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MODELS OF LANDSCAPE UNITS – UTOPIA OR NECESSITY?

Abstract: This paper is devoted to typology as the basic method of landscape research. The first part shows the cognitive, educational and practical roles of landscape typology models. Second part presents a new method of creating a universal model, independent of the charting scale. The results of the paper confirm the feasibility of creating a reference base of Earth's landscapes and indicate the necessity to an international discussion on this topic.

Key words: Landscape typology, methodology of geography, landscape reference base.

THE IMPORTANCE OF LANDSCAPE TYPOLOGY MODELS

Typology is the basic method of identification and description of objects in natural sciences. Having a catalogue of models, with which the reality under investigation can be compared, is a necessary condition for creating a typology. Such models, also called types, may be real or ideal. Real models are objects existing in reality, whose features illustrate a certain group in the most faithful and complete manner. In the scientific practice using such models is not convenient, since referring to a specific terrain as a model does not ensure the precision of the description. For that reason ideal models, that is, sets of features whose presence determines a certain type, are used most often.

Creating typological models is one of the most important tasks of natural sciences. Models (or types) function as the fundamental language of science, without which investigating the reality would be nothing more than collecting facts, without the possibility of comparing them with other facts or – the more so – without the possibility of explaining them. It is worth emphasizing that without models of objects, communication of the research results, their verification and scholarly critique would also be impossible. As Prusinkiewicz (1985) aptly emphasizes, creating even one model is regarded as a success of science, since it allows to compare the newly researched areas with the model.

Education is the second purpose of creating models of natural objects. In teaching practice, we teach not about each individual geographic object

(a specific soil pit, specific frontal moraine), but about characteristic features of models (e.g., soil types, relief form types) and about spatial distribution of objects satisfying the characteristics of the given model. Creating a universal catalogue of models is therefore important for the teaching of geography, especially nowadays, when great significance is attached to the globalisation of the education process and of the ecological education.

Practice is the third purpose of creating models. This purpose is becoming particularly important in recent years because of the introduction of the principle of sustainable development to the spatial planning. Rational management of natural resources requires a good documentation, which in turn is not possible without unified, accurate, and at the same time universal models of charting.

In view of the above, creating unified models of typology of natural objects, including landscape geosystems, achieves the rank of a basic task for all physical-geographical disciplines. And yet since the 1990s in the Polish landscape geography one can observe a certain regress in the interest in these issues, sometimes described as the crisis of the "geocomplex paradigm" (cf. Richling, Ostaszewska 1993, Widacki 1994, Pietrzak 1994). In the author's opinion the crisis of the paradigm should be referred only to a certain method of distinguishing geocomplexes. This method made the kind of the typology model used in practice dependent on the charting scale and assumed the objective existence of the reference fields, that is, of spatial units of various taxonomical ranks. Rejecting this assumption does not in any way diminish the importance of the typology as a method of research of landscape patterns. On the contrary, typology is the fundamental method in investigation of natural qualities, regarded as continuous (a continuum). Each point in space can be mentally separated from the environment and compared with the model, without which its characteristic **loses its scientific sense** (Prusinkiewicz 1985). For that reason, the crisis of the geocomplex paradigm should not in any case be a reason for the regress of work on the creation of a catalogue of models, which would function as a reference base of Earth's landscapes. An important stage of this work will be the creation of universal models, that is, of models independent of the area of research and of the charting scale.

A SUGGESTED METHOD OF CREATING THE UNIVERSAL LANDSCAPE MODEL

A basic obstacle for creating an ideal model of an object is the selection of the characteristics regarded as gauging the object. Two approaches are here possible. The first focuses on factors influencing the state of the object; the second, on the characteristic of the object itself. In modern natural science typologies one can encounter both approaches, but the latter seems to gain importance in recent times, in particular in soil-science and soil geography (Systematyka ... 1989, World ... 2003). Below we present a proposal of

creating landscape models of the Earth, related to the methodology of both disciplines (cf. Ostaszewska 2002).

