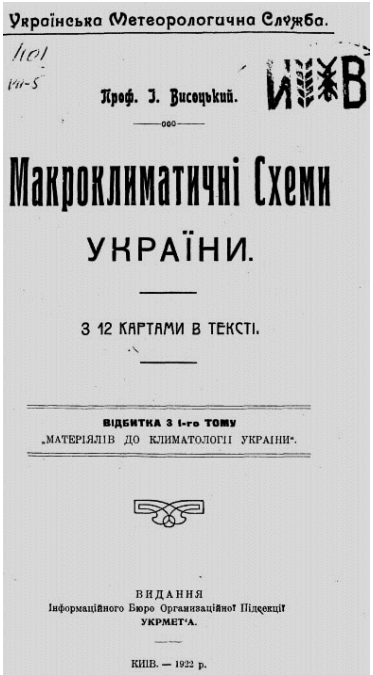


..... Но, кромѣ a) *воды* и b) *воздуха*, въ нашихъ степяхъ, *какъ извѣстно*, находятся еще c) *грунты* съ ихъ разнообразными *водами* и *полезными* (въ томъ числѣ, и *сельскохозяйственными*), *ископаемыми*,—d) *почвы*, геологія, химія и физика, а слѣдовательно, сельскохозяйственная *правоспособность* и *культурныя требованія* (способъ и время *обработки*, *пригодность* тѣхъ или другихъ культурныхъ растеній и пр.) которыхъ крайне *разнообразны*, а иногда и діаметрально *противоположны*,—живетъ, наконецъ, e) *своеобразный растительный* и *животный міръ* съ своими обычаями и привычками, съ своими собственными *требованіями* и *запросами* къ *человѣку* вообще, и *сельскому хозяйству*, въ частности; словомъ, *тамъ*, какъ и повсюду, конечно, существуетъ *цѣлый рядъ* естественныхъ, *природныхъ* (значитъ, *обязательныхъ*) *факторовъ* (c—e), которые, по самой сути дѣла, совершенно *равноправны* съ *климатомъ* и *водой* и имѣютъ, поэтому, совершенно *одинаковое значеніе* для правильной постановки нашей сельскохозяйственной промышленно-

Figure 1, b. A fragment from the work of V. V. Dokuchaev on natural conditions (Dokuchaev, 1892, p. 118).

Climatologist and geographer O. I. Voieikov (1842–1916) also contributed to the study of chernozems and other types of soils, but among his main works is the theoretical justification of climatic zonality alongside natural zonality and directions of agricultural production. Engaged in the problems of agriculture and forestry, the eminent forest scientist G. N. Vysockij (1865–1940) worked on theoretical aspects of physiographic zoning, taking into account the relationships between different components and substantiating zoning schemes based on quantitative indicators of moisture conditions and the relationship of other zonal factors. He proposed a statistical method of grouping territorial units into integrated natural regions, introduced the concepts of locality, microrelief, microclimate, etc. (Vysockij, 1941, pp. 27–30). Subsequently, G. N. Vysockij became a proponent of the idea of geographic

(landscape) zonality, distinguishing four regions (moist forest, transitional forest-steppe, moderately dry steppe, southern dry steppe) (Fig. 2, a, b).


Українська Метеорологична Служба.

Проф. І. Висоцький.

Макроклиматичні Схеми України.

З 12 КАРТАМИ В ТЕКСТІ.

ВІДБИТКА З І-го ТОМУ „МАТЕРІЯЛІВ ДО КЛИМАТОЛОГІЇ УКРАЇНИ".

ВИДАННЯ Інформаційного Бюро Організаційної Підсекції УКРМЕТ'А.

КИЇВ. — 1922 р.

Figure 2, a. Work by G. N. Vysockij, 1922.

