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LANDSCAPE ECOLOGY — GEOGRAPHICAL RESEARCH DIRECTION OR AN INTERDISCIPLINARY RESEARCH PROGRAMME?

Emil Mazúr, Ján Drdoš: Landscape Ecology — Geographical Research Direction or an Interdisciplinary Research Programme? Geogr. Čas., *40,* 1988, 1—2; 27 refs.

In international science landscape ecology is much discussed in recent years, this being considered a new branch of an interdisciplinary character. In so doing it is gone out from the term and not from the orientation existing in geography since the times of A. von Humboldt. In the past century this research direction was named landscape physiology and the last one, i. e. landscape ecology, was obtained in 1939. Landscape ecology was formed as a research direction aimed at studying the balance of processes in the landscape, the processes being the basis of solving relationships between man and his environment. With this dimension landscape ecology acquires a significant social charge and becomes basic tool in solving rational utilization of the landscape. Its central concept is landscape potential assigning it a prognostic character.

Within international science, particularly in biological branches, or in those closely cooperating with biology in recent years landscape ecology is much discussed as a new branch of an interdisciplinary character. In so doing landscape ecology is not interpreted in its true orientation, its scientific substance is mistaken considering it a new revelation of biologico-ecological sciences and concluding that the holistic approach (substantially employed in ecology) is a new, progressive attainment of contemporary ecology, however, omitting the true task of the practice research considered as a theoretical enrichment of science, etc. (see e. g. publications by Z. Naveh, A. S. Lieberman 1984 and others, too).

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THE DEVELOPMENT OF LANDSCAPE ECOLOGY

In the development of science since the times of the bloom of antique culture in ancient Greece there was a branch aimed at the surrounding material reality from a complex view, studying the surrounding landscape or environment as a whole of abiotic and cultural elements. In dependence on developmental level of human knowledge this whole was approached as a sum of elements, mutual dependences and correlations being revealed gradually and in this way conditions for a system conceiving of the landscape were formed. Within this branch dynamically developing and named *geography* since the beginnings, since it was aimed at recognizing the Earth, which is inhabited by man forming a civilization, various directions were formed successively. At the same time the holistic approach and empiric methods of investigation were characteristic for this branch in the past.

Under the influence of the 1st industrial revolution, which conditioned the development of new directions in science, above all in physics, along with descriptive methods (it is to be pointed out that well-worked out and exact) new views of *the landscape* began to be born, the landscape being since the beginnings of this science its main and fundamental subject of investigating. One of the new views of the landscape under the influence of the development of recognizing both the dynamics of natural processes and functioning of organisms was *landscape physiology* (A. Guyot 1849) in American science. In the Old Continent landscape physiology was developed, for instance, by L. Waibel (1928, 1933) and J. Granö (1929), according to the latter landscape physiology examines dynamic acting and mutual connections between various phenomena in the landscape.

In the thirties of this century the American concept of ecology began to develop rapidly in European science. W. Tansley (1936) formulated the notion of *ecosystem,* which up to this time is the basic notion of ecology and denotes a dynamic whole forming a section of the biosphere. Under the influence of the development of landscape ecology in the late thirties of this century the German geographer C. Troll formed the term of *landscape ecology* and by it the denoted determination of the character of various abiotic factors by means of evaluting vegetation on aerial photographs and laying out landscape areas by means of this procedure. After a long-lasting interval, in 1950 he published an essential study about the landscape, in which he bears a new, more suitably outlined conception of landscape ecology. In the new conceiving it was aimed at studying the site, being based on Tansley's concept of ecosystem. The space of ecosystem in the earth's surface was named *ecotope* by C. Troll, which ought to be the basic cell of the landscape.

As written by C. Troll in 1970, he had tried to integrate geographical and ecological approaches with the research of natural phenomena by means of landscape ecology. According to this author, the geographical approach is aimed at regional differentiation of spaces of the Earth, its aim lying in recognizing mutual acting of natural phenomena in space. On the contrary, the ecological approach is aimed at functional dependences on vertical cross-section of the biosphere, i. e. between elements of different natural character. Its aim lies in recognizing mutual acting of natural phenomena in a small site (within an ecotope).