The starting point of the discussion is the establishment of the set of characteristic features defining the model. Analogously to the modern methodology in soil science, and contrary to the traditional physical-geographical approaches, we propose to use as the criteria of the delimitation of the highest-ranking units, or types, not factors shaping the landscape (e. g., climatic conditions, kind of substratum), but easy to observe and describe **material results of functioning** of the landscape geosystem. As opposed to the suggestion of ecologists, we do not regard only the character of the vegetation cover as such result. There are three reasons for that. First, the vegetation cover does not fully render the specific character of the landscape geosystem, whose thickness may be much larger than the reach of plant roots, especially in areas utilised by humans. Second, materials dealing with the potential vegetation, whose use is recommended in the case of charting of areas subject to anthropogenic pressure, are not available for the whole Earth. Third, the vegetation cover, being the most dynamic indicator of the landscape condition, preserves the relict features, which often determine the current specific features of the landscape (e. g., in periglacial or medium-mountain terrains) only in a very insignificant degree. Because of the reasons listed above it is suggested that both the actual vegetation cover and – equally importantly – the soil be regarded as the diagnostic horizons of a landscape; such horizons are material, easy to describe results of its functioning.

As was said by Boris Polinov (1956), soil is the mirror of the landscape. Its characteristics are formed under the influence of the effects of the climate, parent rock, water, relief and organic world. The quality of humus, and sometimes even the soil type, depend to such a large extent on the animate nature that it is erroneous to regard soil as part of inanimate nature. Soil is the bridge between animate and inanimate nature, being the only result of its kind of the effect of the **whole** landscape, both recording its history and presenting its current state.

Accepting both vegetation communities and soils as “diagnostic horizons” of the landscape facilitates a quick and effective introduction of models tested by other disciplines. The selected diagnostic features are therefore subject to verification and their selection as the indicators of the model satisfies the condition of the interpersonal control of the correctness of the method. The following arrangements may serve as examples of models (types) of landscape geosystems:

- Deciduous/ mixed forest – grey brown soil (luvisol); arrangement typical for the moderate zone;
- Oak forest – terra fusca soil (chromic luvisol); arrangement typical for the Mediterranean zone;
- Coniferous forest – podzolic soil; arrangement typical for the boreal zone.

As in the case of soils, the number of climatic zones does not limit the number of landscape models. For instance, brown and grey brown soils, as well as forest communities such as beech forest and mixed forest are characteristic for the moderate zone; in the Mediterranean zone apart from the terra fusca soils one can encounter calcaric cambisol and terra rosa; apart from oak forests, coniferous forests, macchia and frygana occur often. As can be seen, in both cases the "coarse" small-scale division gives a relatively rich material for determining the arrangement of diagnostic horizons.

In the suggested method the determination of the landscape type, and – if needed – also of the subtype is done on the basis of the identification of the diagnostic horizons, that is, of the soil type and the plant community type. An additional characteristic of the landscape is achieved thanks to the determination of the models of the landscape kind. Similarly as in the Polish soil science (Systematyka ... 1989), we suggest to use the substratum quality as the determinant of this model.

Fig. 1 shows an example of the large-scale typology of a high plain landscape in Poland, obtained by the method suggested here. The investigated arrangements of components have been included in the two main taxa: types and kinds of landscape.

On the analysed area the presence of three physiognomic "zonal" landscape types has been observed. The first is formed of mixed forests on grey brown soils, characteristic for the landscape of the moderate zone; the scope of landscapes of this type coincides with the occurrence of the loess substratum. Xerothermal grass on lithogenic non-zonal soils constitute the second type; the physiognomy of this terrain fragment is determined by the occurrence of the grassland vegetation; the kind of the landscape is determined by the marly, carbonate substratum. The third type includes landscapes of "Mediterranean" type of physiognomy, belonging to two subtypes. The first subtype is formed of areas covered by dry pine forests on soils of the carbonate rendzina type. The second subtype consists of oak forests on acid rendzinas of the terra fusca type. Climatic and edaphic indicators, worked out by Ellenberg for plant communities of the Earth, constitute additional characteristic of the landscape arrangements; they are used also in large-scale ecological research (Kostrowicki, Solon 1994).