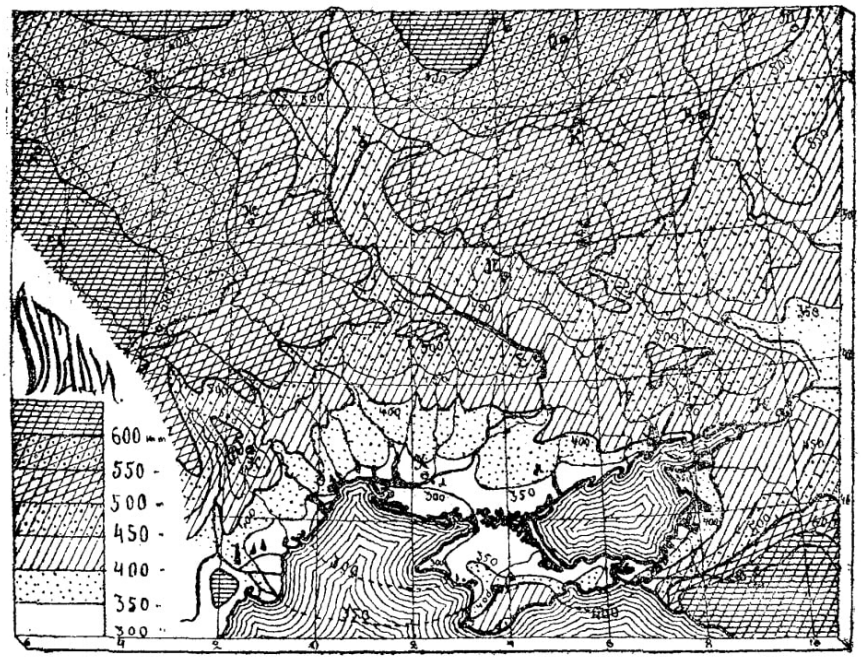


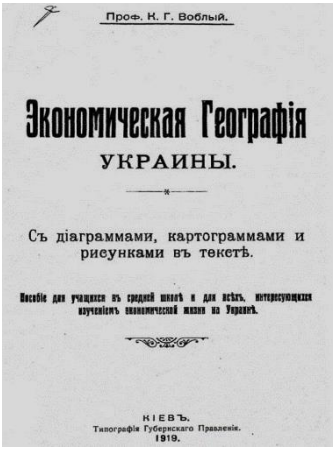
Figure 2, b. The scheme of precipitation distribution taking into account the main features of the relief of Ukraine (Vysockij, 1922, p. 18).

One of the first attempts at a comprehensive characterization of Ukrainian lands, taking into account both zonal and provincial differences, was made by the soil scientist and geographer H. I. Tanfiliev. He justified the division of the East European Plain into "regions," "belts," and "districts" according to the features of zonal distribution of soils and vegetation based on the assertion of the continuity of changes in the composition and physical properties of soils, which in turn affects vegetation (Tanfiliev, 1897). Further application of the hypothesis of the evolutionary path of landscapes proposed by H. I. Tanfiliev served as confirmation, as it was applied in studying the relationship between soils and vegetation of different natural-climatic zones.

Further development of the natural zoning system of Ukraine occurred in the early 1920s with the emergence of natural-geographical works by prominent geologists B. L. Lichkov (1888–1966) and P. A. Tutkovskyi (1858–1930). Based on geological and geomorphological features, B. L. Lichkov identified seven regions (forest, sandy, terminal moraine, moraine, island mountains, loess, and granite) considering their genesis (Lichkov, 1922). It is noteworthy that P. A. Tutkovskyi referred to the identified units as "landscapes" and directly linked their types (forest, sandy, terminal moraine, moraine, drumlin, loess, granite landscapes, landscapes of Devonian ridges, and denudation island mountains) with human activity, primarily everyday life and culture (Tutkovskyi, 1922). In the 1920s, a more refined and still relevant scheme of Ukrainian land division was substantiated by Ukrainian geographer S. L. Rudnitsky (1877–1937), described in two parts of the work "Foundations of Ukrainian Land Studies" (Rublov, 2018). The scholar firmly believed in aligning natural zoning with

physical-geographical and especially ethnographic principles, as well as historical and political boundaries.

Approximately during the same period, the economist and geographer K. G. Voblyj (1876–1947), in a brief characterization of the general geographical conditions of Ukraine, distinguished three natural-historical regions (Voblyj, 1919, p. 16) (Fig. 3, a, b).


Проф. К. Г. Воблый.

Экономическая Географія
УКРАИНЫ.

Съ діаграммами, картограммами и рисунками въ текстѣ.

Пособіе для учащихся въ средней школѣ и для всѣхъ, интересующихся изученіемъ экономической жизни на Украинѣ.

КІЕВЪ.
Типографія Губернскаго Правленія.
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Figure 3, a. Textbook by K. G. Voblyj, 1919.