The first criticism addressed to the term of landscape ecology and its aiming was expressed by E. Winkler (1949). He reminded that if we are to respect the meaning of the term of landscape ecology, then it necessarily must denote the study of relationships between the landscape and its surroundings and that this term would make only misunderstandings in the future. At the same time he emphasized that the research direction that C. Troll wants to represent with landscape ecology, i. e. the research of the system of relationships in the landscape with its spatial manifestations, is not anything new in geography. In so doing he pointed out to landscape physiology above mentioned. Take it all round this opinion is confirmed by the works of A. von Humboldt.

Landscape ecology as a hopeful direction, in its aiming at the dynamic landscape system able to utilize results about the environment from various scientific disciplines, possesses all the conditions to become an efficient scientific tool especially for applying scientific knowledge in social practice. This, however, required an arrangement of its terminology. Particularly it concerned the German expression „Landschaft", which is untranslatable into English („landscape" has another meaning). Therefore in 1970 C. Troll suggested to rename landscape ecology to *geoecology.*

The term of landscape ecology caught quickly above all in German geography. After the first works by E. Paffen (1948, 1953) and J. Schmithüsen (1948) a bulk of works from the sphere of geographical workplaces in Leipzig and Dresden under E. Neef's leadership appeared after 1960 (1962, 1963, 1964, 1967, and so on). Gradually it penetrated to the FRG, Switzerland, Austria, Netherlands, Czechoslovakia and other countries.

If we analyze the definitions and characteristics of landscape ecology in the authors that formed it as a scientific direction, or done as a discipline and established within the system of sciences (more accurately in geography), i. e. in E. Neef and his followers, we can state that in its real form as it developed and realized itself it differs strikingly from the ideas of its founder C. Troll. In E. Neef et al. (1973) it is defined as „ . . . a direction in landscape research, which sets up both an analysis and an integrating approach to complex actings of components of the geocomplex and thus the elucidation of the natural balance as matter and energetic balances into the crucial point, further also an ascertainment of interventions of society into the landscape (landscape space) as taking into account the changes in matter and energetic quantities". A more accurate definition of landscape ecology as a research direction aimed at the dynamics of processes in the landscape is quoted in a dictionary of geography (W. Tietze ed. 1968—1970): „The research ... of *landscape balance* (Landschaftshaushalt), the recognizing of causes and connections in its manifold possibilities of forming itself, of being disturbed etc. is the essential task of geography. According to the origin from various spheres (physical, biotic, anthropogenic ones) and owing to mutual acting of geofactors various notions have been formed, parallel by the contents, as landscape physiology, further *dynamic,* or *functional approach.* The notion today widely accepted goes out from the image of natural landscape balance and therefore it is spoken of landscape ecology, first time by C. Troll (1939, 1943) within widening Haeckel's concept of ecology into an integrative complex of mutually connected natural factors."

Specialists in landscape ecology reminded that direction of research differed

itself from the conceiving of biological ecology. H. Klink (1964), one of the most significant West-German authors in that field, writes: „Ecological geobotany examines relationships between individual plants and different vegetation associations on one hand, and particular factors of their environment on the other... Landscape ecology, on the contrary, examines the kind and distribution of various landscape factors and correlations between them. All the natural given facts in the given space of the Earth are, at the same time, determined qualitatively and as far as possible also quantitatively, and their acting is mediated to the physiognomy of landscape spaces ... Landscape ecology is, in this way, substantively more extensive than bioecology ... it is particular about „the total character (Alexander von Humboldt) of the Earth's spaces. H. Leser (1976) remarks, that „... ecologies that appeared in foreign (i. e. extra-German, a note by the authors) areas have methodically, methodologically and practically only hardly anything common with the continental-European way of looking upon landscape ecology as well as with the landscape as a spatial-natural-scientific problem with a substantial anthropogenic stamping" adding that „landscape ecologies developing in the other (non-geographical, a note by the authors) branches confirm its geographical character best." Also H. Langer (1970) mentions that landscape ecology is substantially determined by the geographico-spatial moment.

The specificity of landscape ecology is formed by its aiming at the dynamics of processes in the landscape. Nevertheless, using ecological terminological means causes misunderstandings within the landscape-ecological research, since they were formed owing to other scientific aims. J. Schmithüsen (1976) wrote in that case: „Of the causes of these misunderstandings it may be said as follows: Carl Troll who introduced the term of landscape ecology meant by this fact ecology in the sense of biological scientific concept as the research of relationships between life and environment. Others ... took a wrong turn to a „doctrine of landscape balance" in translating from landscape ecology and the word of ecology in wrong assuming that it means balance they used as an objective notion of matter and energetic exchange in geosynergetic systems. They speak about this ecology also in anorganic landscapes, in which there are no relationships between life and environment. To be sure, the word of landscape balance in itself indeed does not provide an incentive to be restricted to the relationship between life and environment."

