Kryvyi Rih regional landscape technical system: history of knowledge and specifics of economic development

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Abstract. The article is devoted to the study of Kryvbas – a unique landfill for understanding the structure of landscapes. In the history of studying the nature and landscapes of Kryvbas, the authors have identified two main stages: initial knowledge (ancient times – the first half of the XIX century) the second half of the XIX – beginning of the XXI century), which gave the opportunity for 130 years to form one of the largest not only in Ukraine but also in the world landscape and technical system. The formation of this original landscape-technical system is due to three factors: a) detailed studies of the nature and landscapes of Kryvyi Rih region, b) the richness and diversity of natural resources of the region, c) intensive development. The authors paid special attention to the functional-genetic classification of anthropogenic landscapes of Kryvbas, their characteristics and mapping. The authors note that among the industrial ones, special attention should be paid to mining and industrial landscapes, in particular dumps, which are the most suitable landscape complexes not only for reclamation works, but also for cultivating the entire landscape and technical system of Kryvbas.

1. Introduction
1.1. The problem statement
Kryvyi Rih region is a unique landfill for the study of industrial landscapes, within which a powerful landscape-technical supersystem has been formed, which combines landscape-engineering and landscape-technogenic components. Modern study of this pronounced zone of technogenesis is extremely important for the sustainable future not only of the region, but also to some extent of the geosystem as a whole, because Kryvyi Rih region is characterized by abnormally rapid changes in the structural organization of geocomponents and landscape complexes and relationships. Some aspects of the researched problem are covered in the works of classical and anthropogenic landscape science, landscape geochemistry, ecology, constructive geography and geobotany, in particular in the works of such scientists – T. Andrienko [1], D. Armand [2], S. Berg [3], M. Grodzinsky [4], V. Dokuchaev [5,6], G. Denisyk [7,8], A. Isachenko [9], V. Kazakov [10], O. Marynych [11], F. Milkov [12], V. Pashchenko [13], V. Petlin [14], P. Pogrebnyak [15], M. Solntsev [16], O. Smetana [17], V. Sukachov [18], Y. Tyutyunnik [19–21], V. Fedotov [22,23], P. Shishchenko [24] etc.
The study of the modern structure of mining landscapes of the Kryvyi Rih landscape-technical system is not possible without a retrospective analysis of its development, and therefore this aspect is currently in the field of our scientific research. At the same time, we are aware that the research conducted is only a small part of the knowledge of the general image of the Kryvyi Rih regional landscape-technical system.

1.2. The objective of the article
The objective of the proposed publication is a retrospective analysis of the knowledge and specifics of economic development of the Kryvyi Rih regional landscape and technical system.

1.3. Methodology
The study is based on the theoretical foundations of anthropogenic landscape science, constructive geography and geobotany. The authors used interrelated approaches (landscape-dynamic, constructive-scientific), principles (historicism, complexity and natural-anthropogenic combination) and research methods (retrospective, systemic, structural, etc.).

2. Results and discussion
The nature and landscapes of Kryvyi Rih region as a kind of historical and geographical region of the central part of Ukraine have long been of interest to scientists, but have been studied unevenly. Their uniqueness was recognized in the process of economic development, especially from the second half of the XIX century. Based on the analysis of the scientific literature in the history of the study of nature and landscapes of Kryvyi Rih region, we have identified two stages, which we describe below.

1. Stage of initial knowledge of nature (ancient times – the first half of the XIX century).
There are no direct written data that would record the beginning of this stage, but it is indirectly confirmed by archaeological materials. People began to actively inhabit the central part of Ukraine from the Upper Paleolithic (40–35 thousand years ago). The use of animals, plants, fishing, and later the development of animal husbandry and agriculture contributed to the diverse knowledge of nature associated with these forms of economic activity. Undoubtedly, this knowledge was at the household level, but it was purposeful. People studied only what was necessary for direct use – flora and fauna, in part – the soil. Knowledge of soils was due to the development within the Right Bank of Ukraine Trypillia Neolithic hoe-agricultural culture (V–IV thousand years ago). In the absence of writing, the transmission of knowledge (from father to son, from generation to generation or genus) and their dissemination took place orally and through practical skills. The first, original (oral) information bank of practical knowledge about the nature of certain regions of the Right Bank of Ukraine was created [25]. Moreover, people first tried to record their knowledge of nature in graphic images: rock paintings, individual stones and animal bones. No such materials have been recorded within Kryvyi Rih region, but they are available in the adjacent regions [25]. The illiterate period of learning about the nature of Kryvyi Rih region requires more detailed, related research by archaeologists and geographers.

