Shaping relations between natural and artificial landscapes on the example of selected riverside cities: Budapest and Rzeszow

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Abstract. The article discusses the nature of the relationship between the natural landscape and the transformed landscape. The description of these ties was limited to two interdependent and simultaneously contrasting creatures - a river of a fully natural landscape and a city as an artificial landscape resulting from the Anthropos genic transformations. The relationship between these two opposing types of landscapes is centuries-old and thus constitutes a rich source of search and study of human-environment relations. The direct reason for addressing this issue is a gradual change in the approach to landscape shaping of the river valley existing with the urban landscape. Clear transformations of these dependencies and the creation of a return of the city to the river can be observed, for example, in the London docks or Mill Island in Bydgoszcz in Poland. The research area is the coastline of two administratively, culturally and historically different European cities: the Wislok coastline in Rzeszow, the capital of the voivodeship in south-eastern Poland, and the Danube coastline in Budapest, the capital of Hungary. In Budapest, the coexistence of the river and the city is very clear, and their mutual connections are historically anchored and clearly visible in the city's urban structure. On the other hand, the dynamic changes that have taken place over the centuries in the riverbed of Wislok in Rzeszow caused that the river is not the urban axis of the city and did not significantly affect its urban layout in the past. Throughout most of its existence, the city was formed in fear of the river. The comparison of the shape of the coasts of the cities mentioned above resembles a master-pupil relationship. The two cities share a historical link with the river valley, but the degree of development of these relations varies considerably. The observation was used as a research method. The selected cases are the family towns of the authors, which made it possible to confront the results of literature research, mainly related to the historical layer, with long-term observations of the discussed areas. The article also defines the features distinguishing riverside cities and the advantages and fears resulting from the coexistence of these two seemingly contrasting landscapes.
1. Introduction

City - "a document carved in the landscape by history"[1]. The city is defined as a densely built-up, historically formed settlement [2] with a sociologically diverse society which constitutes an area of an irreversibly transformed natural landscape. Therefore, it is a fully anthropogenic creation, contradictory to the natural environment and natural landscape, which definition an individual type of a transformed landscape - a cultural landscape.

River - a large natural flowing watercourse. It is worth emphasizing that not only is the river a watercourse and its channel, but also its valley. The floodplains, as well as the fluvial terraces and their slopes, constitute the valley [3]. Hence the meaning of a river is extended to far wider areas than the watercourse itself.

While considering these two entities separately, one may conclude that they oppose each other. The antagonism between these two terms excludes their coexistence, the river as a part of the landscape of a fully natural origin and the city as a planned and designed creation.

Nonetheless, both of these entities are sources of motion, set for further expansion and in search of new areas and opportunities. The river, due to its life-giving, transportation, defence and cultural qualities, has become the foundation for the creation of numerous settlements. The fields of mutual and complex interactions have come to being. The coexistence of these two elements in time has not been based on harmonious coexistence, as both of them have the qualities which threaten each other. The river as one of four elements is characterised by its unpredictability, changeability and occasional high-water levels which determine the history of riverside cities. Cities as large population centres have perceived the river as an element to be taken possession of, a gift. It resulted in transforming rivers into wastewater recipients, inconsiderate building practices, changing outflow structures due to, among others, excessive regulation or covering of streams, sealing surfaces which were followed by lowering of groundwater levels and occurrences of sudden floods.

Particularistic approach to natural elements began to be globally restricted in the second half of the 20th century. Regulations determining the character of human-environment relationship have been introduced[2]. Adopting these regulations was the concern for preserving the environment in the best possible condition for future generations. The basis for taking these actions was the trinity of interrelated society, economy and environment.