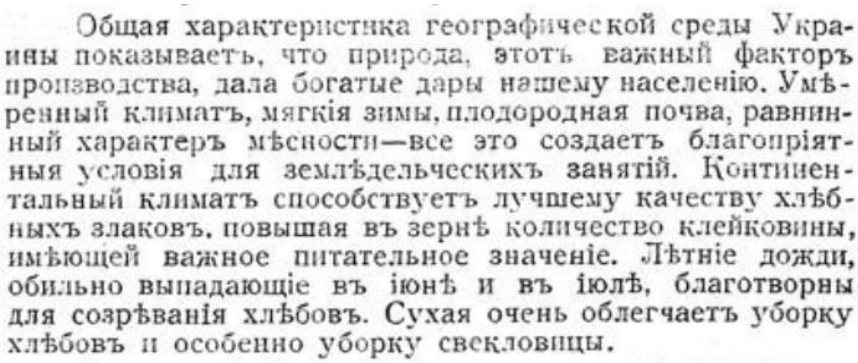

Общая характеристика географической среды Украины показываетъ, что природа, этотъ важный факторъ производства, дала богатые дары нашему населенію. Умѣренный климатъ, мягкія зимы, плодородная почва, равнинный характеръ мѣсности—все это создаетъ благопріятныя условія для землѣдельческихъ занятій. Континентальный климатъ способствуетъ лучшему качеству хлѣбныхъ злаковъ, повышая въ зернѣ количество клейковины, имѣющей важное питательное значеніе. Лѣтніе дожди, обильно выпадающіе въ іюнѣ и въ іюлѣ, благотворны для созрѣванія хлѣбовъ. Сухая очень облегчаетъ уборку хлѣбовъ и особенно уборку свекловицы.

Figure 3, b. Fragment from the work of K. G. Voblyj (1919, p. 18).

Given the importance of the present aspect of economic opportunities, let us delve deeper into the main points of K. G. Voblyj's description. Thus, the Ukrainian Polissia region (northwestern and northern district) was attributed by the scholar to the northern and northwestern part of Volyn Governorate, Radomysl County of Kyiv Governorate, northern parts of Kyiv, Skvyra, and Vasylkiv Counties, and northern parts of Chernihiv Governorate. Polissia was characterized by high humidity, small temperature fluctuations, a large number of rivers, lakes, and swamps, with predominance of loam. The economy mainly relied on animal husbandry, forestry, and timber rafting. Due to the low productivity of agriculture, grain had to be imported from other governorates. The transition zone from forest to steppe, which encompassed the southern parts of Volyn, Podillia, and Kyiv Governorates, Poltava and Kharkiv Governorates (excluding the southern part of Starobilsk County), was called the Forest-Steppe. The region was characterized by diverse relief, a sufficient number of rivers, and soils predominantly consisting of dark gray loam and degraded chernozem. Agriculture developed through crop farming with a specialization in sugar beet and wheat. The plain part of Ukraine, which also included a part of the Baltsky County of Podillia Governorate, Starobilsk County of Kharkiv Governorate, and the entire territory known as New Russia, was called the Steppe. The plain stretched along the shores of the Black and Azov Seas, with almost no forests but numerous navigable rivers. Coal and ore deposits facilitated industrial development, and the presence of chernozem allowed for successful cultivation of wheat, barley, and vegetable crops. It's worth noting that unlike in Polissia, the Forest-Steppe and Steppe regions were dominated by the population of large cities. However, overall, the moderate climate, mild winters, fertile soil, and flat terrain created conditions for successful agriculture. The continental climate

contributed to the improvement of the quality of grain crops, increasing the amount of gluten, which has important nutritional value. Summer rains allowed grains to ripen in time, and dry autumns facilitated harvesting. The natural conditions of the southern part favored horticulture and viticulture.

The above-mentioned studies of the natural-geographic character indicate the formation of the natural-historical zoning of Ukraine during the first quarter of the 20th century. Somewhat later, a series of Soviet works on comprehensive zoning of the former USSR emerged, where the territory of Ukraine's East European Plain was divided into four zones (forest, forest-steppe, steppe, and arid-steppe) with a characterization of their natural resources in terms of agricultural needs. Directly agricultural zoning of the territory of Ukraine was first presented in the early 1970s in general Soviet works, and in separate publications in 1985 authored by R. G. Derevyanko, D. S. Dobryak, O. P. Kanash, B. S. Noska, and other Ukrainian naturalists. Subsequently, there was an improvement in the methodology of zoning and clarification of the boundaries of natural-agricultural and administrative districts, their coordination, and so on.