CONTEMPORARY TENDENCIES AND THE SIGNIFICANCE OF LANDSCAPE ECOLOGY FOR SCIENCE AND SOCIAL PRACTICE

Landscape ecology relatively rapidly reorientated itself from the problems of classifying natural areas in the beginnings of its existence to studying natural processes and their balance, too. In the course of the sixties this study was utilized more and more to solve the relationship between *man and environment,* so that gradually landscape ecology became basis and instrument for forming environment and *rational spatial organization of the environment.* This fact is a consequence of the fact that landscape ecology has developed in Europe, in which both the landscape and natural processes are under a heavy influence of man. A great role has been played here also by social requirements to science, namely in solving acute problems resulting from the

conflicts within the relationship between man and environment. They are not only the problems of air and water pollution with emissions, the soil degraded by intensive agricultural large-scale production, but also above all problems of spatial organization of the environment, resulting above all from both an expansive and disproportional urbanization and non-balanced social-economic activities in the landscape space (E. Mazúr 1977).

The contemporary global problems of mankind not only in advanced industrialized countries of Europe and North America (the environment immoderately technicized), but also in the developing countries (due to a heavy destruction of the biosphere owing to overcrowding in population) are a great stimulans for the development of landscape ecology in the world-wide view.

Landscape ecology has been able to react very efficiently and promptly to the needs of social practice, because it has developed the approach to the landscape as a dynamic spatial system of phenomena of both natural and socio-economic character, which is bound to the earth's surface. It is variable in time *(landscape variability)* and in space *(landscape diversity)*.

A landscape exists objectively and independently on man, because it came to existence and was developing to the present-day physicogeographical form long before man appeared. Man appeared only amidst interacting elements within a highly organized natural landscape system. He is a subsequent phenomenon in the landscape. He does not make conditions for existence of natural elements, but he does depend upon them. A landscape is an existing basis of man, a source of his life. Man was born in it, inhabiting and utilizing it. He is both its inhabitant and user.

The relationship between man and the landscape is considerably ambivalent. On one hand, man is a system element of the landscape, while on the other man appears in relationship to the landscape not only as a component, but also as a recognizing, evaluating, using, planning and deciding subject. From this fact it results that if man manipulates the landscape, automatically he manipulates with himself, too. On one hand, a landscape is a source for man to be satisfied from the viewpoint of biological requirements, while on the other, it itself is an object of formation and transformation according to the social-economic requirements.

Very significant approach of landscape ecology to the landscape is that considering the landscape as a home of man (J. Drdoš, E. Mazúr, J. Urbánek 1980). This significance increases along with the degree of „a denaturalization" and with increasing technicization of the landscape. In addition, there is landscape space being reduced relatively due to both being filled with the works of man and acceleration of the transportation means (E. Mazúr 1977), and further there are both destruction and homogenization of the structure due to removing diversity in the landscape. Consequently man is increasingly getting estranged in relation to the landscape as well as he is aquiring a feeling of home loss. Thus landscape ecology reacts in this approach to the most intimate human feelings, where man has been lost in the activity by technology.

The enforcement of landscape ecology as a basic human „criterion" in relation to the environment at present does not mean a unilateral emphasization of nature protection to the detriment of socio-economic development. Landscape ecology has formulated the notion of landscape potential (E. Mazúr, J. Drdoš 1984) due to a well-balanced nature and society development.

The landscape potential expresses a precondition of the landscape to fulfil functions required from it by man. These preconditions of the landscape (as consisting of man, his home as well as the object of his work) result from both the properties of landscape's natural structure, the properties of the social-economic sphere, and also from the whole-society interest of man in *protecting the long-term reproduction ability of the landscape* (E. Mazúr 1977) in harmony with the subsistential interest of man in keeping his future. Very significant role is played in this case by the knowledge of socio-economic activity limits resulting from the specificity of natural structure of the landscape. It is the conception of landscape potential that substitutes *the obsolete conception of natural resource,* which was topical in the period of a qualitatively, lower degree in the development of production forces, when man co-existed with the landscape and did not live and develop his activities to the detriment of it. The conception of natural resource is based on the sectorial development of society, on egoistic interests of individuals and also social groups. Thus the present-day stage in the development of production forces as well as *the global problems concerning the landscape destruction* call for overcoming the sectorial approach to society's development and for substituting it by an integrative approach (E. Mazúr 1977).