Analysis of data related to thermal, humidity and trophic characteristics makes possible the determination of the potential condition of the landscape and the reconstruction of its origin. The landscape marked on the illustration as 1 (mixed forest on grey brown loess soil) matches best the zonal type of natural conditions. Referring to the terminology used in Polish soil science one can call it the authogenic zonal landscape. The remaining arrangements are of more complex character. In the case of landscape 3, the vegetation type is anthropogenic (pine plantings), while the character of the habitat and the potential vegetation is determined by the substratum (lithogenic landscape). Of a somewhat different character is unit 4, occupied by an old oak planting, which is a potential mixed forest habitat. The unusual feature

Climate conditions:

- Insolation (on the scale from 1 — shadow to 10 — sun-lit)
- Temperature (on the scale from 1 — cold to 10 — very warm)
- Degree of continentalism (on the scale from 1 — Atlantic to 10 — continental)

Edaphic conditions:

- Humidity (on the scale from 1 — very dry to 10 — aquatic)
- Acidity (on the scale from 1 — strongly acidic to 10 — alkaline)

Conclusions about the origins of the system

Potential landscape system	<i>Tilio-Carpinetum</i> on luvisol	Oak forest on <i>rendzina</i>		<i>Tilio-Carpinetum</i> on chromic luvisol
Origin of actual system	natural zonal	lithogenic-relict	lithogenic-anthropogenic	lithogenic-anthropogenic

Fig. 1. An example of a large-scale landscape typology, based on small-scale models (after Ostaszewska, 2002)

of this unit are substratum and soil, atypical for the contemporary climatic conditions. Acid *terra fusca* was formed probably under the influence of a warmer and more humid climate; the determination of its age requires additional research (dating). In the case of unit 2, the vegetation is of relict character (early Holocene grassland vegetation), while the substratum is analogous to unit 3 (lithogenic landscape). In the current conditions both units are potential habitats of the plant community of the same kind (oak forests).

The terminology of landscape types can be of course different. It was applied to show the process of going from the small-scale typology of perceived contents to the more accurate scales. Gradually, more measurable features (e. g., physico-chemical or mineralogical indicators, etc.), occur in the characterisation of the model. In the typology shown in Fig. 1 only simple quality indicators have been applied: topoclimatic, humidity, acidity. This follows from the essence of the presented example. Its contents is an illustration of the **method of action**, in which spatial typological units are formed as the result of comparison with the model, determined on the basis of earlier small-scale research. Well-documented, easy to chart physiognomic features (arrangements of "diagnostic horizons") play the superior role during the creation of the model. Such features demonstrate the result of the functioning of the entire landscape. Additional characteristics are achieved by determining the leading genetic factors (climate and substratum). It seems that the presented method of action, well developed in soil science, landscape geochemistry, ecology and biogeography, was halted in landscape geography on a general, overview scale – the scale of Earth, continents and countries.

