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Geography and landscape science

Marc Antrop

Introduction

- 1 Once the study of landscape was a core topic of geography. It was seen as a unique synthesis between the natural and cultural characteristics of a region. This synthesis embraced geo-ecological relations, spatial patterns and aesthetical properties. To study landscape, information was gathered from field surveys, maps, literature, sketches and photographs. Since the Second World War, aerial photography, and from 1970 on also satellite remote sensing, gave a completely new approach in the study of landscape. As in the beginning the study of landscape was situated mainly in departments of regional geography, these new technical disciplines were introduced here as well. They stimulated the study of landscape on a more holistic basis and in a broader multidisciplinary field. The landscape became the common framework for regional geography, historical geography, landscape ecology, as well as more applied research in land classification and evaluation for planning purposes. Since the 1960s, the quantitative approach in many sciences initiated scientific specialisation and divergence between human and natural sciences. In geography, this 'new orientation' considered the purely descriptive geography of regions and countries to be old-fashioned and non-scientific. In many countries the geographical curriculum was restructured and resulted in a definite split between physical geography and social geography, while regional geography, including the study of landscapes was abolished or became marginal. At the same time, interdisciplinary relations were lost or became lost.
- 2 However, soon this split and the loss of a holistic synthesis was missed, especially by geographers concerned with the landscape. Geography, ecology, soil science, history, archaeology, psychology and aesthetics started to study landscape more independently. A new synthesis, a new transdisciplinary approach emerged with landscape ecology. Landscape research no longer is restricted to geography alone. Therefore, it is not appropriate any more to speak about the geography of landscapes, but rather about what

geography can bring to the study of landscape. The whole of the disciplines involved in landscape research will be referred to as landscape science, although this term was used first in 1885 by the geographers Oppel and Troll (Troll, 1950). In most countries the number of researchers studying the landscape is limited and fortunately this stimulated in the development of an international network. Many landscape researchers meet under the umbrella of the International Association for Landscape Ecology (IALE), which has national, (supra)regional groups and thematic workshops. Also important is the Standing European Conference for the Study of the Rural Landscape (Verhoeve & Vervloet, 1992). Landscape research is no longer restricted to local or regional interest groups, but has become really international. For this reason, this contribution will describe not only the activities in Belgium, but will try to present a more general overview of geography in relation to the growing landscape science in an international context.

Dealing with the landscape: a history

The early beginnings

- 3 Early geographical descriptions dealt with characteristics of foreign regions or countries and focused upon the landscape and the people living there. With the renaissance period in the 15th century the first painting and pictures of landscape appeared in the Western world (Troll, 1950). Kolen and Lemaire (1999) see this as the emergence of a landscape conscience. The systematic exploration and description of landscapes start with the Age of Discovery, characterised by a fast development of cartography and a growing interest of naturalists. Some locate the start of geography as a scientific discipline at the end of the 19th century (Claval, 1976, Larnoe, 1987), evolving from naturalists such as Alexander von Humboldt and Darwin. The physical-determinism that characterised the German approach was tempered and broadened by the French approach of the school of Vidal de la Blache and with the concept of possibilism as paradigm.
- 4 It is not the purpose of this contribution to restart these old discussions about the true nature of geography or whether landscape should be a core topic in geographical research. The main focus here is the landscape as studied nowadays and how geographers approach this study. Only the view upon the landscape of a few 'ancient' geographers will be discussed. Carol (1956), Zonneveld (1971) and later Saey (1990) give a more elaborate discussion of the relation between the study of landscape and geography.
- 5 Alexander von Humboldt gave a short and very to-the-point definition of landscape: 'Landschaft ist das Totalcharakter einer Erdgegend' (Zonneveld, 1995). This definition implies that regional diversification is expressed by the landscape and that landscape should be considered as a holistic phenomenon that is perceived by humans. Although von Humboldt was a pioneer in biogeography, physical geography and climatology, he always stressed in his writings the human and cultural aspects in the landscape and above all the aesthetical qualities, which he considered even as mentally healing (von Humboldt, 1814).
- 6 Vidal de la Blache (1922) had a more literary approach of the landscape, although he used similar techniques of annotated sketches and his prose was not so different from von Humboldt's. The main difference is the recognition of the importance of a local society in organising the landscape, which results in a regional differentiation not only based upon natural conditions but also upon settlement patterns and territories. Also here, landscape

is seen as a holistic unity as well expressed in the recognition of 'pays' each one having a proper name. The description of regions became synthetic 'tableaux' of idealistic landscapes (Giblin, 1978). Both von Humboldt and Vidal de la Blache implicitly include the perception of landscape and its aesthetic qualities in their work.

- 7 Later, Carl Troll elaborates this view and gives it a more sound methodological basis and integrates aerial photography as the new way of observing the landscape at that time (Troll, 1939, 1950, 1959, 1963). He called 'Luftbildforschung ist zu einem sehr hohen Grade Landschaftsökologie' ('aerial photography is in a high degree landscape ecology'). Troll called the approach of landscape ecology an 'Anschauungsweise', a way of looking at the subject and he explained the birth of this idea as 'a marriage between biology and geography' (Zonneveld, 1995). The introduction of the term landscape ecology in this sense promoted a new holistic synthesis in landscape research and also reconfirmed the perception as an integral part of the concept of landscape. At the same time Richard Hartshorne in his 'The Nature of Geography' (1939) considers the term landscape with its multiple semantic meanings too confusing and abandons it at the object of study in geography in favour of concepts as region and space (Muir, 1999). During the 1960s and 1970s a deductive and rationalistic approach dominated the new orientation in geography. Based upon the optimistic development in economy and technology, the common focus of geographers upon landscape was lost and a divergence and specialisation in geography started. Gradually geographers in Western Europe lost their interest in the visual appearance and aesthetics of the landscape as subject of study temporarily.