With the advent of writing, the need for geographical knowledge is realized at the level of society. This was a kind of period in the knowledge of the nature of Kryvyi Rih region, and it is confirmed by Greek and Roman ancient sources. Almost all recognized Kryvyi Rih Regional Landscape Technical System: History of Knowledge and Specifics of Economic Development ancient Greek authors mentioned the ancient Ukrainian lands (Black Sea and steppe regions) in their works [26]. But, perhaps, the Hellenes really discovered Scythia after Herodotus’s History of Apodeiktis (Description of History) in 9 volumes. For almost a thousand years of ancient Greek culture, the idea of the permanence of the spatial image of Ukraine with well-defined coordinates has been preserved. Some descriptions were illustrated with cartographic images. The descriptions were complex: nature, population, economy, customs, traditions, etc.
Examples of complex descriptions of rivers became classic, in particular Gipanis (Southern Bug) and Borisfen (Dnieper), steppe and partly forest-steppe of Ukraine – Herodotus, Strabo, Ptolemy and others.

Much more information about the nature of the Kryvyi Rih region can be found in chronicles (late 1st millennium AD – XIII century), which was due to the origin, formation and intensive development of Kievan Rus and, accordingly, economic development of the Right Bank Ukraine.

Geographical information about the northern steppe regions of the Right Bank of Ukraine is in the chronicles, travel notes of Arab and Byzantine authors. These are mainly fragments of descriptions of the nature and population of certain regions of the Eastern Slavs – the Dnieper, the Northern Black Sea coast and natural objects – rapids on the Dnieper, individual rivers and more. Chronicles have become a qualitatively new form of describing the nature of Ukraine. Their complete collection consists of thirty-seven volumes. Chronicles are the only written sources that provide reliable chronologically recorded material about the nature of the forest-steppe and steppe of Ukraine, especially about adverse events: climatic, hydrological, biological and solar eclipses. The territory of Kryvyi Rih region at that time belonged to the Wild Steppe, where mostly Turkic tribes roamed. However, this does not mean that these steppe areas were unknown to the outside world. Thus, the meridional trade routes from the southern steppe regions of the Black Sea to the northern forest-steppes, laid in the Bronze Age and well mastered in ancient times, gradually turned into the famous Dnieper way from Vikings to Greeks in the early Slavs and Kievan Rus.

After the Tatar-Mongol invasion, the steppe part of Ukraine was occupied by nomads and often suffered devastating raids by Crimean Tatars, and is recorded in chronicles and historical documents as wild steppe or wild field. Later (XV–XVI centuries), rich in natural resources and sparsely populated Right-Bank Ukraine, especially the southern forest-steppe and steppe, attracted the interest of Western Europeans, who have already begun to develop intensive capitalist relations. This interest is well illustrated by the famous Description of Ukraine by G. Boplan [27]. In France alone, it has been republished 12 times [25]. This description contains detailed and true information about individual natural components – rocks, rivers, fertile lands, partly climate and plants. Repeated reprints of Description of Ukraine and other works by Western European authors show that in the sixteenth and seventeenth centuries. Right-bank Ukraine was well known, its nature studied and described in detail [25]. Undoubtedly, this also contributed to the fact that since the middle of the eighteenth century. Active economic development of not only the forest-steppe, but also the steppe regions of Ukraine begins, maps of individual provinces are drawn up in connection with the general demarcation of the Russian Empire. The stage of initial knowledge of Kryvyi Rih region ends with the fact that in addition to descriptions of nature, in the second half of the eighteenth century elements of scientific research and research are launched, expressed by academic expeditions (1768–1774) and intelligence of individual scientists. It was at this time that V. Zuev [28] found iron ores (iron slate) of Kryvbas. Their discovery gave impetus to new, more detailed studies of the nature of Kryvbas and became the starting point of its anthropogenic changes in the future.