Based on the analysis of natural conditions using materials from agro-soils, agro-climatic, geobotanical, geomorphological, as well as physical-geographical zoning of the territory of Ukraine, a unified system of taxonomic units was eventually adopted – zone (5), province (19), district (31), and sub-district (196) (Martyn, Osypchuk, Chumachenko, 2015, p. 28). These taxonomic units of natural-agricultural zoning of the territory of Ukraine serve as a scientific basis for the differentiation of the agricultural sector, its priorities, innovations, and prospects for further development (see Figure 4).

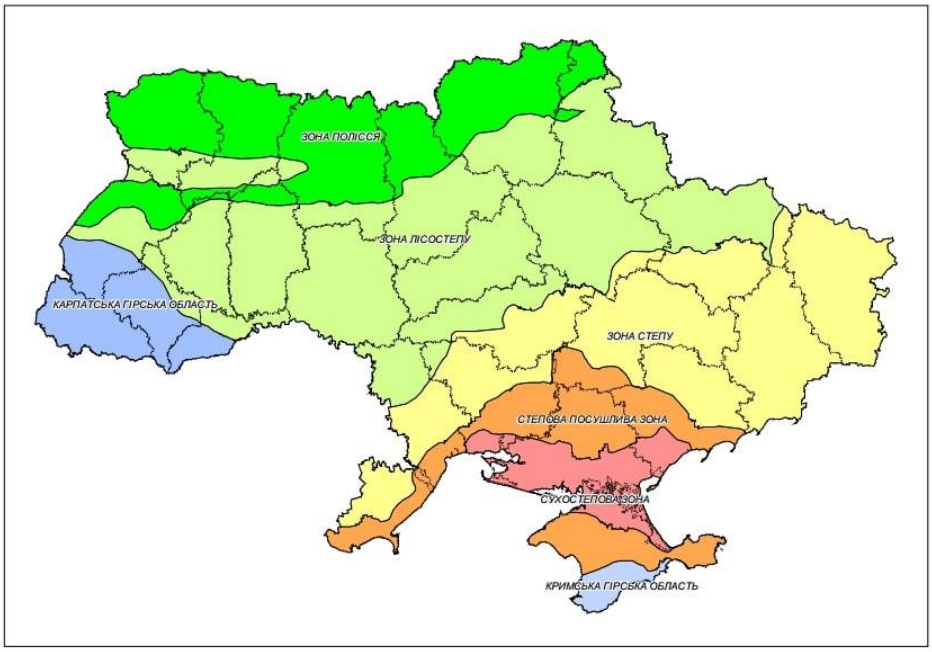


Figure 4. Natural-agricultural zones and mountainous regions of Ukraine (Martyn, Osypchuk, Chumachenko, 2015, p. 62).

In addition to the Land Code of Ukraine (2001), legislative support for natural-agricultural zoning has been provided by the regulatory framework formed in the last decade, mostly through subsequent laws of Ukraine such as "On Land Management," "On Land Valuation," "On Land Protection," "On Environmental Protection," and others. These legislative acts are aimed at fulfilling obligations regarding the rational use of land areas and their responsible protection within various types of agricultural formations, taking into account zoning, or regional division.

The term "zones" or "regions" refers to designated territories based on specific soil-climatic conditions, which in turn shape zonal types of soils, agricultural production, and consequently, systems of agrotechnical and land improvement measures. In this context, examining the scientific and organizational development of agricultural research in the Forest-Steppe zone of Ukraine during the first quarter of the 20th century, we note its conditional division into the right-bank (Kyiv) and left-bank (Kharkiv) Forest-Steppe regions. Overall, as noted by the eminent soil scientist H. H. Makhov (Makhov, 1924) (Fig. 5.a), the results of comparative analysis of natural-historical and natural-agricultural zones not only indicate their correspondence but also genetic zoning, which was conducted through the study of basic natural conditions (Makhov, 1925) (Fig. 5.b). Thus, it can be argued that there were already existing natural knowledge within the framework of zonal characteristics of the territory of Ukraine, which served as the basis for the active development of agricultural research.