The renewed interest and the rebirth of landscape ecology

- 8 Zonneveld (1980) defined the loss of the regional holistic synthesis of landscape research in geography clearly in a paper entitled 'Het gat in de geografie', 'the hole in geography'. He stimulated the landscape ecological thinking, mainly from the German and Central-European schools, in the education of geography students in the Netherlands. The missing of a transdisciplinary and holistic based approach of landscape study became rapidly clear in the fast changing environment in crisis, with new challenges in natural, ecological, cultural and social issues. The changing attitude towards landscape was also clearly expressed in philosophical essays such as 'Filosofie van het landschap' ('Philosophy of landscape') by Lemaire (1970) and 'The angst voor het nieuwe landschap' ('The fear of the new landscape') by Lörzing (1982). The first attempt to restore the interdisciplinary approach of landscape research was made in the Netherlands with the creation in 1972 of the Working group landscape ecological research (Werkgroep Landschapsecologisch Onderzoek, WLO) (Zonneveld, 1972). It grouped geographers of different kind, biologists and ecologists, as well as social scientists and planners. Less involved were historical landscape geographers who did however important work in the field of settlement geography (Renes, 1981) and the mapping and classification of historical cultural landscapes in the Netherlands (Vervloet, 1984).
- 9 It was the WLO that took the initiative in 1981 for an international and multidisciplinary meeting in Veldhoven to reflect upon the future of landscape research. Basically, the broken link with the tradition of landscape ecology as defined by Troll in 1939 was re-established and led to the formal creation of the discipline of landscape ecology. Also contacts between the West European approach with the schools of landscape science of

the Central and East European countries was renewed. Besides more national journals such as *Landschap* and *Landscape Research*, two new international journals were published focusing upon the landscape: *Landscape and Urban Planning* in 1986 and *Landscape Ecology* in 1987. In 1988 the International Association of Landscape Ecology (IALE) was created. Since then, landscape research expanded over many different disciplines. Debates are still going on about the specificity of landscape ecology and the definition of landscape. Moss (1999, p. 138) gives a simple and practical approach: 'To me, landscape ecology is simply about the study of landscapes and of the need to derive understanding about landscapes in order to enhance our abilities to manage them more effectively. Landscape ecology is not the only field to focus on the landscape but it has emerged in the last few decades because, quite clearly, existing approaches that sought to address a whole range of landscape scale environmental issues were proving to be inadequate'. Indeed, many new environmental problems demand a better understanding of the functioning of landscape and ask for rapid solutions.

- 10 The new transdisciplinary approach is mainly found in the domain of the new emerging landscape ecology (Moss, 2000; Wiens & Moss, 1999; Brandt, 1999; Zonneveld, 1995; Naveh & Lieberman, 1994). Anyhow, landscape research is widening, new fundamental knowledge is needed as well as more practical applications. The integration is achieved by multiple exchanges of ideas and methods. Landscape ecology is seen by some as a *transdisciplinary science* (Naveh & Lieberman, 1984; Zonneveld, 1995; Moss, 1998). This means that landscape ecology is not just combining sciences (multidisciplinary), nor is 'in between' sciences (interdisciplinary), but is situated above different sciences, trying to integrate them with a common way of looking.
- 11 Figure 1 gives an impression of the historical evolution in landscape research and the interaction between disciplines. Disciplines in square boxes are the actual ones that contribute actively to the development of landscape science. The ones in bold are disciplines (mainly geography and ecology) that made the basics for the actual landscape sciences. The concepts, techniques and methods that were important for this development are underlined. Some important persons that stimulated the development are given in italics.

Figure 1. The study of the landscape during history: influences upon the actual disciplines that form the landscape science: landscape ecology, landscape geography, land evaluation and landscape architecture.

Different developments in the world

- 12 When in the Western world after the Second World War most interest for the study of landscape was lost, it continued to develop in Central Europe and the Soviet Union. Different schools for landscape study emerged during the post-war period. In Russia many new concepts related to landscape classification and landscape ecology were developed (Pedroli, 1983). In Eastern Germany it was geographers who developed the theoretical concepts of what they called 'Landschaftslehre' (Neef, 1967; Haase, 1977). Richter and Schönfelder (1986) give a more physical-geographical approach to the study of landscape, while Smithüsen stimulated the link with biogeography. In Poland and the former Czechoslovakia emerged the Geoecology as an ecological approach of physical geography (Richling, 1996, Drdoš, 1983). Besides the Geoecology there was also an approach more oriented to human geography and problems related to urbanisation (Bartkowski, 1982). Ruziška and Miklos (1990) succeeded to introduce landscape ecological principles in the environmental legislation of Slovakia. Mazure (1983) and Drdoš (1983) stimulated the idea of landscape synthesis within a working group of the International Geographical Union, a working group, which is now active within the International Association of Landscape Ecology (IALE) (Moss & Milne, 1999).
- 13 In France, the study of the landscape issued from the school of Vidal de la Blache and resulted in a series of regional geographical studies with an important emphasis on the landscape (Blanchard, 1906; Peltre, 1971; Viers, 1975; Meynier, 1976; Livet, 1978; Ferras *et al.*, 1979; Flatrès, 1980; Fénelon, 1982; Mergoïl, 1982; Bouet & Fel, 1983). Gradually, the geographers in France and many other Mediterranean countries lost also their interest for the landscape research and oriented themselves more towards economic and regional planning and urbanisation. However some interesting fundamental studies. Lebeau (1972) made a comprehensive overview of the field systems in the world. Flatrès (1979) gathered the studies of the rural landscapes in Europe. Phipps (1981, 1984) introduced quantitative

approaches for studying landscape patterns and dynamics and theoretical systems aspects including visual ones (Berdoulay & Phipps, 1985). Nowadays most of the landscape research is by non-geographers (Forman & Godron, 1986; Baudry & Merriam, 1988).