2. Stage of knowledge of the nature of Kryvbas for the purposes of industrial development (second half of the XIX century – the beginning of the XXI century). The rapid development of industry in the second half of the nineteenth century not only in Western but also in Eastern Europe led to the active search for minerals, including fuel (coal, oil) and ore (iron, manganese, polymetallic, etc.). Favorably located in spatial terms, Kryvbas has attracted the attention of many scientists. Naturally, their attention was focused mainly on geocomponent research and primarily on the search for iron ore. It is here, in Kryvyi Rih, that a galaxy of wonderful and famous geologists has grown up. Their discoveries are recorded and analyzed in many scientific works, especially (as a result) in the Encyclopedia of Kryvbas [29]. In the second half of the XIX century. Exploration of iron ores of Kryvbas was successfully conducted by R. Kulshin.
(1825-1837), M. Barbot-de-Marne (1866–1867), L. Strippelman (1872), S. Gartung (1872-1873), L. Semechkin (1874), S. Kontkevich (1878–1887), V. Domger (1875), P. Pyatnititscy (1881). The results of their research have made it possible since the 80s of the XIX century actively extract iron ore and form a new industrial area.

In the late XIX and early XX centuries geocomponent research of Kryvbas is significantly expanding. Scientists are in the field of view of all components of nature, although their study is uneven. Productive geological research is conducted by A. Mikhalsky (1886–1888), M. Szymanowski (1888), geological and geomorphological – M. Sokolov (1896), V. Tarasenko (1914). At the end of the XIX century Klosovsky organizes the first meteorological network in the Middle Dnieper, which includes the areas of Kryvbas (Kryvyi Rih meteorological station was established in 1881); Zemstvo expeditions conducted in 1882-1916 under the leadership of V. Dokuchaev contributed to the study of soils. More attention is paid to geobotanical research of the steppes in general and the Kryvyi Rih region in particular – E. Lindeman, I. Akinfeev, A. Beketov, A. Grossheim (1917), I. Pachosky (1890-1915), I. Ryabkov (1898) and others. Hydrological research was conducted in conjunction with geological; less attention was paid to the river network and wildlife.

The First and Second World Wars weakened the process of learning about the nature of Kryvyi Rih region and only in the middle of the twentieth century Studies were continued. Among the scientists of this time geocomponent research was conducted by: geological and geomorphological – Y. Belevtsov, Y. Polovinkina, V. Natarov, D. Sobolev, G. Malakhov, V. Bondarchuk and others; groundwater – A. Alekseev, R. Ponov and others; climate – employees of Kryvyi Rih and Dovchynstev meteorological stations; vegetation cover – I. Dobrovolsky, V. Danko, V. Tarasova, V. Tereshchenko and others; surface waters – V. Natarov, P. Kalinin, V. Popov and others.

In the early 50’s of the twentieth century, in Ukraine Landscape research begins together with geocomponent ones. They were exploratory and initially performed ancillary functions in the conduct of research on physical and geographical zoning. This is most vividly reflected in the fundamental work Physical and geographical zoning of the Ukrainian SSR [30]. In this work, Kryvyi Rih is referred to the Ingulets, Saksagan valley-beam district, the characteristics of landscape complexes are given at the level of local types. Partially complex studies of the nature of Kryvyi Rih region were conducted earlier and were published in the form of separate chapters (essays) in monographs [31]. The most detailed physical-geographical description of Kryvyi Rih region was made only in the early 90’s by L. Bulava, but this work was deposited, not published [32].

During the twentieth century, as a result of intensive development of iron ores, not only geocomponents but also landscape complexes of Kryvbas have been radically rebuilt. Accordingly, the content of scientific research is changing – the object of study are anthropogenic geocomponents, landscapes and environmental problems inherent in the zones of technogenesis. Geological research is conducted by V. Reshetnyak, M. Semenenko, E. Shnyukov, B. Pirogov, I. Paranko, V. Evtekhov, E. Lazarenko; geomorphological – M. Semenyuk, I. Dobrovalsky, V. Shanda, I. Comisar, A. Denisov et al. The vegetation of rock refuse is studied by V. Chayka, M. Smetana, V. Kucherevsky, S. Yarkov and others. The first attempts to study the changed landscapes of Kryvyi Rih region began in the 50-60s of the twentieth century. These attempts also do not belong to geographers, but to geologists – V. Bondarchuk and T. Klevtsov. In particular, landscapes formed under the influence of mining and mining techniques, V. Bondarchuk suggested calling it mining. In the meaning of the term mining landscape he focused on landscape and geomorphological features, and saw the difference between them only in appearance: color is a characteristic feature of the iron ore landscape [33].