During the Lisbon Waterfront Expo conference in 2007, the Ten Rules of Sustainable Development of Urban Waterfronts were developed[3]. The city became responsible for its relationship with the blue infrastructure. The scope of responsibilities includes water purity, restoration of degraded river banks and transforming them into functionally diverse public space. This diversity should manifest itself by the coexistence of cultural, dwelling, commercial and recreational functions. The shaping of waterfronts should clearly reflect the historical identity of the relationship between the river and the city. The values of public-private cooperation and social participation have been laid down. Transformation processes are not understood as a single action, but a long-term course of actions. Their implementation may be extended over generations; nonetheless, it is vital that each member of the public should benefit from

1 J. Bogdanowski, [1, p.11], thesis of G. Bronisch.
2 The Earth Summit - The United Nations Conference on the Human Environment in Stockholm, 1972 and the second conference, The United Nations Conference on Environment and Development in Rio de Janeiro, 1992. The idea of sustainable development was coined in 1987 by the World Commission on Environment and Development in the report Our Common Future.
3 The Rio+20 conference in 2012, the eighth phase of the UNESCO's International Hydrological Programme to be implemented in the period 2014 - 2021, the Water Framework Directive adopted in the EU member states, [4].
them. Local authorities should take charge of these undertakings by means of financial and substantial support. Moreover, the said undertakings should be perceived not only as local actions, but part of the activities of an international structure. The cities from which the authors come establish two examples of the interdependence between the river and urban structures. The cities are located in two different cultural regions, two different countries, the cities of different sizes and administrative importance. Both of the cases here in discussed are at different stages of shaping these relations. Nonetheless, they are very much alike in terms of the rivers which accompanied their historical permanence.

2. Rzeszow – the Wislok River

Rzeszow is a provincial capital located in south-eastern Poland. Its urban structure is situated on the Wislok River, a third-degree river, which belongs to the Baltic Sea watershed. The city's history reveals its ages-long interdependence between the creation of the urban structure and the blue infrastructure. The hydrological background for the creation of the city was not only its main river – the Wislok, but, above all, its left tributaries, which left their marks, nowadays blended with the urban tissue, yet present in the inhabitants' awareness.

Sub montane streams flow into the Wislok River. Mlynowka, one of the right tributaries, is the longest stream of the biggest elevation difference (170m) with its source in the Carpathian part of the city. Other streams are characterised by much smaller elevation differences (42 - 74m) [5].

The rich hydrography of the area and vast wetlands were used for the founding of the pre-location settlement defended by the Przyrwa stream, a left tributary of the Wislok River and an artificial pond called Popie Jezioro [the Priest Lake]. The chartered town was founded southwards from the aforementioned settlement, at the bifurcation of the main river - the Wislok and its left tributary - the Mikoska. The location of the city at the fork of two watercourses which used to burst their banks often, surrounded by wetlands in the south, formed the character of the city which was described as a hill among the wetlands [6]. This cityscape full of water was a characteristic feature of Rzeszow almost until the end of the 19th century. A highly suggestive description of this phenomena can be found in the records of the order of Piarists in Rzeszow: "sea-like waters have surrounded the whole city" [7]. Not only has the richness of hydrographic resources shaped the character of the city, but also considerate engineering solutions and natural features of the terrain.

Due to a real threat of Tatars raids in the 17th century, the city owner decided to create vast artificial wetlands which could protect the city from the west and the south [8]. The western part of the city was defended by the Wislok River. The system of water defence structures included the biggest of the ponds

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4 According to Kondracki.
5 J. Lach, A. Michalik, Środowisko geograficzne, [6].
- the Bernadine Lake and two ponds which were also of economic importance\(^6\) - the Great Castle Boroughs Lake and the Small Castle Boroughs Lake. The Bernadine Lake, into which the Mikoska stream at which the chartered city was located used to flow, defended the city from the North West. The Rudka stream, a left tributary of the Wislok River, used to flow into the aforementioned ponds, which defended the castle from the south and the west. The translocation of the Mikoska riverbed and reinforcement of its banks is connected with very complex planning of water structures. The damming up of water was also used for economic purposes. A watermill was built at the mouth of the lake, on a levee [9].

The richness of the "sea-like waters [that] surrounded the city"\(^7\) is reflected in numerous travel journals, but first of all, the Wiedemann's plan drawn in 1762 by an architect and military engineer. The plan shows a bird's-eye view of the city.

Water resources used to determine the urban planning of the city almost until the end of the 19th century. Unfortunately, vast wetlands, which failed to continue to perform their defence functions, were transformed into unauthorised landfill sites. On the other hand, the Mikoska, the most important stream in the history of Rzeszow was transformed into a sewer due to the fact that it flows across the city centre. Over time the stream has been covered because of the stench and epidemiological factors [9, 10]\(^8\).