- 14 During the same period many geographers and ecologists from a 'northern' tradition were active in the Mediterranean (Daels *et al.*, 1971; Verheye & Lootens-De Muynck; 1974; Marius, 1974; Antrop, 1982; Snacken & Antrop, 1983; Larnoe, 1987; Antrop, 1993; Vos & Stortelder, 1992; Rackham & Moody, 1996; De Dapper *et al.*, 1997; De Vlieghe *et al.*, 1997; Vermeulen *et al.*, 1997; Goossens *et al.*, 1998; Sevenant, 1999).
- 15 In Scandinavia and the Baltic, geographers took the lead in the development of landscape ecology (Brandt, 1997; Fry, 1998; Ihse, 1996; Mander & Palang, 1997). In particular the Danish national association for landscape ecology is very active and integrates intimately geographers, ecologists and planners.
- 16 In Britain many different approaches in landscape research developed rather independently. Geographers were mostly involved in historical studies of settlements and the cultural landscape (Baker & Harley, 1973; Roberts, 1987). This offered an important stimulus in the protection of landscapes. Ecologists focused upon diversity and dynamics of landscape and started important monitoring programs (Dover & Bunce, 1998). The British Directory of Overseas Surveys (DOS) focused upon rapid surveys of vast areas without detailed map data and developed systems of land classification based upon air photo interpretation (Mitchell, 1973), based upon a multi-scale hierarchical land systems concept. It led to the elaboration of a mainly practical and pragmatic approach for land classification and evaluation and was applied worldwide. In Oxford the MEXE-system for land classification was developed (Webster & Beckett, 1970).
- 17 Canada and Australia followed a similar approach as the British DOS. In Australia it was the CSIRO that stimulated land evaluation over vast areas (Aitchison & Grant, 1968; Christian & Stewart, 1964; Mabbutt, 1968; Howard & Mitchell, 1980). It gradually evolved from surveying and assessment to landscape ecology and restoration ecology (Hobbs, 1999).
- 18 In the U.S.A. the main interest for landscape studies grew from the relatively recent development of landscape ecology (Forman & Godron, 1986; Forman, 1998a). The approach is distinct from the European one and more oriented to the quantitative analysis of landscape patterns and problems the relation between processes and spatial structures, scale, heterogeneity (Turner, 1987 *et al.*). The application of models and the introduction of landscape indices or landscape metrics is an important innovation that gradually spread over the rest of the world of landscape ecology. Although much fundamental work is done, practical applications follow rapidly and are oriented towards planning and landscape architecture (Dramstad *et al.*, 1996; Nassauer, 1997; Forman, 1998b).
- 19 The Asian activity related to landscape research is difficult to assess. Only the increasing number of participants from China and Japan at the IALE-meetings gives some idea how landscape ecology is approached. The IALE-conference in China (Anon, 1998) showed a clear focus upon the study of landscape types, in particular (sub)urban and industrial ones, as well as river and forest landscapes. This interest is linked to the study of changes and disturbances. The analysis of landscape structures is oriented towards planning and management, mainly for conservation purposes. There is here a clear demand for

practical applications of landscape ecology. The need for gathering the appropriate information, for surveying and monitoring is important. In Japan, the focus is also the use of landscape ecology for environmental applications, but more quantitative structural analysis is used (Nomura & Nakagoshi, 1999). Besides this more applied orientation of landscape research, it should be noted that there is also a more philosophical and aesthetical interest for the landscape, based upon the oriental view of nature and man's place in it (Nakagoshi, 1999).

- 20 As discussed earlier, the Netherlands was the cradle of the renewed landscape ecology. Dutch physical and historical geographers were very active and so were biologists and ecologists. Landscape research in the Netherlands covers a broad scale of topics. Only a few representative references are given here: typology of cultural landscapes (Meeus *et al.*, 1990; Vervloet, 1984; Zonneveld, 1985), ecological networks and small biotopes (Opdam *et al.*, 1986), statistical techniques for ecological analysis (Jongman *et al.*, 1987), application of landscape ecology in nature conservation and restoration (Vos & Opdam, 1993), planning (Harms *et al.*, 1998), and environmental impact assessment (Dijkstra, 1992), psychology and perception (Albrechts, 1983; Schöne & Coeterier, 1986; Coeterier, 1996), philosophy (Kolen & Lemaire, 1999).
- 21 In Belgium, geographers first followed the French tradition in studying the landscape. This resulted in many regional studies where landscape was an important topic (Tulippe, 1942; Brulard, 1962; Snacken, 1961; Daels & Verhoeve, 1979; Knaepen, 1995). Characteristic was the intimate integration between history, landscape genesis and physical geography, including soil science and geology (Snacken *et al.*, 1975). Some more specific research followed also the general West-European tradition of the study of rural landscapes (Christians, 1982) and focusing upon specific themes in the landscape such as field patterns and hedgerows (Petit, 1942; Dussart, 1961), settlement patterns (Lefèvre, 1964; Dussart, 1957) or land use (Van der Haegen, 1982). Air photo-interpretation became also an important tool, not only for mapping (Wilmet, 1970), but also for the analysis of landscapes (Larnoe *et al.*, 1988; Daels, Verhoeve, Antrop, 1989) and archaeological prospecting (Daels *et al.*, 1982; Ampe *et al.*, 1996). The historical approach to landscape evolution is given by Verhulst (1965).
- 22 Later, landscape research became marginal within geography since the new orientation focused upon economic development and urbanisation. Also, the contacts with historians became looser and very few joined the newly emerging landscape ecology. The gradual process of federalisation of the Belgian State stimulated this split and led to different approaches in the Flemish and Walloon region (Daels & Verhoeve, 1979; Antrop *et al.*, 1985; Christians, 1987; Schreurs, 1986). Publications dealing with the landscapes of Belgium as a whole are becoming rare. The synthesis about Belgian geography made by Christians & Daels (1988) describes landscapes as one characteristic of the geographical regions, although a separate chapter in the bibliography is devoted to landscapes. In the major work about the geography of Belgium (Denis, 1992) no chapter is devoted to landscape; reference to landscapes are only found indirectly in the chapter of the rural areas or regions (Christians, Daels & Verhoeve, 1992). The bibliographic inventories made for I.G.U. congresses (Denis, 1996) do not have a chapter or index entry to landscape research at all. References about landscape studies should be looked for in the chapter of agriculture and rural development. This clearly shows the reduction of the broad meaning of landscape in the thinking of many Belgian geographers. Only at the University of Ghent a core of landscape researchers remained. Their work is

