

Effect of a river valley in a town on its spatial development: The case of Poznań, Warta River ¹

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Abstract

The development of settlement observed in river valleys was connected with the access to water which was drawn mainly from rivers and the access to food obtained directly from the river. The defensive as well as transport-related economic functions of rivers were equally important. According to numerous authors along with the intensive development of urbanisation, industry and river transport in the 18th century the processes of developing river valleys became more intensified. The performed works resulted in transformation of the spatial structure of river valleys through adjustment of the river channel and also of its embankments along with the development of settlement, which consequently led to the change of hydrography and land relief. The valley of the Warta River in Poznań is an example of such landscape in the case of which the man got adjusted to the environment, whilst transforming it at the same time.

Key words:

Warta river valley, functions of rivers, development of urbanisation, transformation of landscape.

Introduction

River valleys are considered to be a very significant landscape element playing an important role in its structure and functions as well as in preservation of wildlife resources. Natural river valleys are characterised by high diversity of ecosystems. Moreover, they are considered to be the most valuable and universal ecological corridors.

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The development of settlement observed in river valleys was connected with the access to water which was drawn mainly from rivers and the access to food obtained directly from the river.

The equally important functions of rivers included also those related to defence and economy, especially with regard to transport.

So the river valley landscapes are formed by big river valleys – most often flat – in which water is the main landscape- and relief-forming factor. The examples of such landscape include the Warta River valley in Poznań. Poznań, one of the oldest and biggest cities in Poland, is located on the Warta River at the mouth of its right-bank tributaries, namely Cybina and Główna as well as the left-bank tributary, namely Bogdanka. It is located in the Wielkopolskie Lake District between Poznań Lake District, Gniezno Lake District, Września Plain and the Poznań Warta River gorge separating Gniezno Lake District and Września Plain (fig. 1).

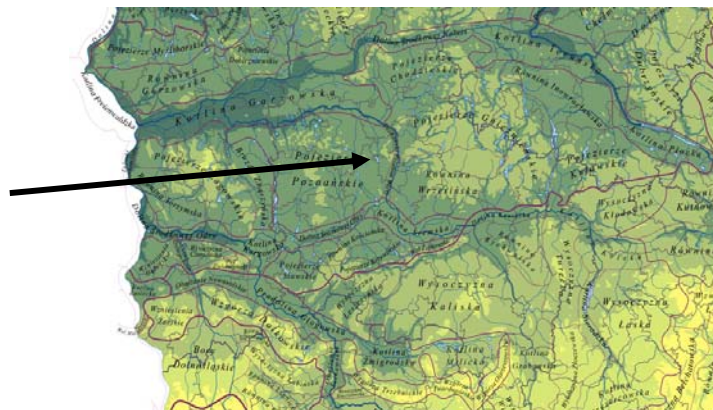


Figure 1. Warta River, West Poland

In 1999 a residence of the first Piast dynasty from the second half of the 10th century and Mieszko's palace and chapel complex were discovered at Ostrów Tumski in Poznań (the archaeological works were conducted under the supervision of Prof. Hanna Kóčka-Krenz of the Adam Mickiewicz University). The complex was an early Piast duke's palace and later a king's palace and at the same time the biggest stone structure of the first Piast dynasty (Kóčka-Krenz, 2005). So, clearly, it is a special place.

The relief in the territory of Poznań is highly diversified and it results from the activity of the glacier ice sheet and postglacial (fluvioglacial) waters. The Warta is the third longest river in Poland (808.2 km) and the main right-bank tributary of the Odra River (Figure1).

It drains the land forming a river basin with the area of 55.7 thousand km². The most important glaciation was the third one that ended about 12 thousand years ago. It formed not only the land surface but also the water network.

Warta River valley in Poznań

The Warta in Poznań runs in a unique and special way, taking advantage of the geomorphological form, i.e. a river gorge. This part of the course, called the Poznań Warta Gorge (Figure 1), is interesting from the perspective of both relief development and river terraces existing in the valley landscape. The Warta River has always played an important role in the economic life of Poznań and according to Kaniecki (2004) since the very beginning the city has been inextricably linked with the river. However, in the 60s of the 20th century when the old channel of the Warta River was buried and communications routes became extended, the insular nature of Poznań was destroyed. The remains include varied landform features within the city territory, land elevations and descents that stand as an evidence of height differences. In some places the relief was totally transformed as a result of adjustment to urbanisation needs.

