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The methodology of landscape science: current state, problems and prospects

Siemionow Ju. M., Snytko W. A. **Metodologia krajobrazoznawstwa: stan współczesny, problemy i perspektywy.** Omówiono historię rosyjskiego krajobrazoznawstwa, przedstawiono główne etapy rozwoju jego podstaw teoretycznych. Powstanie krajobrazoznawstwa jako nauki i gałęzi geografii ma związek z nazwiskiem wielkiego rosyjskiego badacza W. W. Dokuczajewa. Opracował on metodologię syntezy geograficznej, która później w pracach jego uczniów i następców przekształciła się w naukę o krajobrazie. Początek tworzenia współczesnej metodologii nauki o krajobrazach przypada na połowę XX w. na podstawie uzgodnienia poglądów geografii ogólnej i krajobrazoznawstwa. Przedstawione przez W. B. Soczawę podejście geosystemowe pozwoliło na przegląd logicznych podstaw nauki o sferze krajobrazowej, wyraźne rozgraniczenie zadań geografii fizycznej i innych dyscyplin geograficznych. Poznanie i kartograficzne zobrazowanie organizacji geosystemów wymaga określenia prawidłowości ich zróżnicowania, integracji i rozwoju. Dalszy rozwój nauki o geosystemach zależy od stworzenia współczesnej klasyfikacji krajobrazowej, adekwatnie wyrażającej organizację powłoki geograficznej, która powinna łączyć rzędy taksonomiczne: typologiczny, chorologiczny i dynamiczny. Klasyfikacja powinna być oparta na poprawnych danych ilościowych: krajobrazowo-geofizycznych, krajobrazowo-geochemicznych i biogeocenologicznych. Wynika stąd konieczność doskonalenia metodyki zbioru, prezentacji, analizy i tematycznej interpretacji informacji geograficznej. Konieczne są więc nowe, oparte na nauce o geosystemach, standaryzowane metody kartowania tematycznego, tworzenia GIS, zastosowania materiałów satelitarnych. Konieczna jest też kontynuacja zbliżenia krajobrazoznawstwa i ekologii krajobrazowej, sprzyjającego rozwojowi metodologii nauki o krajobrazach.

Семенов Ю. М., Снытко В. А. **Методология ландшафтоведения: современное состояние, проблемы и перспективы.** Рассмотрена история российского ландшафтоведения, представлены основные моменты развития его теоретических основ. Возникновение ландшафтоведения как науки и отрасли географии связано с именем великого российского исследователя В. В. Докучаева, разработавшего методологию географического синтеза, которая затем в трудах его учеников и последователей выразилась в представлении о ландшафте. Создание настоящей методологии науки о ландшафтах было начато в середине XX в. на базе согласования представлений общего землеведения и ландшафтоведения. Предложенный В. Б. Соцовой геосистемный подход позволил пересмотреть логические основы учения о ландшафтной сфере, четко разграничить задачи физической географии и отраслевых географических дисциплин. Познание и картографическое отображение организации геосистем требуют выявления закономерностей их дифференциации, интеграции и развития. Дальнейшее развитие учения о геосистемах требует создания современной ландшафтной классификации, адекватно отражающей организацию географической оболочки, которая должна включать три таксономических ряда: типологический, хорологический и динамический. Классификация должна строиться на корректных количественных данных – ландшафтно-геофизических, ландшафтно-геохимических и биogeоценологических. Отсюда возникает задача совершенствования методики сбора, отображения, анализа и тематической интерпретации географической информации. Здесь необходимы новые, базирующиеся на учении о геоси-

стемах, стандартизированные методы тематического картографирования, создания ГИС, применения аэрокосмических материалов. Необходимо продолжить сближение ландшафтоведения с ландшафтной экологией, способствующее развитию методологии науки о ландшафтах.