characterised by a regional synthetic approach on an interdisciplinary basis (Snacken *et al.*, 1981). Much of the work is interdisciplinary, joining (regional) geographers, archaeologists, historians, soil scientists and (landscape) ecologists in common projects. Meanwhile, the landscape became an interesting subject for other disciplines and a lot of interesting research emerged outside geography (Froment, 1999; Hermy & De Blust, 1997; Tack *et al.*, 1993; Gysels *et al.*, 1993).

The definition of landscape and basic concepts

- 23 In common language, landscape has multiple meanings and these have been discussed since the early start of the scientific study of landscape (Kolen & Lemaire, 1999; Muir, 1999; Zonneveld, 1995; Naveh & Liebermann, 1994; Antrop, 1989). Landscape does not only refer to a complex phenomenon that can be described and analysed using objective scientific methods. It also refers to a subjective observation and experience and thus has a perceptive, aesthetical and artistic meaning as well. Consequently, the perceived landscape is immediately analysed by the observer, compared and evaluated with his knowledge and previous experience. Landscape was also used in some occasions to refer to a piece of land, a region as expressed by the French term 'pays'. Landscape can refer then to a territory or organisational territorial division. Finally, the term landscape is also used as a metaphor, such as in media landscape or political landscape.
- 24 Considering all these aspects, it is not surprising that the approaches to landscape are very broad and not always clearly defined. For example, Muir (1999) describes following ones: landscape history and landscape heritage, the practice of landscape history, the structure and scenery approach, landscapes of the mind, landscape, politics and power, the evaluation of landscape, the symbolic landscape, the aesthetic approach, landscape and place.
- 25 Three aspects are common to most definitions (Antrop, 1989): landscape is (1) a holistic entity or phenomenon, (2) a part of the land that is perceived and thus relative to the observer in understanding and valuation, and (3) a dynamic phenomenon having a unique history.
- 26 These different aspects will be discussed more in detail, but one should always keep in mind that, in fact, they can not be separated.

Rethinking some fundamental concepts

- 27 As a recently developed discipline, landscape ecology borrows many concepts and terms from other, older disciplines dealing with the landscape. Already in the early beginnings of landscape ecology, one of the first tasks was to establish a common vocabulary with well defined concepts and terms (Schroever, 1982). Also, English became the main language in this field, so many term have been translated. Brandt (Brandt, 1998) pointed out how difficult it is to translate many fundamental concepts used in the English dominated landscape ecology to other languages. Many, subtle shifts in meaning do occur and make exact understanding and communication difficult. Zonneveld (1995) stressed the importance of the exact meaning and epistemology of words in his book *Land Ecology*. Indeed, correct use of concepts has to do with the purity of a discipline, the

opposite is pollution and degrading. Many textbooks of landscape ecology contain extensive definitions.

- 28 *Holism* is a bio-philosophical theory that originated with the naturalists during the early 19th century. Although Alexander von Humboldt did not use the term holism, the 'Gestalt'-idea is always clearly present. Holism was also important for the Gestalt-psychology and in particular as a theory to explain how our perception works. It is therefore not surprising that von Humboldt in his writings emphasis the aesthetics and the emotional experience of the landscape simultaneous as the rational observation and measurement of physical variables such as temperature. The perceptive dimension in landscape is fundamental, as the concept landscape combines a piece of land with its appearance, the scenery. Interaction between perception of the environment and behaviour leads to landscaping, i.e. shaping and the organising the land according to the needs of a (local) society and according to ethic and aesthetic values. As the needs and the values change, landscape becomes a dynamic phenomenon that is in continuous transition.
- 29 For many researchers nowadays, holism is outdated and scientifically not to be taken seriously. Maybe this is because holism is an abstract concept and difficult to handle and apply, in particular when using so called objective quantitative methods. A useful additional concept that allows an easier practical application of holism is the concept of a *holon*, which was introduced by Naveh and Lieberman (1994) and made it a building block of the Total Human Ecosystem. Doing so, they placed holism also in a hierarchical scale context in studying the landscape. Hierarchical structuring of landscapes is a classic method in land evaluation of land classification (Zonneveld, 1995; Vink 1980). It offers an approach to break down the extreme complexity of landscape into more comprehensive entities that can be handled, classified, studied and managed more easily. A first and important task in all landscape studies is the definition of the scale at which the study will be done; a task that is mostly achieved indirectly by the definition of the study area, the scope of the study and the resolution of mapping. Therefore, many systems of land classification link the definition of hierarchical land units to the mapping scale (Christian and Stewart, 1964; Webster and Beckett, 1970; Howard and Mitchell, 1980; Antrop, 1989; Zonneveld, 1995) and scale becomes a core concept in landscape ecology (Forman & Godron, 1986; Turner *et al.*, 1991).
- 30 According to holism the landscape should be considered as a complex whole that is more than the sum of its composing parts. This indicates that all elements in the spatial structure of the landscape are related to each other and form one complex system. The basic principles of landscape ecology rely upon these holistic concepts. Some other concepts that are frequently used in geography and spatial analysis are closely related but fundamentally different, such as structure, holon, pattern and scale.
- 31 *Patterns* are perceivable spatial arrangements of land units that are mostly defined as a combination of land form (slope), soil and land cover or land utilisation type. These spatial units are referred to as *patches* in landscape ecology. Patches have intrinsic properties based upon the variables that were used to define and delineate them, but also spatial properties such as size and shape and additional properties such as ownership and ground price. Patterns have also properties that can be described in many ways. Most common are concepts as heterogeneity, complexity and diversity. Most of these spatial characteristics of patches and patterns are nowadays described by quantitative variables, known as *landscape indices* or *landscape metrics*. An important axiom of landscape ecology