Therefore, the aspect of adjustment of the emerging city of Poznań and its subsequent spatial development to the relief and course of the valley of the Warta River and its tributaries forms a very interesting geographical, natural, historical and tourist issue. Already long time ago Stanisław Pawłowski examined land forms, defining their course and importance to the developing Poznań.

The basic morphological unit of the area on which Poznań is situated is flat moraine plateau having elevation of about 80–100 m above sea level. (Żynda, 1996). There is some diversification visible, namely in the southern part of the city the plateau reaches the height of 80-85 m above sea level, whereas in the northern part at the foot of the Morasko terminal moraine its height amounts to 90–100 m above sea level. There are glacial channels, valleys and small valleys as well as closed depressions cut into the area of the moraine plateau. The most significant form in the landscape under consideration is the longitudinally oriented Warta valley that cuts through the city. The valley is about 15 km long with varying width (ranging from 1.5 to 4 km) and relative depth of indentation in the plateau level of up to 20-40 m on average (Żynda, 1996). Such a course of the Warta valley that forms an axis of the whole hydrographical system determines together with valleys of tributaries

the occurrence of so-called city's green wedges. In the north-western part of the city, between Morasko and Radojewo, there are the highest hills of the Poznań terminal moraine.

Their relative height amounts to approx. 50 m with reference to the plateau level and over 100 m with reference to the Warta level (51.8 m above sea level). The culmination is Moraska Mountain (153.75 m above sea level) being the highest Poznań elevation and also the highest hill of the central Wielkopolska. The peak of the hill is situated in the territory of the Morasko Meteorite reserve and is covered with forest.

The Poznań Warta Gorge is a characteristic place determining the development conditions of Poznań. While defining the term of gorge it should be stated that it is a section of the river valley with narrow bed and steep slopes in which the river passes over an obstacle that occurs on its way (e.g. a mountain range or any other land elevation). The total length of the longitudinally oriented section of the Warta valley amounts to 45 km.

One of the types is an epigenic gorge that originates from the transformation of a postglacial channel into a classic river valley. The river takes advantage of the postglacial channel, running however in the opposite direction to the direction of the glacial river. An example of this type is the Poznań Warta River Gorge (Figure 1).

The gorge valley of the Warta River in Poznań is about 15 km long, its width at that point ranges from 1.5 km in the northern part to 4 km in the southern part and it cuts through hills of the terminal moraine of the Poznań stadial and the whole territory of Poznań and its surroundings are characterised by the relief of the post-glacial origin. In the middle of the gorge section of the valley, oriented along the north-south axis, Poznań is located with its oldest part situated on the bed of the Poznań Warta River Gorge (Kaniecki, 2004). As a result of withdrawal of the glacier ice sheet and shifting of its head in the northern direction as well as erosive processes occurring in the Warta River valley river terraces were formed.

The Warta River terraces in Poznań as a result of relief-forming activity of the river

In the case of most of land areas rivers are the most important external relief-forming factors and their activity is among the most common relief-forming processes. The activity of rivers consists in erosion, transport of material and its accumulation. The destruction of the area through which the river passes is a result of the following processes: deep erosion (or bed erosion, depending on rocks forming the bed) – in this case the river deepens the river channel, lateral erosion – when the river has an effect on the banks of the river channel and destroys and shapes them as well as backward (source) erosion – when the river broadens

a spring niche. The constancy and permanence of the erosion processes occurring in river valleys throughout the ages contribute to their evolution and the main form resulting from deep erosion includes river terraces.

A river terrace is a form of land that according to Pawłowski (1929): “is a more or less horizontal step preserved along a longer section of space on the bed or slopes of the valley which originates from the river cutting into its old bed”. Terraces are defined in a similar way by T. Bartkowski (1957) and B. Krygowski (1958, 1961). River terraces have its genesis in alternate activity connected with the processes of deep and lateral erosion and accumulation. Terraces may be present in groups, stretching along the river valley at various heights, on the both sides of the valley or on the one side only (Figure 2).