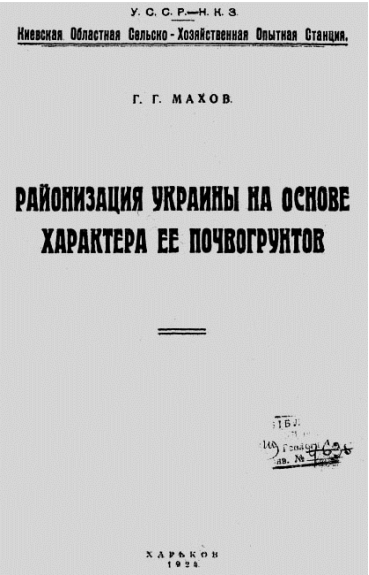


Figure 5, a. Work by H. H. Makhov (1924).

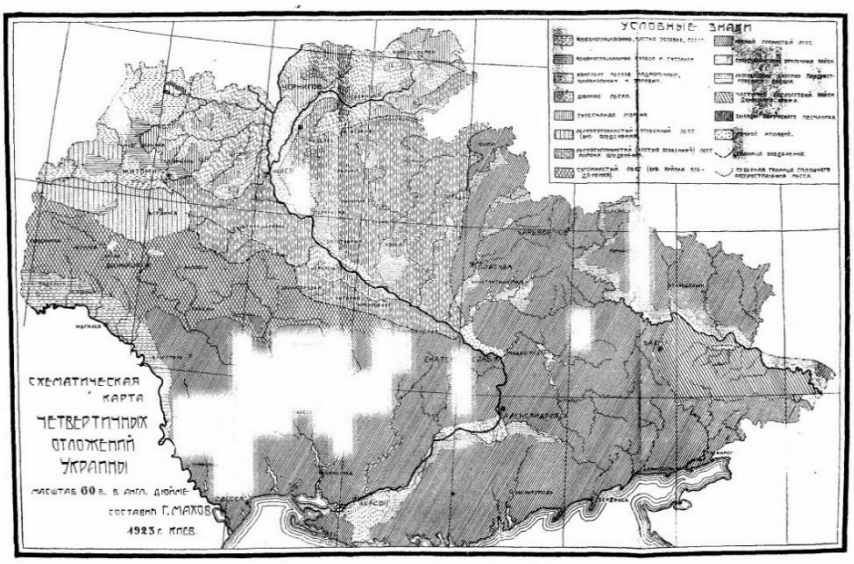
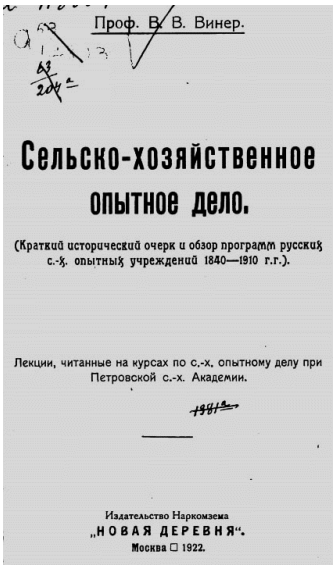


Figure 5, b. Schematic map of soils by H. H. Makhov (1925, p. 57).

Before delving into the specifics of forming the system of agricultural experimentation in the Forest-Steppe zone of Ukraine, it is also worth mentioning the experience of other countries, particularly the practice of organizing comprehensive agricultural research stations in the United States. In each state, a large scientific research institution operated successfully, subordinate to it, with financial support from the Department of Agriculture in accordance with the Adams-Hatch-Parnell Act

(Fig. 6, a, b). Borrowing the experience from the USA and establishing regional agricultural research stations in all natural-climatic zones (Forest-Steppe – Kharkiv, Kyiv; Polissia – Polisska; Steppe – Dnipropetrovska, Odeska) on Ukrainian territories took a considerable amount of time and did not bring the expected results in the long run.


Проф. В. В. Винер.

Сельско-хозяйственное опытное дело.

(Краткий исторический очерк и обзор программ русских с.-х. опытных учреждений 1840—1910 г.г.).

Лекции, читанные на курсах по с.-х. опытному делу при Петровской с.-х. Академии.

Издательство Наркомзема „НОВАЯ ДЕРЕВНЯ".
Москва □ 1922.

Figure 6, a. Work by V. V. Viner (1922).