is that heterogeneity is related to (habitat) biodiversity. From the geographical viewpoint this is too simplistic. The methods of defining land units and describing their characteristics determine almost completely the values of the landscape metrics, which should be correlated to one of the expressions of biodiversity.

- 32 A *holon* is defined by Naveh and Lieberman (1994) as an open system that is part of a hierarchy. It is more or less autonomous subsystem that functions and has emergent properties as a whole. It contains holons at a lower hierarchical level and regulates them, while it is also regulated by higher hierarchical levels. As holons work more or less autonomously, we do not need to gather data of 'the whole is more than the sum of its composing parts' (which is impossible), but only what is related to the intrinsic properties of the feature studied and its context that determines its major functioning. This defines the scope of the study. The first step in the study should be the definition of the scale and context a feature should be studied at. The *ecodevice* concept is closely related (van Wirdum, 1981).
- 33 The word *structure* refers to the representation or description of a certain set of relations between elements. One feature, such as landscape, can be described by many structures. Structures do not exist as real things, they are made to describe the composition or functioning of some parts of a whole we are interested in. In the landscape we can for example recognise structures related to the geology, the drainage network, the transportation system, the urban settlement, the land use patterns, and many others.

Land, property, territory and landscape

- 34 Landscape and land are two different concepts. Landscape refers to a common perceivable part of the earth's surface, land has to do with soil, ground, territory (Zonneveld, 1995). In our modern civilisation, land is property; in many cases even private property. The owner decides more or less freely its use and shaping. The value of the land, the ground price, is an important factor in that decision making. It reflects the (potential) productivity and usefulness of a piece of land, which also depends upon its geographical situation. Consequently, land policy and controlling ground prices are important instruments for the realisation of planning goals. The most striking visible effect of this factor is the building of fences and enclosures and on a larger scale the creation of territories.
- 35 Each human settlement is a 'control' centre for the territory of the social group living there. It organises space around it according to ecological, economic, social, cultural and psychological rules. Most of these 'rules' act in an unconscious way. Generally speaking, following rules can be recognised as initial factors (Roberts, 1987; Antrop, 1988):
 - the land qualities which can be used must be diverse; this determines the extent and shape of the territory, so it offers a variety of natural resources, which is the best guarantee for a long lasting subsistence;
 - the human group tries to have a permanent overview of the land it owns, which determines the choice of the site of the settlement and the elaboration of a communication system between the centre and the periphery;
 - the attempts to keep peace with the neighbours and the marking and bordering of the territory.
- 36 Now, in modern times, the old forms of organisation of the land, which resulted from these rules, can still be recognised in the landscape as remnants of the original

structures. Further examples are discussed by Baker (1971), Roberts (1987), Unwin & Nash (1992), Antrop (1996c, 1997).

Perception, aesthetics and evaluation

- 37 The human perception works in a holistic way (McConnell, 1989; Naveh and Lieberman, 1994; Antrop, 1996a, 1996b) and psychological Gestalt-theory describes some rules or laws that explain how we deal with complex patterns. Some of these laws indicate how we perceive and handle landscape patterns. These aspects, mostly studied by psychologists and sociologists, offer valuable knowledge for practical applications, which are used in landscape architecture and environmental impact assessment. The number of dominant attributes that are important for landscape perception and evaluation appears to be limited and largely common between different western societies (Coeterier, 1996; Nassauer, 1997). These have been used for the assessment of the aesthetical qualities of landscapes (Antrop & Van Damme, 1995). Landscape perception is also intimately linked to identities and right (O'Neill and Walsh, 2000). Landscape evaluation is also needed in planning practice, in particular in managing agricultural systems. Here, more measurable indicators are used for the assessment (Oñate *et al.*, 2000).

Quantification of the landscape: landscape metrics

- 38 Attempts to quantify the characteristics of complex spatial patterns related to landscape heterogeneity and fragmentation, resulted in the application of very different theories from other disciplines in the field of landscape ecology. In fact, these are attempts to quantify purely holistic, i.e. transcendent characteristics of landscapes. The result is the almost explosive development of the most varied types of *landscape indices* or *landscape metrics*. This development was made possible since the spatial analysis using GIS and image-processing tools became powerful enough and available. Many landscape metrics are used in comparing different situations, mostly related to changes in time and disturbances. Also, changes in state using simulation have a wide field of applications, but most often they are related to monitoring issues, such as the loss of diversity. They can be used for landscape typology in geography (Antrop & Snacken, 1999; Phipps, 1981; Kilchenmann, 1973) and to detect and monitor structural changes using a concept like entropy (Antrop, 1998b; Phipps, 1984). Many landscape metrics are abstract and difficult to understand and to interpret. They often express immaterial, transcendent or holistic aspects of the landscape. Important ones are those dealing with fragmentation, a theme that is considered important in the global assessment of the environmental quality (Antrop *et al.*, 1994; Gulinck *et al.*, 1996; Dufourmont *et al.*, 1998; Gulinck *et al.*, 1999).
- 39 Anyhow, the description of landscape characteristics related to spatial patterns and the possibilities of their quantification has become an important topic in landscape ecology (Farina, 1995; Turner and Gardner, 1990; Turner *et al.*, 1990; Hunsacker *et al.*, 1994). The wide variety of landscape metrics or landscape indices (Farina, 1995; Martinez-Falero and Gonzalez-Alonso, 1995) has lead to a discussion about their real significance (Antrop, 1998b; Dramstad *et al.*, 1998; Fry, 1998). However, the possibilities for making such quantitative analysis of spatial patterns fundamentally depend upon the availability of geographical data, preferentially as maps. Spatial analysis remote sensing imagery and raster maps offer new possibilities (Frohn, 1998). The continuous, complex and