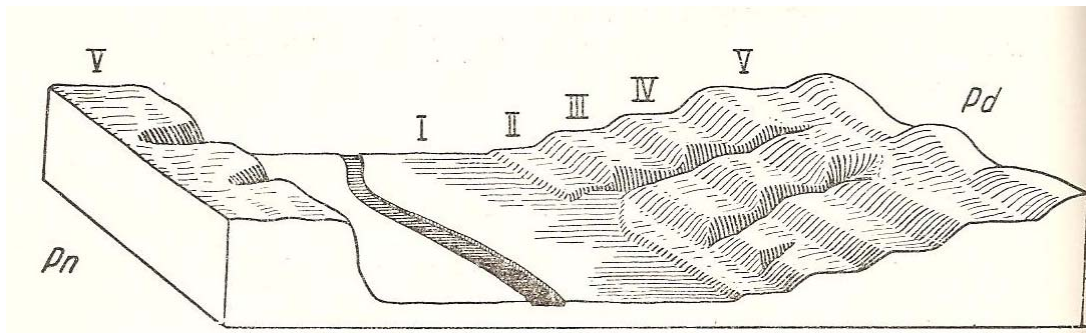


Figure 2. Arrangement of terrace steps that can be seen in valleys and ice-marginal valleys – schematic illustration, (Krygowski, 1958); I – the most recent terrace, IV – the most ancient terrace, V - plateau.

River terraces have its genesis in alternate activity connected with the processes of deep and lateral erosion and accumulation. Therefore, it is often possible to see several steps of river terraces. Each terrace reflects the level of the river bed changing over time. So river terraces are fragments of old valley beds. In a cross section the valleys form a typical stair system (Figure 2). As for relation to the river levels we distinguish between flood terraces and over-flood terraces. There are several terrace levels present in the Warta valley.

On the basis of research Bartkowski (1957) identified in the territory of Poznań **seven river terraces** in the Warta River valley (Figure 3).

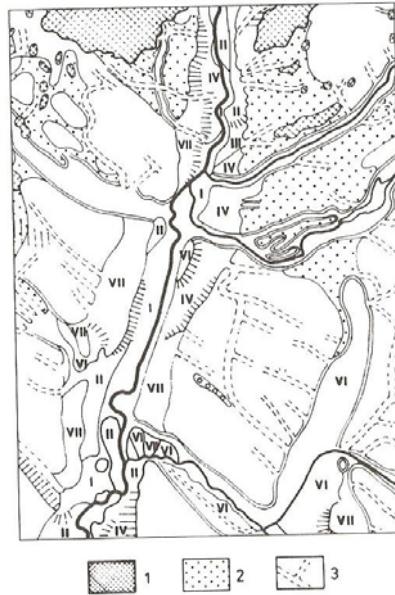


Figure 3. Geomorphological map of the gorge section of the Warta River near Poznań
(Bartkowski, 1957; Kaniecki, 2004).
 1 – terminal moraines, 2 – sandar, 3 – tunnel valleys, I – VII – terrace levels

The following terraces can be found in the valley of the Poznań Warta Gorge:

- **terrace I** – (flood terrace), the most recent one; Holocene form; height of approx. 53 m above sea level (relative height up to 3 m). It occupies the 800-metre wide valley bed and is present on the both right and left banks. Its bottom is made of sand, gravel and other river deposits. Currently significantly elevated by embankments constructed since the Middle Ages. It is developed with Ostrów Tumski with Zagórze as well as Śródka on the right bank and Chwaliszewo, Grobla and Piaski on the left bank.
- **terrace II** – the time of origin of the second terrace is estimated to be 13 – 11.8 thousand years ago; height of 55 – 57 m above sea level (relative height from 3 to 7 m). It is preserved in a small fragment, to the south of the Bogdanka valley. In 1253 Przemysław I founded the city on this terrace situated on the left bank.
- **terrace III** – relative height from 8 to 9 m. Fragmentary on the right bank of the Warta, to the north of the Główna valley.
- **terrace IV** – height of 62.5 – 66.5 m above sea level (from 10 to 14 m on average), its bottom is made of glacial till. The Rataje and Komadoria districts have been developed on this terrace.
- **terrace V** – height from 15 to 16 m. Sporadically present, only in the northern part of the valley.