The landscape potential represents a quantity of a strikingly dynamic character, dependent on landscape changes, but particularly on the development of the needs and value orientations of society. The landscape potential as the central notion in landscape ecology assigns a strikingly *prognostic character.* In this way landscape ecology becomes a tool of the most progressive tendencies in the development of society on a qualitative higher level of the social development.

IS LANDSCAPE ECOLOGY A GEOGRAPHICAL RESEARCH DIRECTION, OR AN INTERDISCIPLINARY RESEARCH PROGRAMME?

We have mentioned that landscape ecology is a contemporary, modern integrated direction in landscape resarch within geography. The fact this direction has acquired to all appearance a non-geographical name is a consequence of the given social-political conditions in the pre-war Germany, where new directions were looked for to substitute the older ones. A great role was played by a wave fashionable of that time in German science, namely the found-again ecology (not the science is resistant to fashionable waves, one it is ecology, then quantitative methods, then informatics, cybernetics, etc.). It is no chance, too, that the term of landscape ecology began to spread in European geography in the course of the sixties. The development of new exact branches inevitably influenced the geographical methodology. Both the method and the object of geography were exactized rapidly. In connection with this fact the static views and approaches were to be substituted with those more dynamic. A starting point was offered by the study of natural processes and their balance.

The geographers in the GDR under the leadership of E. Neef aimed at the study of natural processes and on the basis of them they laid out landscape taxa of various ranks. These problems were denoted landscape ecology by them.

The violently exploding ecological problems in the form of beginning heavy crises in relationship between man and environment since the sixties not only in the advanced industrialized countries, but also in the developing ones with their increasing absolute, but particularly relative overcrowding laid urgent requirements before the science to solve them. The want of time to work out procedures and programmes, which would go out from their own theoretical and methodological sources, urged specialists from applied sciences (agriculturalists, urbanists, water-economists, etc.) and also from basic sciences (biology, ecology) to take such tools that had existed in science. Landscape ecology was a very suitable instrument for these purposes. Its aiming at the balance of processes is a basis that the relationship between man and his environment cannot be solved operatively without. It was suitable also from the terminological viewpoint, since in its name the word ecology occurs as a profile term, while on the other hand the word landscape — as an expression from a wide vocabulary and at last — which is essential — with its *integrate approach* it corresponds to contemporary needs to solve in a complex way the relationship between man and the environment *not from a therapeutic,* but *above all from a preventive-prognostic viewpoint* (E. Mazúr 1977). Landscape ecology with these own aspects has offered very suitable chances for specialists not only from the basic sciences — geographers, biologists, hydrologists, climatologists, etc., but also those from the applied sciences — agriculturalists, urbanists, forest-economists, etc. to join its research programme. This chance has been utilized very intensively particularly in the course of the seventies and the eighties.

Thank to the development mentioned landscape ecology has acquired two aspects. From the viewpoint of the mother science — geography, in which it was born and whose inseparable constituent it is with its character, theory and methodology, landscape ecology is a *resarch direction of geography.* This research direction is nothing new and has been developing in geography since the times of Alexander von Humboldt. On the other hand, from the viewpoint of a wider spectrum of specialists from various fields of both the basic and applied sciences, which treat it at least by word, landscape ecology is *an interdisciplinary research programme.* Concerning the latter the spatial accent is characteristic, however, also in this conceiving and thus *the geographical character continues* to be its substance.

It is possible that landscape ecology will become self-standing formally in the future as an interdisciplinary scientific branch on environment, which essentially will be of geographical character, because without the geographical theoretico-methodological basis it is impossible to solve environmental problems, particularly in the global extent and just this is the most topical at present. This possibility is indicated by contemporary trend in international, especially however in Anglo-Saxon geography, namely that of concentration to social problems only, the successful solution of which is the key to keep further this „green planet" and thus also to survival of the mankind. The protection of nature and ecology alone are not able to fulfil this task sufficiently. Profiling within contemporary modern geography as social science accelerates landscape ecology to be selfstanding. On the other hand, one can hear the voices pressing more and more from the side of more profoundly cogitating landscape ecologists requiring a „sociologization" within this research direction, too.