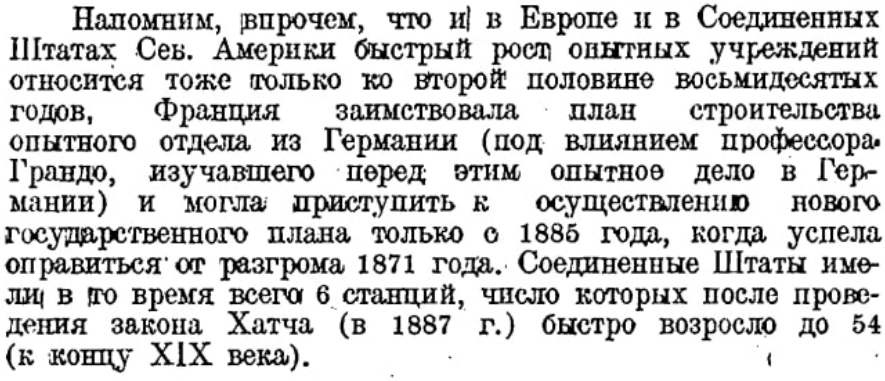

Напомним, впрочем, что и в Европе и в Соединенных Штатах Сев. Америки быстрый рост опытных учреждений относится тоже только ко второй половине восьмидесятых годов, Франция заимствовала план строительства опытного отдела из Германии (под влиянием профессора Грандо, изучавшего перед этим опытное дело в Германии) и могла приступить к осуществлению нового государственного плана только с 1885 года, когда успела оправиться от разгрома 1871 года. Соединенные Штаты имели в то время всего 6 станций, число которых после проведения закона Хатча (в 1887 г.) быстро возросло до 54 (к концу XIX века).

Figure 6, b. Fragment from the work of V. V. Viner (1922, p. 14).

However, it is worth noting that the basis for the developed projects of the network of agricultural research stations by P. A. Kostychev (1894) and V. V. Viner (1908) was the physical and geographical zoning of the territory of the Russian Empire into edges and districts (Shchebetiuk, 2017, p. 110). As V. V. Viner pointed out, its foundation consisted of "…recognized plant regions corresponding to botanical-geographical, soil, and climatic regions," followed by division into districts according to "natural-historical conditions, statistical data characterizing the distribution of land use and field crops, and economic principles" (Viner, 1921, p. 14). Despite the fact that the project of V. V. Viner, which was taken as a basis, was coordinated with the professional communities of researchers in Kharkiv, Kyiv, Odesa, and other cities of Ukraine, state planning of agricultural experimentation based on the regional principle was attempted to be implemented or adapted over almost two decades.

As of the mid-1920s, the organization of agricultural research already had a certain structure, built on a regional (zonal) principle. The Forest-Steppe zone of Ukraine stretched south of the glacial deposits boundary, covering an area of 20.291.100 thousand hectares. The Dnipro River conventionally divided the territory into two parts with different relief, subsoil, soil cover, and vegetation. During this period, the Kyiv part included the southwestern part of Volyn, Podillya, and a significant part of the Kyiv governorate. The area was situated at an altitude of 150–400 meters above sea level, with gray forest soils, degraded black soils, and so on. The main functions of scientific support for agriculture in the right-bank Forest-Steppe zone were entrusted to the Kyiv Regional Agricultural Research Station named after

Ya. M. Dudnyk, established in 1914 (Domrachov, 1927, p. 136). Various departments (agronomy, agrochemistry, breeding, meteorology, entomology, phytopathology, animal husbandry, economics, and adaptation) worked on different issues, including soil fertility, plant protection, fodder production, etc. Prominent scientists such as agronomist K. K. Gedroits (1872–1932), who developed the basics of colloid chemistry of soils and principles of their classification based on exchangeable cations composition, theory of salinity reclamation, and others; agronomist and plant physiologist O. I. Dushechkin (1874–1956), author of rational fertilization methods and the necessity of early spring nitrogen fertilization for plants, among others; agrarian scientist S. P. Kulzhynskyi (1880–1947), organizer of agricultural research, developer of the method of forced propagation of breeding potato varieties by buds, and others; agronomist O. K. Filipovskyi (1889–?) – author of the first textbook for higher agricultural institutions "Agricultural Research" (1928), among others, worked fruitfully at the institution. Research activities in this area were also conducted by district agricultural research stations with different soil types, such as Nosivska, Mokiyivska, Umanska, Chortoryiska, Vinnytska, as well as Mliivska fruit and vegetable research station.