Key words: landscape science, methodology, history of science, geosystem approach, classification of geosystems
Słowa kluczowe: nauka o krajobrazie, metodologia, historia nauki, podejście geosystemowe, klasyfikacja geosystemów

Ключевые слова: ландшафтоведение, методология, история науки, геосистемный подход, классификация геосистем

Abstract

The paper considers history of Russian landscape science and the main moments of the development of its theoretical foundations. The emergence of landscape study as a science and branch of geography is associated with the name of the great Russian researcher V. V. Dokuchaev, who developed the methodology of geographical synthesis, which then manifested itself in the concept of landscape in the works of his students and followers. The creation of a methodology for landscape science began in the middle of the 20th century based on the harmonization of ideas of general geography and landscape science. The geosystem approach proposed by V. B. Sochava had helped redefine the logical foundations of the landscape sphere doctrine, and clearly distinguish between the tasks of physical geography and sectoral geographical disciplines. Cognition and mapping of the organization of geosystems imply identifying patterns of their differentiation, integration and development. Further development of the geosystem doctrine requires creation of a modern landscape classification that could adequately reflect organization of the geographical envelope, which should include three taxonomic series: typological, chorological and dynamic. The classification should be based on the correct quantitative data: landscape-geophysical, landscape-geochemical and biogeocenological. This raises the issue of improving the methodology of screening, representation, analyzing and thematic interpretation of geographical information. Here, new standardized methods of thematic mapping, based on the doctrine of geosystems, GIS creation, application of aerospace materials are needed. Here, new, based on the doctrine of geosystems, standardized methods of thematic mapping, creation of GIS, application

of aerospace materials are needed. It is necessary to continue the convergence of landscape science with landscape ecology, contributing to the development of the landscape science methodology.

Introduction

Landscape science is a branch of physical geography that studies complex natural and natural-anthropogenic geosystems as part of the geographic spheres of the Earth. This science considers the origin, structure, change, spatial differentiation, integration of geosystems, as well as their changes under the influence of natural and anthropogenic factors.

The emergence of landscape science as a science and branch of geography in our country is usually taken to be associated only with names of Russian researchers. Its should be borne in mind that among scientists who somehow perceived the relationship of those natural bodies that we now call landscape components (STC and geosystems), and the differences between the territorial integrity formed by them, in parallel with V. V. DOKUCHAEV (1899) [who developed the methodology of geographical synthesis, which then manifested itself in the concept of landscape in the works of his students and followers (ISACHENKO, 2004)], A. I. Voeikov, A. I. Krasnov, G. I. Tanfiliev, G. F. Morozov, and G. N. Vysotsky, there were also A. Humboldt, C. Ritter, J. P. Marsh, A. Göttner, E. Passargue.

The foundations of the future landscape science and the beginnings of the theory of landscape science here, in the Russian Empire and the USSR, were created by L. S. Berg, S. S. Neustruev, R. I. Abolin, A. A. Borzov, B. B. Polynov,

I. V. Larin, I. M. Krashennnikov, M. A. Pervukhin, L. G. Ramensky, V. N. Sukachev, S. V. Kalesnik and other geographers. Unfortunately, everything that was achieved in this field outside the Soviet Union left no traces in our landscape science.

Emergence of science about a landscape

The year of publication of the monograph "Landscape-geographical zones of the USSR" is widely considered to be the date of emergence of Soviet landscape science. Then, in the "Introduction" L. S. BERG (1947) defined the term "landscape" and outlined the goals of geographers in its cognition (identifying external features, structure, boundaries, relationships with the external environment and other landscapes, history of development and changing landscapes), which actually became guidelines for the development of physical geography. Then, this "country specific" direction changed to a "typological" one, having its main task to develop principles and methods for allocation, classification of "elementary" and "geochemical" landscapes (works by B. B. Polynov, M. A. Pervukhin and A. N. Ponomarev), which became the main one until the end of the 1940s.

That attitude to landscape science and Soviet physical geography, which later became classical for domestic geographers, was formulated in the middle of the 20th century, but we count the very emergence of this methodology from N. A. SOLNTSEV'S (1948) statement at the II All-Union Geographical Congress. In his hypothesis of landscape morphology N. A. Solntsev formulated the fundamental principles of landscape science and developed the principles for allocation of landscapes and their units "in the field". He considered a landscape to be the subject of landscape science and its morphological parts, and attributed natural territorial complexes of a higher rank to the competence of physical and geographical zoning. In landscape science, N. A. Solntsev singled out history, morphology, dynamics, systematics, landscape re-

search techniques, and even applied landscape science, making a significant contribution to the development of all these sections.