CONCLUSIONS

Lack of reference base of Earth's landscapes limits both the development of geography as a science and its practical usefulness. Claims that a catalogue of landscape models is impossible to create are hard to uphold in view of the achievement of soil geography, a discipline dealing with issues that are no less complex. From the formal point of view, landscape and soil have the same degree of complexity. They constitute fragments of perceived reality, characterised by temporal and spatial dimensions. Some of their features (e. g., landscape relief, soil reaction) are registered as continuous. Others (e. g., land use, soil organisms) are of non-continuous character. Just like soil, landscape combines features of inanimate and animate nature. It can be regarded as a three-phase physical system, consisting of solid, fluid and gaseous phases. It can be also investigated from the point of view of its static (structural) or dynamic (functional) properties. It is subject to anthropogenic effects and influences human behaviour (e. g., the economy). It also has its history, whose traces are preserved to a various degree. Briefly, when it comes to the richness of the symptoms of its existence, both landscape and soil are infinitely dimensional manifolds – and science is unable to accu-

ately grasp forms that complex. It is significant that the crisis of the “landscape geocomplex paradigm” in geography coincided in time with the publication of the catalogue of world soils (World Reference Base for Soil Resources 1998, Polish edition 2003), and with the increase in activity of ecologists performing landscape syntheses. Text and graphic publications (so-called atlases) created in recent years and containing more detailed models of the Earth’s ecosystems (e. g., Nachtigall 1986, Pott 1993, Grabherr 1997, Heinrich, Hergt 1998) confirm the vitality and usefulness of typology as a method of investigation of natural systems. In this situation, physical geography should return as soon as possible to the international discussion, so lively in the past, of the landscape typology. Otherwise, we put yet another research field in *jeopardy*. The method of creating universal models independent of the charting scale, presented in this paper, has been presented in the hope of intensifying the discussion on the creation of a reference base of Earth’s landscapes, which would be the geographical counterpart of the World Reference Base for Soil Resources.

REFERENCES

- Grabherr G., 1997, *Farbatlas Ökosysteme der Erde: natürliche, naturnahe und künstliche Land-Ökosysteme aus geobotanischer Sicht*, Ulmer, Stuttgart.
- Heinrich D., Hergt D., 1998, *dtv-Atlas Ökologie*, dtv, München.
- Kostrowicki A.S., Solon J. (eds.), 1994, Studium geobotaniczno-krajobrazowe okolic Pińczowa [Geobotanical-landscape Study of the Environs of Pińczów; in Polish], *Dok. Geogr.*, 1-2.
- Nachtigall W., 1986, *Lebensräume – mitteleuropäische Landschaften und Ökosysteme*, BLV, München-Wien-Zürich.
- Ostaszewska K., 2002, *Geografia krajobrazu. Wybrane zagadnienia metodologiczne* [Landscape Geography. Selected Methodological Issues; in Polish], Wyd. Nauk. PWN, Warszawa.
- Pietrzak M., 1994, Słów kilka w sprawie geokompleksów [A Few Words About Geocomplexes; in Polish], *Biuletyn PAEK* 1(1).
- Polinov B. B., 1956, *Izbrannye trudy* [Selected Works; in Russian], Izd. Akademii Nauk SSSR, Moscow.
- Pott R., 1993, *Farbatlas Waldlandschaften: ausgewählte Waldtypen und Waldgesellschaften unter dem Einfluß des Menschen*, Ulmer, Stuttgart.
- Prusinkiewicz Z., 1985, Teoretyczne i dyskusyjne problemy naukowej systematyki gleb [Theoretical and Controversial Problems of Scientific Soil Systematisation; in Polish], *Roczniki Gleboznawcze*, vol. XXXVI.
- Richling A., Ostaszewska K., 1993, Czy istnieje uniwersalna jednostka przestrzenna? [Does the Universal Spatial Unit Exist?; in Polish], *Przegl. Geograficzny*, vol. LXIV, 1-2.
- Systematyka gleb Polski [Systematisation of Soils in Poland; in Polish], 1989, *Roczniki Gleboznawcze*, vol. XL, 3-4.
- Widacki W., 1994, The end of the geocomplex paradigm in physical geography?, [in:] *Landscape Researches and its Application in Environmental Management*, UW, Warszawa.
- World Reference Base for Soil Resources 1998; Polish edition *Klasyfikacja zasobów glebowych świata*, 2003, ISSC, ISRIC, FAO, PTG, Toruń.

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