heterogeneous character of most landscapes makes the use of spatial sampling necessary (Agger & Brandt, 1984; Bunce, 1984; Hunsaker *et al.*, 1994).

Thinking of the future landscapes

Dynamics: landscape genesis and change

- 40 The 18th century initiated revolutionary changes in society and technology that caused fundamental and rapid change in traditional rural landscapes (Antrop, 2000a). This 'Age of Revolutions' started in the western world with the Industrial Revolution, which provided new technology and social structures for the change, the American and French Revolution, which triggered major social and political changes. The formation of national states were a remodelling with devastating wars that rapidly wiped away traditions, in particular the ones that governed the rural countryside. The rapid growth of industrial centres, associated with urban centres, and new modes of transportation disrupted even more the old relationship between town and countryside (Antrop, 2000b). After the Second World War, the rebuilding of society and economy could almost begin without any reference to the past. Quickly the scale of the development increased and became global. Political institutions, such as the emerging European Union, followed these processes of globalisation and stimulated the changes in landscape even more. Changing land use patterns are nowadays of prime concern to all dealing with the landscape (Jongman, 1996).

The future of the landscape

- 41 Many authors have a pessimistic view of the future of the landscape. This is not only the case in the highly urbanised and industrialised western world (Dessylas, 1990; Stanners and Bourdeau, 1995; Froment, 1999; Kolen & Lemaire, 1999) but also globally as expressed by the many concerns related to environmental and land degradation and desertification (Goudie, 2000) and sustainable development. The fast and profound transformation of most landscapes after the Second World War is generally characterised by a loss of diversity, increasing homogeneity and fundamental breaking with the past. New landscapes are created without history and without links to the natural substrate.
- 42 Urbanisation is a complex process that gradually transforms rural landscapes in new landscape types. Urbanisation has rapidly gained the world-wide interest of geographers, planners and landscape ecologists. Urban fringe landscapes have their own dynamics (Antrop, 1994), specific problems of perception (Smardon, 1988; Sullivan, 1994; Nassauer, 1997; Zmyslony & Gagnon, 1998) and of ecology and environment (Richter, 1984; McDonald & Brown, 1984; Rogers & Rowntree, 1988; Yokohari *et al.*, 1994). Urbanisation is a complex process that can affect even remote regions in the countryside (Lucy & Philips, 1997; Antrop, 1998a) and accessibility becomes an increasingly important factor in understanding changes in the landscapes of the countryside (Lewis & Maund, 1976; Lewis, 1979; Antrop, 1999). Also the rural areas that are confronted with new problems, such as depopulation, continuity of farms in highly urbanised landscapes, were studied for Flanders by De Klerck (1993) and Lhermitte (1993) and in the Walloon region by Christians (1989).

- 43 A similar consideration can be made for the new landscapes created by all kinds of transportation and communication networks. Some call these new landscapes ‘non-places’ or ‘non-lieux’ (Kolen & Lemaire, 1999). Neddens & Wucher (1987) called it the ‘genius loci is lost’. It stresses the importance of recent loss, due modernisation of all kind, of the spiritual, symbolic and religious character and values that once were vital. The interest of studying such road corridor landscapes is still very recent (Forman, 1998a, 1998b).

Landscape planning and maintenance of the natural and cultural heritage

- 44 The loss of biodiversity is related to a loss in landscape heterogeneity and the loss of gradients between different landscapes (Green *et al.*, 1996). Generally, the landscapes in the world are rapidly uniforming globally, a process referred to by some as macdonaldisation (Kolen & Lemaire, 1999). The process is related to rationalisation in agriculture, increased urbanisation (Antrop, 1998a, 2000) and changing patterns in transportation and mobility (Forman, 1998; Antrop, 1999; Kolen & Lemaire, 1999). Consequently, landscape heterogeneity, fragmentation, disturbance and changing land use, urbanisation of the countryside, transportation and networking, interaction between spatial structure and functioning of the landscape become new key concepts in the study of the landscape.

New thoughts for landscape architecture

- 45 Landscape architecture evolved from the garden architecture of palaces, in particular in Western Europe since the Renaissance (Troll, 1950; Antrop, 1989). Kolen and Lemaire (1999) consider the Renaissance as the first emergence of what they call ‘landscape conscience’. It was closely related to new urban planning as realised in the founding of some new residential cities. The first association was founded in the USA in 1919 (Jellicoe, 1975). Many concepts and principles of the ‘landscape gardening’ were applied in the modern urban and spatial planning, in particular during the post-war rebuilding and the creation of new towns. During the seventies and eighties less attention was given to the shaping of landscape as part of planning policy. Since the nineties, landscape architects are involved again in spatial planning, in particular for ‘finishing’ and ‘integrating’ new infrastructures and reshaping congested urban centres. Gradually, also landscape ecological principles were integrated into landscape architecture and planning (Nassauer, 1992, 1995, 1997).