Archive photographs\(^9\) from the end of the 19th century depict fragments of broads under the castle and the Bernadine church, where it used to be turned into an ice-skating rink in the winter.

The existence of the stream on the surface definitely ended at the beginning of the 21st century, when the last urban section of the stream which flows into the Wislok River was covered and on the "recovered" area, a parking lot was built. The Rudka stream shared the Makossa's fate. Its riverbed was covered and only a 200m long section which flows into the Wislok River remains open. The longest section of a stream which flows through the city and has resisted the urban anthropic pressure is the Paryja stream. The stream runs through the protected area of the Lisia Gora nature reserve, created around a reservoir on the Wislok River. Nowadays, the remaining streams such as the Czekaj or the Strug are being more and more regulated due to the building of housing estates in the area of their catchments.

Covering of the streams facilitated the planning city's communication structures. Nonetheless, at the same time, it made the city devoid of a very important recreational and culture-forming factor, diminishing the inhabitants' feeling of identity with their place of residence.

Artificial plans regarding the water infrastructure prevailed in the city's water history, especially in the 17th and 18th century, stamp out the history of the main river - the Wislok. The Wislok was described by researchers as capricious, often changing its watercourse and threatening the city. At the same time, its naturally formed waterfronts facilitated the strengthening of the relationship between city dwellers and the river over generations. The regulation of the Wislok River took place in 1901, in accordance with the stipulations of the National Act on the Regulation of Galicia Rivers. The watercourse of the Wislok River was make straight and its banks were regulated, at the same time moving away from its riverbed from Rzeszow's urban structures.

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\(^6\) The Great Castle Boroughs Pond and the Lesser Castle Boroughs Pond were used for fish farming and provided the most fundamental food in the 17th century.

\(^7\) The Wiedemann's plan was made well-known after it was painted on the gable wall of one of the tenement houses in the centre of Rzeszow.

\(^8\) J. Małczewski, Mikoska, [10].

\(^9\) Archive photographs by E. Janusz.
Partial taming of the Wislok River allowed the development of the city on its both sides. Almost to the second half of the 20th century, the development of the urban tissue took place on the left bank of the river. Straightening of the Wislok’s watercourse also resulted in the disappearance of a right-bank meadow, which was later located on the left bank of the river. To the present day, they are a walking boulevard, popular among the inhabitants of Rzeszow. Yet another significant change in the watercourse of the Wislok was the building of a dam, which dammed up the water for the industrial use of a nearby factory and human consumption purposes. The creation of a 120-ha reservoir area with numerous recreational facilities along its banks was planned. Unfortunately, only approximately 60 ha reservoir was created, the area of which was diminished by one third to date [10, 11]. Silting of the reservoir weakens its sailing capabilities. Nonetheless, certain failures in the realisation and functioning of the reservoir brought unexpected results. Interesting and rich ecosystems originated on the banks of the reservoir, along which a 6 km-long walking boulevard and a nature trail is located (Figures 1).

3. Budapest – the Danube
The Danube plays a crucial role in the existence of Budapest, the capital of Hungary. This site was selected in paleolith due to the narrowing of the river in this place that made crossing it easier. The city appears to be divided into two parts by the river, but in fact, it is one entity. Budapest was founded by combining the city Pest of a relatively even surface, located on the left bank of the Danube and the right-bank, hilly city Buda in 1973. The increased development of both cities began in the second half of the 12th century. In spite of the fact that Pest and Buda were administratively separate and independent, the disproportion between urban growths of both of these urban structures located on two different river banks is not observed in the case of Budapest. The symbol of Budapest, Lanchíd (the Szechenyi Chain
Bridge), was the first bridge to connect both banks of the Danube in 1849. Nowadays, Budapest has 7 road bridges, which make up an unforgettable cityscape.