History of development of the landscape ideas

In my view, creation of a real, full-fledged methodology of landscape science was started in the middle of the 20th century, when our physical geographers came to a "regional" understanding of landscape as one of the taxonomic units of physical and geographical zoning based on harmonization of the concepts of general geography and landscape science. In 1950s and '60s some attempts were made to conceptualize general geographic and landscape approaches in physical geography (S. V. Kalesnik, A. G. Isachenko, D. L. Armand, and F. N. Milkov), and in 1960s and '70s geosystems of regional dimension also became full-fledged objects of landscape science (N. A. Gvozdetsky, A. A. Makunina, V. A. Nikolaev, G. S. SamoiloVA, A. E. Fedina and K. N. Dyakonov).

In 1963, the term "geosystem", proposed by V. B. Sochava first appeared in geographical literature (SOCHAVA, 1963). The systematic approach enabled the reconsideration of logical foundations of the hypothesis of landscape sphere, and clear division of tasks of physical geography and sectoral geographical disciplines. Geosystems are open hierarchically organized dynamic systems, and each level of their hierarchy represents a dynamic integrity with a special inherent geographical organization. The organization of geosystems includes their differentiation, integration, development and their functioning, therefore, the hypothesis of geosystems includes theoretical statements that substantiate the laws of their classification, mapping, dynamics and evolution. Investigations of Siberian landscape researchers, V. B. SOCHAVA (1978) and his followers (SNYTKO, 1978; KRAUKLIS, 1979; MIKHEYEV, 1987), made a significant contribution to the establishment and adoption of a new paradigm of physical geography. At the Siberian geographical stations, ma-

ny methodological aspects of experimental research have been developed, expanding knowledge about the development and functioning of landscapes, and actually leading to the creation of a new structural and dynamic direction in landscape science, which has ultimately ensured a methodological and thematic restructuring of the theory of complex physical geography. Based on this trend, in 1977 a typological landscape map of the south of Eastern Siberia, M 1 : 1,500,000 (MIKHEYEV, RYASHIN, 1977), was published, and subsequently, geosystem maps of other territories or on different scales were compiled (V. S. Mikheyev, L. N. Purdik, V. V. Ryumin, Yu. M. Semenov, E. I. Kuzmenko, E. G. Suvorov, G. I. Lysanova, T. I. Kononova, T. I. Kuznetsova et. al).

Approaches by N. L. BERUCHASHVILI (1989), who believed that geomasses are the elementary structural and functional parts of the NTC, and considered the homogeneous layers in the NTC profile to be geohorizons, were quite close to the geosystem doctrine. The synthesis of changes in processes and phenomena in the NTC are "NTC states": short-term ("steks"), medium-term, and long-term. N. L. Beruchashvili was perhaps the first famous landscape scientist who made computer modeling, developed computer models of state transitions and managed to show the forecast of steks on TV. He also owns the concept of "landscape ethology".

According to A. G. ISACHENKO (2004), when studying carefully various definitions of "complexes" and "systems", we can distinguish semantic differences between them: the "system" contains an emphasis on orderliness, and the "complex" – on communication and interdependence. Every complex is a system, but not every system is a complex: a system is a broader (universal) concept, generic to the complex.

The current state and the main problems of science about a landscape

At the present stage of landscape study, our science has been enriched with new sections, such as landscape geophysics, multisystem analysis and synthesis, GIS application, landscape agriculture, landscape aesthetics, landscape forecasting, landscape planning, etc. (V. A. Nikolaev, K. N. Dyakonov, Yu. G. Puzachenko, I. I. Mamay, E. G. Kolomyts, A. Yu. Reteyum, V. I. Bulatov, V. V. Kozin, A. K. Cherkashin, M. D. Grodzins'kii, A. N. Antipov, A. V. Drozdov, A. V. Khoroshev, E. Yu. Kolbovsky, D. V. Chernykh, E. A. Pozachenyuk and V. T. Starozhilov).

K. N. DYAKONOV (2008) identifies different directions in the development of modern landscape science, namely structural-genetic, functional-dynamic, evolutionary and applied one. A. V. KHOROSHEV (2016) believes that the functional and dynamic directions should be separated, and the applied direction should not be considered in isolation, but in conjunction with structure, dynamics, functioning and evolution of geosystems. In his opinion, all issues in landscape science can be represented as a "web" of plot branches originating from the terms "structure", "functioning", "dynamics" and "evolution".