Studies of anthropogenic landscapes of Kryvyi Rih region began only in the 80s of the twentieth century. Y. Titiunnik, L. Bulava and especially in the 90s and now – V. Kazakov.
In addition to landscape scientists, industry experts, including geologists, zoologists, and geobotanists, have begun to conduct research related to landscape science. In this regard, the most interesting are the studies of I. Malakhov, O. Smetana and M. Smetana. In the works of I. Malakhov often focuses on the identification of factors of technogenesis in the geological environment from landscape perspectives; It is shown that the Kryvyi Rih iron ore basin is a typical object for studying man-made changes in the geological and, in general, natural environment. I. Malakhov compares the natural and man-made parameters of Kryvbas ecosystems, considers some aspects of management of man-made processes in the natural environment [34].

If we take into account that changes in zoocenotic complexes of steppes are still insufficiently studied, the study of O. Smetana and N. Smetana on the structure of the terrestrial mesoform of Kryvbas is extremely relevant [35]. The structure of a biocoenotic group or its components is inextricably linked to the state of the environment and can therefore be an indicator of ecotoxicological effects. These authors were able to determine the most informative indicators of structural organization of terrestrial mesofauna groups to assess the degree of anthropogenic transformation of biogeocenoses, ecological status and indication of the most important soil formation processes in anthropogenically disturbed and man made biocenoses of Kryvyi Rih region. The research coincides with the research of landscape scientists at the level of facies and, in part, tracts.

The relative flatness of the Kryvyi Rih iron ore basin, typical steppe climatic conditions and soils give the impression of simplicity of natural conditions, and there were no reports of natural resources until the second half of the nineteenth century. In fact, the Kryvbas region is extremely interesting and rich in nature, which has attracted many researchers. Thanks to their research, it was proved that Kryvyi Rih region is unique in its natural and, later, social features.

Having paid attention to the periodization of the history of knowledge of Kryvyi Rih region, we intend to dwell briefly on the specifics of economic development of this region.

Kryvyi Rih region, as it is now, began to take shape in 1881, when, due to the beginning of iron ore mining, the first industrial complexes appeared. Iron ore mining was started by O. Pol that started not only the mining industry in the area, but also a consistent geological study of Kryvbas. In 1835, P. Kulshin, an engineer in the mining department, began his research work. His book, published in 1839, contained the first qualified description of aspid and iron-quartz shales, brown coal seams, and quartz cores with copper. M. Barbot-de-Marne, doctor, professor of geology at the St. Petersburg Mining Institute, wrote in 1869 that ore layers here themselves come to the surface. In 1872, at the invitation of O. Pol the mineral fields of Kryvyi Rih region were studied by mining engineers from Germany, Gartung and Stripelman. After translating their work, O. Pol published a book in 1875, where for the first time it was about the occurrence in Kryvyi Rih region of powerful deposits of ores with high iron content (70%). In 1874, the mining engineer Felsko wrote that Kryvyi Rih could be called the Golden Horn. In 1880 S. Kontkevich published the work Geological description of the vicinity of Kryvyi Rih in the Kherson province, which was about the layers of ferruginous quartzites. Information from the study of S. Kontkevich reached Western Europe, and these data were included in the 19-volume work of French geographer Jacques Elise Reclus Earth and People.

Convinced of the industrial significance of the iron ore deposit, O. Pol, together with French financiers and entrepreneurs, founded The Kryvyi Rih Iron Ore Joint Stock Company in 1880. This year can be considered the beginning of constant and significant industrial development of the Kryvyi Rih iron ore basin. Initially, these were only iron ore mining sites. In 1884 the first Ekaterinoslav railway was built, which connected Kryvbas with Donbass, which gave impetus to the development of the metallurgical processing industry. From 1892 to 1917 the Gdansk Iron Foundry operated in the city – the first metallurgical complex for iron ore processing. The development of ferrous metallurgy, with a break during the Civil War and postwar
devastation (1918–1922), continued. This was due to the construction in 1934 of the Kryvyi Rih Metallurgical Plant and the Coke Plant in 1936. Water resources of the region have been actively used since 1932, when the first stage of the Karachunov Reservoir on the Ingulets River and the Kresiv Reservoir on the Saksagan River (1948) was put into operation. In 1952, the Mining and Cement Plant was launched, which gave a significant impetus to the development of construction geosystems to meet the needs of industrial and residential construction.