- **terrace VI** – height of approx. 70 m above sea level (relative height from 17 to 20 m), preserved in a very small fragment on the right bank between the Cybina valley and Starołęka.
- **terrace VII** – the most ancient one, came into existence 18.4 – 17.2 thousand years ago; height of 71–73 m above sea level (relative height from 19 to 20 m), width of 1 – 2 km, gradient of 5‰ on the right bank and 7‰ on the left one. Once it was separated from the lowest levels with a step threshold but the threshold was significantly smoothed as a result of earthworks performed during the city development. The bottom is made of glacial till. In the City Centre it encompasses the area between Plac Wolności and the Main Railway Station. The following districts are situated on the terrace: Wilda, Starołęka, Naramowice and a part of the City Centre.

A good example of the case study is an analysis of modifications introduced by the man in the city space, made on the basis of archive and aerial photographs (Figure 4).



Figure 4. The Warta River fragment in the city of Poznań on the plan of 1938; (*Klause G., 2008*)

and currently (source: <http://mapa.zumi.pl/poznan>)

Over 58% of the Poznań area is located on the plateau land over 80 m above sea level, about 35% on the river terraces and within the area of tunnel valleys and about 7% on the flood terrace of the Warta valley. The highest point in the territory of the city is Moraska Mountain (154 m above sea level) situated in its northern part whereas the lowest

area of the city is the Warta valley (60 m above sea level). This clear relief and height diversification is perfectly reflected in the spatial development of the city, arrangement of buildings and street routes.

Plan of a geographical tour “Following the Warta River terraces in Poznań”

Taking into consideration the processes of erosive activity of the river and the resultant forms and having the knowledge of the geological and historical past of Poznań and the Warta River valley, it is worth tracking the route of the river terraces in the territory of Poznań. The fact of adjustment of the city to the land relief and hydrography is equally interesting. By combining geomorphological and hydrological aspects with the issues of spatial development, history and cultural elements the proposed tour gives an opportunity to get to know the city area and its development over the centuries in an interdisciplinary way. It is perfectly visible on the satellite photo showing the route of the Warta River valley and the city spatial arrangement (Figure 5).



Figure 5. Poznań in the Warta valley (Source: Google Earth)

Therefore the main goals of the tour should include: - presenting relief-forming activity of the river using an example of river terraces; - presenting the river role in the process of city development; - making aware of the impact of both relief and hydrological conditions on the spatial development possibilities and – defining a role of the river in the cultural landscape of Poznan.



Figure 6. **Plan of a geographical tour “Following the Warta River terraces in Poznań”**

(white fields mark educational sites – from the east: Jordana Bridge, Ostrów Tumski, Chrobrego Bridge, Chwaliszewo Street, Wielka Street, the Old Market, Paderewskiego Street, Plac Wolności); author’s proposal (Piotrowska, 2010). Illustration - source: <http://mapa.zumi.pl/poznan>

The tour route (Figure 6) was marked out from the place of the city origin, so it includes: Ostrów Tumski, Jordana Bridge (from the eastern side with a chance to have a look at Śródka), Chrobrego Bridge, further Chwaliszewo Street, Wielka Street, the Old Market, Paderewskiego Street to Plac Wolności. The advantage of the proposed tour is a partial reference to the Royal and Imperial Route existing in the territory of Poznań.

At the same time, while observing the spatial scope of the terraces it is possible to imagine the great power with which the river affects the geographic environment.

Conclusions

The landscape of the Warta valley and its natural and tourist values as well as very interesting geomorphological, geological and historical past are worth noticing. The Warta together with its tributaries, especially Cybina and Bogdanka, form a characteristic cross shape (Klause, 2008). The numerous tributaries and division of the main Warta current into many branches (with two of them embracing Ostrów Tumski island preserved up to now) made such districts as Piaski, Czartoria, Chwaliszewo or Rybaki form separate islands. The changes in the valley landscape took place throughout a long time both as a result of natural river processes and conducted hydrological works (Kaniecki, 2004). It resulted in the development of isolated fragments of higher terraces creating so-called "mountains." The ones preserved to this day include Przemysła Mountain and St. Wojciech Hill whereas Musza Mountain (the area of the present Plac Wolności) and St. Martin Mountain (its remnants include a steep descent of St. Martin Street to the east behind the church and less steep descent to the west) were levelled. Throughout the ages, for over 750 years of the city (and previously town) existence the land level, especially in the valley itself, has considerably increased. According to Kaniecki (2004) in some parts of the city the thickness of alluvial soils (sands, gravel, frequently waste) reaches about 7 m.

So through forming of embankments and raising of the land level the area where Poznań is located became a place subject to significant impact of the man and transformation of the river valley landscape.

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