The key to the landscape science methodology is, firstly, that the landscape (NTC, geosystem) is an objective reality, secondly, it has dimensions, external borders and internal structure, and, thirdly, it was once formed and is still developing.

Landscape science, in spite of the emergence of branches – geochemistry of landscapes, geophysics of landscapes – in and of itself, as before, comes down mainly to landscape morphology. Due to reasons far from science the evolutionary-dynamic concept created by V. B. Sochava, A. A. Krauklis, V. S. Mikheyev, V. A. Snytko, N. L. Beruchashvili, I. I. Mamai and other researchers, "goes hungry" without experimental data obtained in field stations in re-

cent decades. Our landscape science remains, on the whole, a qualitative science, and all sorts of morpho- and cartometric surveys, appeals to Earth remote sensing and GIS cannot give a quantitative idea of the properties of geosystems.

There are landscape scholars who believe that the pure physical-geographical concept of landscape science is generally outdated. So, E. Yu. KOLBOVSKY (2013) maintains, that in recent years there has been a theoretical breakthrough, bringing us closer to understanding the landscape as not a natural, but a natural-cultural phenomenon, i.e. geographers seem to have managed to bridge the gap that has long existed between physical-geographical ("natural") landscape study and the theory of cultural landscape.

In recent years, Russian landscape science has found common ground with landscape ecology, which was proposed by V. B. SOCHAVA (1978). The result of the interaction of Russian landscape science and the "western" landscape ecology was, in particular, the emergence and development of such branches of landscape science as landscape planning and assessment of ecosystem services.

In Russian landscape planning, there are at least three main currents: 1) "classic", common in Western Europe (in the most developed form in Germany), performed by landscape planners (landscape engineers), 2) Russian "landscape", developed at Moscow State University and a number of other universities, which is based on the principles and methods of landscape science and is carried out by landscape experts, 3) Russian "ecological" (environmentally oriented land use planning), based on the approaches of integrated physical geography and carried out by a team of specialists under the guidance of a landscape specialist. The first current usually does not use landscape maps, only as an auxiliary tool for assessing the appearance of landscape and its recreational capacity. In the second one the landscape maps are the most important tool and source of information about the natural properties of the territory; in the third,

they are a cartographic basis and a tool for assessing landscapes (geosystems). An integrated physical and geographical approach, involving specialists of individual components of geosystems, is able to work fruitfully in landscape planning, considering natural features of the territory in details would be done by landscape planners without the participation (assistance) of industry specialists (SEMENOV, 2017).

Conclusion

Cognition and mapping of the organization of geosystems imply identifying patterns of their differentiation, integration and development, and all these can be obtained only as a result of analysis, interpretation of certain data on the properties of both individual components and the geosystems as a whole. In geography empirical data are obtained in expeditions, field stations, and key and profile sites. The expeditionary method provides only a small range of data on the landscape structure and properties of geosystems, but in order to obtain information on dynamics and functioning of geosystems, we need undertake research at field stations and key sites with seasonal or other periodic semi-stationary investigations. In key sites of reference landscapes, typological units should be studied that determine the epiphacial structuring of knowledge as a whole. Analysis of all modifications of indigenous geosystems should focus on identifying the principal defining core of the study geochore. Description techniques, indicators of the structure and dynamics of geosystems need to be developed and unified, and cadastres of features, including physiognomic and decoding ones, for analysis and interpretation of satellite imagery data have to be established.

Further development of the geosystem doctrine requires creation of a modern landscape classification that could adequately reflect organization of the geographical envelope, which should include three taxonomic series: typological, chorological and dynamic. The classification should be based on the correct quantitative da-

ta – landscape-geophysical, landscape-geochemical and biogeocenological. This raises the issue of improving the methodology of screening, representation, analyzing and thematic interpretation of geographical information. Here, new standardized methods of thematic mapping, based on the doctrine of geosystems, GIS creation, and application of aerospace materials are needed. Moreover, everything should be balanced and worked out specifically for the purpose of mapping geosystems.

It is also necessary to continue the convergence between our landscape science and landscape ecology, develop theoretical foundations of such co-creation and put its results into practice more widely.

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