The territory of the Kharkiv region (left-bank Forest-Steppe) was situated at an elevation of 60–250 meters above sea level, with a conditional division into the lower Dnieper region with the near-Dnieper area, the western part of Poltava region, and elevated terrain, which included part of the Poltava region and the entire Kharkiv region. The responsible function of scientific support for agricultural production in this region was entrusted to the Kharkiv Regional Agricultural Research Station. Departments (agronomy, agrochemistry, meteorology, breeding, animal husbandry, entomology and phytopathology, horticulture, gardening, economics, and adaptation) worked on issues such as soil cultivation and fertilization, investigated agrochemical properties of soil and plants, crop rotations, varieties of agricultural crops, and so on. They studied pests, diseases of agricultural plants, and developed methods for their protection, as well as specific issues of horticulture, gardening, economics, etc. It is worth noting that scientific staff of district agricultural research stations, located on different types of soil (Sumy, Poltava, Chervonograd, Drabiv), and individual specialized research stations (Kharkiv Beekeeping, Lubny Medicinal Plants, Lokhvitsa Tobacco) were actively involved in agricultural experimentation in the region. Among the most significant achievements of this period, the breeding and successful testing of new varieties of winter and spring wheat on the territory of Poltava and Kharkiv regions can be mentioned, such as Bilozerna 0676, Yuriivka, etc. (Domrachov, 1927, p. 139). These mentioned varieties of winter wheat, particularly Bilozerna 0676, became widespread throughout the territory of the Ukrainian Republic.

Overall, in the territory of both right-bank and left-bank Forest-Steppe, as well as in the rest of Ukraine, district agricultural research stations developed and implemented scientific programs according to the specific needs of various sectors of agriculture in the region. Conducting various analytical work, elaborating on theoretical and methodological aspects of agricultural experimentation, such as determining natural

and agricultural factors in a given zone within districts, fell within the prerogative of regional stations.

The organization of scientific support for the development of the agricultural sector was carried out centrally, and accordingly, management structures also developed their own framework. In 1918, the coordinating body, the Agricultural Scientific Committee of Ukraine (ASCU), began its scientific and organizational activities. In 1921–1922, under the People's Commissariat of Agriculture of the Ukrainian Soviet Socialist Republic (PCA USRR), a research department was established under the leadership of D. V. Domrachov. Additionally, in the previous two years, the All-Ukrainian Bureau of Research Affairs, the Bureau of All-Ukrainian Congresses, and the All-Ukrainian Committee for Agricultural Research Affairs (1921) were created. Besides these central bodies, regional administrations of agricultural research affairs began operating in 1921. Thus, the principle of zoning territories was extended to the management apparatus of the agricultural experimentation system. By 1922, the network of research institutions had reached about fifty, but the scale and the discursive format of the organizational process, as well as numerous economic difficulties, hindered the establishment of effective operations (Shchebetiuk, 2017).

In the late 1920s, increasing demands of the socio-economic situation, taking into account the low level of material provision, led to a reassessment of the existing regional organization of agricultural experimentation and the search for a more rational structure that could avoid previous shortcomings, particularly of a methodological nature. For many debating parties, the gradual institutionalization of scientific and organizational forms for conducting agricultural research affairs, which eventually occurred, served as a guiding principle.

According to the project of the PCA USRR and various additions from state institutions, by the end of the 1920s, a system of scientific support for the agricultural sector was being established. Its basis comprised research institutes of various types and levels of subordination. Looking at the situation in the focus zone of the Forest-Steppe of Ukraine, we can mention republican-level institutes such as soil science, plant protection, fodder, forestry, mechanization and electrification, scientific-practical veterinary medicine, organization and economics of socialist agriculture, and animal husbandry. Among the specialized institutes of all-Union significance were those for grain farming, dairy farming, medicinal and aromatic plants, fruit and berry production, pig farming, sugar beet farming, and sugar-bearing plants. The structure of agricultural research was complemented by zonal stations, including in the Forest-Steppe zone such as those for beekeeping, vegetable production, hemp and flax production, fodder production and fodder plants, rabbit breeding, onions and pastures, dairy farming, meat animal husbandry, poultry farming, sericulture, and sugar beet farming. Furthermore, supporting points and research farms were also established, mostly based on institutions that did not fit into the general structure. The entire process of institutionalization, which lasted almost a decade, contributed to the transition of agricultural research to an academic form, formally confirmed in 1931 by the establishment of the All-Ukrainian Academy of Agricultural Sciences. In subsequent

years, the Soviet model of the structure of scientific support for the agricultural sector of Ukraine underwent constant contradictory reorganizations under the influence of centralization and ideological trends. In contrast, the global natural science and its coordinating links within university education successfully developed based on scientific and organizational principles built on private initiative and private ownership.