The landscapes in Belgium. A small country, a high diversity of landscapes

- 46 The regional and landscape diversity is very large in the small geographic territory of Belgium (Christians & Daels, 1998; Antrop, 1994, 1996). This is explained by its physical structure, which is very varied and which is amplified by very diverse cultural influences during a long history, sometimes described as the battlefield of Europe and finally resulting in the creation of Belgium as a buffer state. The physical structure gives the

basis for the classification of geographical regions and of the traditional landscapes (Antrop, 1997). In a densely populated and highly industrialised country, the pressure upon the geographical space is high and the changes are rapid.

Highly urbanised and at the cross-roads of Europe

- 47 The landscapes in Belgium show a wide variety of changes due to urbanisation and fragmentation due to transport infrastructures. In fact, the development of the new mode of transportation by the railway started in 1835 (Van der Haegen, 1992). The problem of distinguishing between urban and rural can be illustrated very well with the Belgian situation. The Global Report on Human Settlements (United Nations Centre for Human Settlement (HABITAT), 1996) gives for Belgium the misleading figure of 97% for the urban population in 1995. In the most urbanised part, i.e. the region of Flanders, the average population density was about 431 inhabitants per square kilometre in 1993 (Van Hecke & Dickens, 1994). Urban centres are defined and classified according to many criteria such as: the concentration of population, the multi-functionality of the centre and its sphere of influence, the heterogeneity of the population and the building density. It is more sensible to say that Belgium has 15 urban regions of at least 80,000 inhabitants, grouping about 53% of the total population. Besides the main cities there are many other (large and small) towns and urbanised villages. The urban fringes occupy vast areas. The urbanisation of the countryside occurs in many different forms and is the most important factor in the transformation of the landscapes of Belgium (Antrop, 1994, 1998a).

Geography and landscape science in a federal state

- 48 Gradually, Belgium has become a federal state with three regions (Flanders, Wallonia and Brussels-Capital) and three communities (Flemish, French and German-speaking). Policy in different aspects was decentralised accordingly. Spatial and urban planning, environmental planning, nature conservation and protection of landscapes and monuments became the responsibilities of the regions and communities. Agriculture remains a federal matter, but will be regionalised probably in the near future.
- 49 The consequences for a comprehensive study of the Belgian landscapes are important. First, the natural landscape gradients (soils, geology, relief) in Belgium are almost all west-east oriented zones varying from the north to the south. The hydrological system is completely oriented from south to north. The political borders divide the whole of this natural pattern. The results are differences in policy, legislation, data collection and monitoring. Second, most research nowadays is funded on an international (European) or regional basis, not on a federal or interregional one. Studies covering the whole of Belgium and dealing with landscapes are rare (Christians & Daels, 1988; Christians, Daels & Verhoeve, 1992).

Taking care of the landscape

- 50 In the 19th century the new state of Belgium followed the international trend of protecting areas for their natural, and aesthetical quality (Van Hoorick, 1999). This resulted in laws concerning the protection and classification of monuments and landscapes. Landscapes could be protected for their 'scientific, cultural-historical and

aesthetical value of national importance'. After the federalisation of the Belgian State, protection of the landscape became the responsibility of the Regions. Today, the three regions of Belgium have their own legislation. Gradually, objectives, interests and legislation of nature conservation and landscape protection diverged, not only between the federal regions but also within. In Flanders for example, visions about the landscape are found in the legislation for landscape protection, but also in the ones concerning nature conservation and spatial planning. Although the three decrees focus upon different aspects of the landscape, they are not always concerted and makes an integrated holistic approach of the landscape management difficult. However, in Belgium, there is a growing interest in grouping and organising the many local thematic initiatives for the protection of the cultural heritage in the landscape.

- 51 In Flanders, a survey has started to map the relics of the traditional landscapes based upon the orthophotomaps of 1990 (Antrop & Van Nuffel, 1997). For each province, an atlas was created with maps at a scale of 1/50,000. These indicated the cultural and aesthetical relics that were complementary to the natural ones already mapped in the Biological Valuation map (De Blust *et al.*, 1985). Relics are not classified according to their age or nature, but to their spatial properties. Thus, relic zones, anchor places, lines, points and views are distinguished and mapped in a GIS linked to a relational database. The finalisation of this atlas will be achieved in 2000. It gives for the first time a complete coverage of remaining landscape values in the highly urbanised and fragmented Flemish landscape. The atlases are to be used intensively for further landscape protection, spatial and environmental planning and environmental impact assessment.
- 52 Important are also are non-governmental initiatives, such as the ones by the Flemish Contact Commission for Monument Care (Vlaamse Contactcommissie Monumentenzorg VCM), and the Foundation of Flemish heritage (Stichting Vlaams Erfgoed SVE), both private organisations (Balthazar, 1998). The first organises meetings and conferences to bring all interests together in as much an interdisciplinary approach as possible. The second promotes restoration and will organise from now on the successful Open Monuments Day.
- 53 In the Walloon Region, the work of Neuray (1982) was fundamental for an integrated and multidisciplinary approach to the assessment, evaluation and appreciation of landscapes as a basis for planning and landscape management. Associations to promote active protection of sites, heritage values of the rural countryside were created. These include the Walloon Village Quality (Qualité Village Wallonie) and the Rural Foundation of Wallonia (Fondation rurale de Wallonie) (Matthys, 1998). However, their approach is somewhat different to the one of Flanders. Here, much of the deterioration of landscape and the cultural heritage it contains, is caused by an increasing depopulation of the countryside and by strongly localised pressures from recreation and tourism. The general question here becomes clear: who will maintain the future landscape of the countryside?