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KRAJINNÁ EKOLÓGIA — GEOGRAFICKÝ VÝSKUMNÝ SMER ALEBO INTERDISCIPLINÁRNY VÝSKUMNÝ PROGRAM?

Krajinná ekológia je v súčasnosti najdiskutovanejšou témou vo vedách zaoberajúcich sa prostredím. Podľa geografov je to špecifické výskumné zameranie geografie, podľa biológov a ekológov predovšetkým nová vedná disciplína, podľa odborníkov najmä zo spoločenskej praxe interdisciplinárny vedný program.

V geografii sa prinajmenej od čias A. von Humboldta rozvíja smer zameraný na krajinu, ktorý vyzdvihuje jej dynamiku a premenlivosť. Nazýval sa krajinná fyziológia (v 19. storočí) a v druhej polovici nášho storočia ako krajinná ekológia (podľa C. Trolla z r. 1939), ako dynamický alebo funkčný prístup.

Exaktizácia metód v geografii vyvolaná rozvojom nových vedných odvetví v období vedeckotechnického rozvoja, t. j. po roku 1950, spôsobila vo výskume krajiny zdôrazňovanie štúdia procesov a ich bilancovanie. Problematika sa začala označovať ako krajinná ekológia. Tento smer rozpracovaním systémového prístupu ku krajine, štúdiom jej dynamiky a vzťahov človek—krajina sa stal kľúčovým nástrojom na riešenie problémov prostredia ako interdisciplinárneho problému. To spôsobilo, že vedné odvetvia zaoberajúce sa prostredím, teda popri geografii najmä biológia, ekológia i aplikovaný výskum, siahli po krajinnej ekológii, považujúc ju za niečo nové, doteraz nepoznané. Prienik krajinnej ekológie do rôznych odvetví umožnil aj jej názov, prijateľný pre široké spektrum odborníkov. Krajinná ekológia tak získala dva aspekty — z hľadiska geografie ako špecifický výskumný smer zameraný na procesy v krajine za účelom tvorby racionálnej priestorovej organizácie krajiny, z hľadiska aplikovaného výskumu ako interdisciplinárny program, na ktorom sa môžu podieľať najrôznejšie odvetvia zaoberajúce sa prostredím.

Эмиль Мазур, Ян Дрдош

ЛАНДШАФТНАЯ ЭКОЛОГИЯ — ГЕОГРАФИЧЕСКОЕ ИССЛЕДОВАТЕЛЬСКОЕ НАПРАВЛЕНИЕ ИЛИ ИНТЕРДИСЦИПЛИНАРНАЯ ИССЛЕДОВАТЕЛЬСКАЯ ПРОГРАММА?

Ландшафтная экология — это в настоящее время наиболее дискутированная тема в науках, занимающихся средой. По мнению географов это специфическое исследовательское направление географии, по мнению биологов и экологов это, прежде всего, новая научная дисциплина и по мнению специалистов из сферы общественной практики это интердисциплинарная научная программа.

В географии, минимум со времен А. Гумбольдта, развивается ориентированное на ландшафт направление, подчеркивающее его динамичность и переменчивость. Раньше (в 19 веке) это направление называлось ландшафтная физиология и лишь во второй половине нашего века получило название ландшафтная экология (по К. Троллу с 1939 г.) как динамический или функциональный подход.

Экзактизация методов в географии, внедряемая вследствие развития новых научных отраслей в период научно-технического прогресса, т. е. после 1950 г., при изучении ландшафта способствовала повышению роли исследования процессов и их подытоживания. Эта проблематика стала означаться как ландшафтная экология. В результате разработки системного подхода к ландшафту, а также в результате изучения динамики ландшафта и отношений человек-ландшафт, это направление стало ключевым орудием для решения проблем среды как интердисциплинарной проблемы. Это способствовало тому, что научные отрасли, занимающиеся средой, т. е. наряду с географией преимущественно биология, экология и прикладные исследования, стали принимать ландшафтную экологию как нечто новое, до сих пор не обнаруженное. Проникновению ландшафтной экологии в разные отрасли способствовало также ее название, оказывающееся приемлемым для широкого круга специалистов. Ландшафтная экология, таким образом, получила два аспекта: с позиций географии она стала считаться как специфическое исследовательское направление, ориентирующееся на процессы в ландшафте с целью создания рациональной пространственной организации ландшафта и с позиций прикладных исследований она стала считаться как интердисциплинарная программа, в которой могут принимать участие разнообразные отрасли, занимающиеся средой.