![ Figures 2. The banks of the Danube in Budapest. Photo by A. Rybka ]

In Budapest, often described as Europe's Little Paris, similarly to the capital of France, the majority of representative landmarks, that is, the Buda Castle, palaces in the old town, the parliament and churches were erected face to the banks of the river (Figures 2). The Danube River is widely perceived as the urban axis of the city, to which urban planning schemes were adjusted. Along the banks of the Danube, there are promenades, including the most famous one - Korso, with its numerous cafés, hotels and recreational facilities.

The former border of the Roman Empire, the Danube River, crosses the borders of 10 countries: Romania (29.0% of the river basin), Hungary (11.6%), Serbia (10.2%), Austria (10.0%), Germany (7.0%), Bulgaria (5.9%), Slovakia (5.9%), Croatia (4.4%), Ukraine (3.8%) and Moldavia (1.6%). As Budapest's water supply is based on the Danube, the impact on water quality in the river basin and in the countries located in the upper Danube is of crucial importance.

Water supply in Budapest is based on riverside filtration. 764 water wells exploit water from the Danube with a nominal output of 1190 million liters daily. It is the world's biggest water supply system of its kind. The majority of water boreholes are located on two islands: Szentendre in the north and Csepel Island in the south, of the length of 150 km along the Danube. The riverside filtration system ensures natural biological processing of raw water, which results in a very good quality of drinking water.

Before the building of the Central Wastewater Treatment Plant in 2010, only approximately 20% of wastewater was processed biologically. This resulted in lower water quality in the wells in the Csepel Island: rapid biodegradation processes in the soil caused by increased amounts of organic matter resulted in the excessive spread of iron and manganese. Due to this fact, iron and manganese treatment plants had to be built in the southern area of water production.
The Danube is the main water route, both in terms of trade and tourism. Therefore, Budapest has a significant commercial and industrial port in its lower area. Passenger and tourist vessels sail on the river in the city centre. There are sport and recreation facilities, yet they are limited. These are mostly rowing and canoeing facilities.

Nevertheless, the Danube, apart from its cultural and landscape values, provides Budapest with drinking water and is a wastewater recipient, but sometimes it creates a threat of flooding. Not long ago, in 2013, in Budapest, a historical flood caused by heavy rains, connected with the Danube's tributaries bursting their banks took place. The water level in Budapest reached the highest level of 891 cm, 31 cm higher than the previous one peak level (860 cm in 2006). Due to the flooding risk, the creation of flood protection structures, flood banks and levees is of vital importance.

4. Conclusions
Budapest is an example of the city, the structure of which was shaped faced to the river. The Danube connects the two sides of the city and fosters its identity. Vast inner-city boulevards with representative buildings mediate the urban tissue and the river. The importance of the river is not limited to its communication values, but it also improves aesthetic values and constitutes a unique collet for the historical city frontages. The highlight is strengthened by the monumental architecture of the bridges which link Buda and Pest, deepening their bonds. In Budapest, the coexistence of the river and the city is very clear, and their mutual interrelations are historically anchored in the urban structure of the city.

Rzeszow and its interrelations with the Wislok River are different from Budapest. Changes in the Wislok's watercourse, which were taking place over ages, resulted in the fact that the river is not the urban axis of the city and fails to determine its urban layout. Throughout most of its existence, the city was formed fearing the river, yet not the water. Nowadays, in pursuance of the tendency to return to the riverside by cities and carrying out numerous programmes of blue infrastructure revival in Poland, Rzeszow changes its waterfronts slowly, turning them into public spaces, making them present in the inhabitants' awareness. The Wislok River slowly becomes a constituent part of the mental map of Rzeszow, a socialised space, facilitating the mental health improvement of the inhabitants, threatened with industrial fatigue. Rzeszow, similarly to other developing cities, needs durable elements in the city's history, such as the system of rivers and streams, which should be connected with the city by means of a harmonious dialogue between the man and the environment[12].

In both cases, the rivers decide of the individuality of these cities, their cultural identity and they are their important landmarks. The synergy of both of these cities and their rivers allows them to obtain their characteristic features, at the same time providing them to maintain the ecological balance between the natural and the transformed landscape. This relationship provides the inhabitants with a sense of security of a purely environmental character and also determines the existence of an area free from the influence of the city life.

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