Issues of environmental and spatial planning and monitoring

- 54 Care for the landscape is explicitly mentioned in the spatial and environmental planning policies of the different regions of the federal state of Belgium. Because of the different conditions of the landscapes and because of differences in policy and legislation, the approach to landscape management is different too (Van den Bergh 1999). In Flanders, policy rules related to the landscape are found in both the spatial planning ('Ruimtelijk

Structuurplan Vlaanderen' RSV) and in the environmental planning (Mina-plan2). Both plans explicitly refer to the landscape in different aspects. The 'quality of space', which implies environmental quality as well as spatial organisation and physical planning, is considered insufficient and should be improved. It is believed that a structural change will improve many functional aspects. Considering the landscape, attention is given to the conservation of (remnants of) undisturbed traditional landscapes, keeping recognisable structural relief forms and transitions between different landscape types and regions, stressing of the perceptive importance of visual landmarks in structuring geographical space and making buffer corridors of open landscape between urban zones. The main problems are defined by the important suburbanisation and the high density transportation infrastructure, both causing severe fragmentation of the countryside with important losses or degradation of both the natural and cultural values of the landscape. As another core problem, the rapid homogenisation of these landscapes is recognised, as well as the related loss of their identity and the diversity of natural, ecological and cultural values. Therefore, surveys and inventories of landscapes and environmental qualities are considered of high importance. Also, the setting up of integrated monitoring systems is considered.

- 55 In the Walloon region, the spatial planning policy is based upon the 'Code Wallon de l'Aménagement du Territoire, de l'Urbanisme et du Patrimoine' (CWATUP) and realised by a spatial schemes called 'Schéma de Développement de l'Espace Régional' (SDER). Development means here also the improvement of the quality of living. The Walloon territory is seen as 'a collective heritage for its inhabitants'. Urban and rural landscapes are considered and both are valued for having a great diversity, which is important for the environmental quality and for cultural and territorial identity. Urbanisation processes are important but localised and major population migration is an important factor in landscape change. Specific problems are the poor integration of recreation and tourism in the landscape, with local overcrowding and ecological problems. Degraded landscapes are considered as bad for the image of the Walloon region.

Conclusion

- 56 The study of the landscape spread from a core topic in geography to many other disciplines. Landscape is a dynamic synthesis between the natural and cultural environment of a region and has strong holistic properties. Consequently, many approaches are possible and needed. Important ones are the typological and chronological classification of landscape as also used in land evaluation. Historical geography and geo-archaeology emphasised the unique history of landscapes as a fundamental aspect their identity. In the beginning of landscape ecology brought the ecologists to a higher scale of observation. Gradually, landscape ecology became a multidisciplinary and is still widening towards transdisciplinarity. This was important to keep the scientific interest upon the landscape as an important aspect of our environment. Also, this shift clearly shows a growing interest for practical applications, especially in different forms of planning.
- 57 The landscape research in Belgium started also within geography, in particular regional geography. The cultural landscape was studied in a multiple approach, using soil science, physical geography, history and archaeology. The landscape genesis and historical evolution was more studied by the Flemish researchers, while the Walloon ones also used

socio-economic development of the regions to characterise landscape. During the 1970s, the interest for regional geography decreased in favour of a polarisation between physical and socio-economic geography. The interest for landscape research diminished as well. Since the 1980s many geographers and ecologists from Belgium found new mutual interests in landscape ecology, with strong emphasis for practical applications towards planning and management. However, Belgium becoming gradually a federal state, enforced the different approaches in landscape research between the Flemish region and the Walloon region, while no proper interest emerged in the Brussels Capital region. This is particularly important nowadays, as these regions make their own new legislation and have different policies concerning the landscape. This causes a growing divergence of the focus and interest in landscape research for practical applications between these regions. The actual trend is a growing interest of Belgian landscape researcher to participate at the international level, in particular the rapidly vanishing cultural and natural landscapes of Europe.

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ABSTRACTS

The study of the landscape was once the main subject of study in geography. Now, it is a core topic in many disciplines, such as geography and ecology, soil science and land survey, landscape architecture and planning, psychology and philosophy, history and archaeology. This essay analyses how this evolution came about in Europe in general and focuses then upon the Belgian situation. Landscape is still seen as a dynamic synthesis between the natural and cultural

environment of a region. At the same time it is the expression of the consecutive human attitudes towards the occupied and organised land. Landscapes have a unique history that is part of their identity. The meaning of the word landscape is multiple and so is the research related to the landscape. From local and regional monographs the study of landscape became transdisciplinary and landscape science emerged as an international network of researchers of very different training but sharing the same interest. All are trying to understand the complex interactions between structured landscapes elements and relational processes and their significance for human valuation and attempts to organise and maintain the land in a sustainable fashion.

Le paysage, qui fut autrefois le principal sujet d'étude en géographie, se trouve aujourd'hui au coeur de nombreuses disciplines où interviennent géographes et écologues, géologues et géomètres, architectes paysagistes et aménageurs, psychologues et philosophes, historiens et archéologues. Cet article analyse comment cette évolution s'est produite en Europe en général avant de se pencher sur le cas de la Belgique. Le paysage est toujours vu comme une synthèse dynamique entre environnement naturel et culturel d'une région, reflétant également les attitudes successives des hommes par rapport au territoire occupé et organisé. Les paysages ont une histoire unique qui fait partie de leur identité. La signification même du mot paysage est multiple, ainsi que la recherche dans cette matière. Initialement limitée aux monographies locales et régionales, l'étude du paysage est devenue interdisciplinaire. Quant à la science paysagère, elle rassemble aujourd'hui un réseau international de chercheurs diversement formés mais partageant un même intérêt. Tous ont pour souci de comprendre les interactions complexes entre les éléments paysagers structurés et les processus relationnels, ainsi que leur poids dans les estimations et les tentatives humaines d'organiser et de conserver le territoire de façon durable.

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Mots-clés: géographie, science paysagère, écologie du paysage

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