In the 1950’s and 1960’s, the 5 largest mining and processing plants in Europe for the extraction, enrichment, and processing of poor iron ores began to operate: the Southern, Novokryvyi Rih, Central, Northern, and Ingulets. Along with them, mines continue to operate, where rich iron ores, to a lesser extent iron quartzite, are mined underground in mines.

During the 60–70’s of the twentieth century a number of machine-building plants are under construction: Kryvyi Rih Central Ore Repair Plant (1961). Kryvyi Rih Diesel Plant (1966), Kryvyi Rih Electric Plant (1971), Remgormash Plant (1975) and others. In the same years, the light (wool spinning, shoe and garment factories), food (bakery, dairy, bakery, etc.), construction (Kryvyi Rih silicate plant, house-building plants), chemical (Kryvyi Rih meer factory) industries developed. The length of the railway of the Kryvyi Rih branch of the Dnieper Railway increases to 985 km.

The main difference between the development of the nature management system and the population in Kryvyi Rih region since the 80’s of the XIX century there was a narrow specialization - ferrous metallurgy, mining and processing of iron ore. To achieve this goal, the able-bodied population was concentrated extensively, developed as ancillary transport, construction, engineering, light, food, chemical industries, created reservoirs and water canals, Kryvyi Rih region power plant. All this was to serve the Kryvbas mining and metallurgical complex.

Natural resources were also used to a limited extent. The main valuable raw materials were and still are iron, iron ore. Other mineral resources – building materials (sand, clay, limestone, granite), meerschaum – were of secondary importance in the system of nature management. The peripheral zone of Kryvbas supplies food to the population of Kryvyi Rih region, which is obliged to work on metal. Forests and reservoirs around Kryvyi Rih play a conservation and recreational function. There is a close interaction of nature, economy and population, which takes place in a small and compactly organized area. Interacting with each other, these factors for 120 years have formed a special, unified space-time integral structure, which is traditionally called Kryvbas, Kryvyi Rih, Kryvyi Rih region. Kryvbas has outgrown its original meaning only as the Kryvyi Rih iron ore geological and mining basin.

The phenomenon of Kryvbas is wider and deeper, it combines nature, technology and man, gave grounds for the formation of a kind of social mentality in Kryvyi Rih. Close interaction of nature, economy and man, narrow specialization of the economy is the basis for the development of Kryvyi Rih region unique for Ukraine anthropogenic landscapes.

From the second half of the XIX and to the beginning of the XXI century the natural steppe landscapes of Kryvbas have been radically replaced by mainly industrial and residential ones. The processes of technogenesis affected no more than individual geocomponents, and the landscape as a whole, created new, unprotected for steppe zones anthropogenic landscapes.

The main classes of such landscapes are industrial (mining rock refuse, dips, quarries and factory), transport (in other interpretations – road landscapes), recreational, residential (residential and non-residential), agricultural, forestry, water management, beligerative (military), service, wastelands (landfills, industrial rock refuse, abandoned and demolished settlements, etc.), protected areas (reserves and monuments that develop under moderate pressure from man) and other landscapes, which are presented in the map below.

We characterize some modern landscapes of Kryvyi Rih region, mapped in figure 1.

*Residential landscapes* (from the word “settle”) are anthropogenic landscapes of settlements...
Figure 1. Modern landscapes of Kryvbas.
1 – factory; 2 – mining; 3 – dumps; 4 – about free; 5 – extractive; 6 – non-residential;
7 – residential; 8 – serving; 9 – reservoirs; 10 – pond; 11 – transport; 12 – beligerative;
13 – forestry; 14 – tourist; 15 – forest parks; 16 – field; 17 – garden; 18 – garden; 19 – pasture;
20 – country; 21 – post-industrial PTC; 22 – borders of Kryvbas.
with their buildings, streets. The city of Kryvyi Rih region with its economy and population is an active form of human influence on nature. Natural landscapes were radically rebuilt. In Kryvybas, urban landscapes together with mining are harbingers of the formation of a more powerful anthropogenic landscape.