Conclusions.

In the face of global changes in natural habitat conditions, there is a heightened demand for a reassessment of the evolutionary progress of natural sciences knowledge and its application in ensuring food security. The establishment of theoretical and practical foundations for scientific support of the agricultural sector's development in leading countries occurred in the second half of the 19th century and reflects a systematic process of successful implementation of state policy under conditions of private ownership.

The scientific basis for the differentiation of the agricultural sector and the implementation of technological solutions in Ukraine was the accumulation of experience in agro-soil, agro-climatic, geobotanical, geomorphological, and physico-geographical zoning of the territory. Natural-agricultural zoning occupied a leading position in the variable structure of the scientific-methodological support of state agriculture in Ukrainian territories. However, the adoption of American experience during the establishment of scientific-organizational forms of agricultural experimentation in the first decades of the 20th century, along with attempts to achieve maximum profitability of farms under state ownership, proved unproductive for various reasons. Nevertheless, the achievements of Ukrainian scientists have demonstrated the ability of science to accumulate experience, the regularities of natural science knowledge movement, and socio-cultural changes, as well as produce new knowledge about the mechanisms of new technological approaches in various spheres of development in Ukraine, including in the direction of innovative scientific methodology.

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Conflict of Interest.

The authors declare no conflict of interest.

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Віктор Вергунов
Національна наукова сільськогосподарська бібліотека Національної академії аграрних наук України, Україна

Наталія Щебетюк
Національна наукова сільськогосподарська бібліотека Національної академії аграрних наук України, Україна

Розвиток природничих знань як основа організації аграрного дослідництва у зоні Лісостепу України (І чверть ХХ ст.)

Анотація. *Використання інновацій та інформаційно-технологічних підходів в аграрній сфері України за умов глобального впливу ґрунтується на результатах різнобічних довготривалих досліджень. Розкрити особливості становлення українських природознавчих знань в історичній ретроспективі за допомогою застосування проблемно-хронологічного і порівняльно-історичного методів і стало нашою метою. Аналіз розвитку сільськогосподарського районування території України аргументовано його теоретико-методологічним наповненням, що слугувало науковим підґрунтям організації й становленню у перші десятиліття ХХ ст. аграрної науки і дослідної справи. Акцентовано увагу на посталій тоді потребі поглибленого вивчення особливостей різних територіальних частин Російської імперії у зв'язку з проблемою географічного поділу і зростаючими запитами економічного розвитку. Розкрито перші напрацювання географів і ґрунтознавців щодо поділу й відображення на картах ґрунтового покриву України, серед яких вирізняється доробок В. В. Докучаєва, як автора методики картографування і теоретичного обґрунтування явища природної зональності. Праця його послідовника Г. І. Танфільєва стала однією з перших спроб комплексної характеристики*

українських земель з урахуванням зональних і провінційних відмінностей. Виокремленню єдиної системи таксономічних одиниць (зона, провінція, округ, район) природно-сільськогосподарського районування посприяли праці П. А. Тутковського, К. Г. Воблого та інших учених, розробників агроґрунтового, агрокліматичного, геоботанічного, геоморфологічного та фізико-географічного районувань території України. Розглянуто спробу створення впродовж першої чверті XX ст. структури аграрного експериментаторства в зоні Лісостепу (правобережний і лівобережний краї) України за крайовим принципом, який передбачав функціонування двох крайових сільськогосподарських дослідних структур у дещо відмінних краях Лісостепу. У правобережній частині аграрне експериментаторство здійснювала Київська сільськогосподарська дослідна станція з низкою районних установ, а лівобережну обслуговувала Харківська сільськогосподарська дослідна станція, районні та спеціалізовані дослідні установи. Накопичений у перші десятиріччя XX ст. природознавчий досвід сприяв виробленню теоретико-методологічного інструментарію подальшого розвитку аграрної науки й дослідної справи в Україні.

Ключові слова: *історія науки; природні умови України; зональний поділ території; природно-сільськогосподарське районування; крайовий принцип; аграрне експериментаторство*

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