The structure of urban landscapes, in our opinion, has a number of specific features:

- in the urban landscapes of Kryvyi Rih region all natural components and landscape complexes have undergone radical changes, while in agricultural landscapes – mainly soil cover, anthropogenic aquatic – surface waters and so on. Moreover, they can be rebuilt repeatedly and in the end bear little resemblance to their natural counterparts;
- some landscape complexes within the city level facies, tracts, types of areas disappear completely: covered and leveled ravines and gullies, lakes; floodplains are being flooded; hills are cut off. In Kryvyi Rih, the scale of such transformations, in our opinion, reaches the level from physical and geographical areas to the region, but does not yet affect the zonal formations. The city has radically rebuilt or re-created landscape complexes that have lost the ability to self-development.

The structure of urban landscapes introduces new anthropogenic components - technomass and technocomponent (asphalt pavement, residential and industrial buildings) and created on their basis landscape complexes, the functioning of which is directed and controlled by man. There is a technicalization of natural landscapes - filling them with different techniques [36]. At the same time, urban landscapes continue to be an integral part of nature and continue to develop according to its laws.

Residential landscapes of Kryvybas are divided into 2 subtypes: non-residential (cemetery) and residential, with such genera as low-, medium-altitude and high-altitude geosystems.

Service landscapes are represented by subtypes of household, managerial, scientific-educational, trade, and by their properties are close to residential and are formed on a paragenetic basis.

Agricultural landscapes (AGL) of Kryvybas are divided into field, garden, garden, pasture and country. These landscapes are the oldest of the anthropogenic -ones formed in Kryvyi Rih. Organizational heterogeneity of agricultural landscapes allows us to divide them into two groups: the actual SGL and agricultural landscape engineering systems.

Forestry landscapes – planted forests. Forest plantations with genera: forest protection and forest-strip landscape complexes. It should be noted that there are no natural forests left in Kryvyi Rih. Here the forests are planted by man. They now occupy an area larger than before the active transformation of the natural landscapes of Kryvyi Rih region. In Kryvyi Rih plantings you can find almost all types of trees that form natural forests. All silvicultural landscapes belong to the type of perennial, partially regulated anthropogenic complexes. With the successful selection of trees, planting sites and the necessary forestry equipment, they can exist for decades or even centuries.

Water management landscapes – reservoirs, ponds, canals and settling tanks, built mainly in the 50-60s of the twentieth century, during the most active economic development of water resources of Kryvybas. In the vicinity of Kryvyi Rih region, only 9 reservoirs with a total area of 9,340 hectares have been created for water supply and public utilities; there are 25 reservoirs for agricultural purposes.

Gradually changing the natural landscapes of rivers and their floodplains, water-anthropogenic landscapes have become carriers of information about the state of river basins and surrounding areas. This applies primarily to ponds created in the floodplains of Visuna, Bokova, Zhovta, Zelena and other small rivers of Kryvybas.

Road (transport) landscapes have subtypes: railway, automobile, aviation, pipeline and electrical, pedestrian. Two hundred years ago, several roads passed through Kryvyi Rih, the
most famous being the Kyzykyrmen (Black Way). Now all Kryvyi Rih region is crossed by highways. Now road landscapes are a complex system of various anthropogenic complexes. In their structure there are actually anthropogenic landscapes (abandoned sections of roads, quarries, swampy depressions formed as a result of road construction and roadside forest belts), landscape-technogenic and landscape-engineering systems. These complexes include existing railways, highways and dirt roads, interchanges, overpasses, stops, and for the past 15-20 years and service facilities. Landscape-technogenic geosystems are represented by drainage structures, bus stops, wells, numerous monuments of the historical past, etc. These are azonal landscape complexes, the development of which is determined by the technical unit, and the functioning depends in part on natural conditions.

Beligerative landscapes are landscape complexes of military origin: military training grounds with fortifications, ramparts, trenches, explosion funnels, dugouts, etc. They can often be found in Kryvyi Rih, especially in the area of the 17th tank division. Of particular interest are the tracts of single mounds – the simplest beligerative complexes. Their age – from several millennia (Bronze Age) to several hundred years. More often it is graves, but also guard mounds. Currently, most of the single mounds of Kryvyi Rih region are plowed. Every year they become less noticeable. Almost all mounds of Kryvybas must be protected.

Recreational landscapes. In the structure of anthropogenic recreational landscapes by age the youngest. Purposeful formation of recreational landscapes began in Kryvyi Rih at the end of the XIX century construction of parks for citizens (F. Marshavtsev Park) and in the estates of landowners. Despite the youth of these landscapes, their role will continue to grow in the future. Thus, the possibility of recreational development and formation of recreational neo-landscapes at the expense of other classes of anthropogenic landscapes, including industrial.

Desert landscapes have subtypes of post-industrial, post-residential, landfill, agricultural, water-desert. These are the so-called "abandoned" lands after their use. The development of these landscape complexes is complex and diverse. If agricultural dependent lands can be transformed into zonal steppe landscapes through the process of synthetic genesis, then post-residential or industrial ones have unpredictable development and can be replaced by new ones.

Industrial landscapes. Taking into account the peculiarities of development, landscape structure and impact on the environment, industrial landscapes should be divided into industrial and mining. In fact, industrial landscapes are formed around large industrial enterprises or areas. Mining landscapes are those that are formed under the influence of mining and mining techniques. These landscapes, in comparison with other industrial landscapes, have the most significant impact on the material composition, development and structure of natural and anthropogenic landscapes.

In the region of mining, all components of the natural environment have been radically changed, specific, depleted and less stable, compared to natural, mining landscapes with a more differentiated, contrasting and dynamic structure.

Field landscape research and analysis of literature sources on mining (technogenic) landscapes allowed for the zone of technogenesis of Kryvbas to make a system of typological structures, presented in the table 1.

In landscape studies of man-made (mining) landscapes, facies types are not always distinguished due to their significant diversity, small area and short-term operation. Facies are of paramount importance in the cognition of the synthetic genesis of plant groups of man-made landscapes, they are clearly distinguished and studied in detail. They are the basis for further research on the synthetic genesis of plant communities and man-made landscapes in general.
Table 1. A system of typological structures.

| Typological structures of the zone of technogenesis of Kryvbas | Characteristics of typological structures                                                                 |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Man-made tracts                                               | are distinguished as a result of differences in the lithological composition of soil mixtures, relief and phytocenotic cover; |
| Man-made landscape areas                                      | system of interconnected tracts, sufficiently separated in the structure of localities under the influence of morphological or any other factor; |
| Man-made areas                                                | system of tracts and landscape areas, the formation of which is due to one way of technological (mining) activities in similar geological-geomorphological and hydrogeological conditions. Depending on the physico-chemical composition of extractive rocks, the peculiarities of their interaction with water and physico-geographical processes, the types of man-made areas are divided into options (iron ore, manganese, granite, sandstone, limestone, etc.); |
| Man-made landscapes                                           | system of tracts, landscape areas and areas formed in areas with the same type of technological schemes of economic activity. As an example: due to the development of minerals formed quarry-dump, underground – mine subsidence-heap types of man-made landscapes; |
| Man-made facies                                                | is distinguished on the basis of the unity and homogeneity of soil mixtures, moisture and vegetation in the corresponding micro shape of the surface and is often an indicator of various processes that characterize a typological structure of the man-made landscape. |

3. Conclusion

The analysis of literary and cartographic sources allowed to distinguish two stages in the history of landscapes, as well as economic development of Kryvbas: the stage of initial knowledge of nature (ancient times – the first half of the XIX century) and the stage of nature research for industrial development (second half of the XIX century – the beginning of the XXI century).

Periods differ in time intervals and results, but really show the course and features of the formation of a complex and unique landscape-technical system of Kryvbas. This system was formed on the basis of unique reserves of mainly iron ores, partly other types of minerals. In the process of its operation (over 120 years) geocomponents and landscape complexes with an area of over 100 thousand hectares have been involved and radically changed. Here were formed industrial and residential landscapes that have no analogues in world practice. Their structure is unique and includes fragments of all other currently available classes of anthropogenic landscapes. Among the industrial ones, mining landscapes, in particular, deserve special attention. They are the most suitable landscape complexes not only for reclamation works, but also for cultivation of the whole landscape-technical system of Kryvbas.
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