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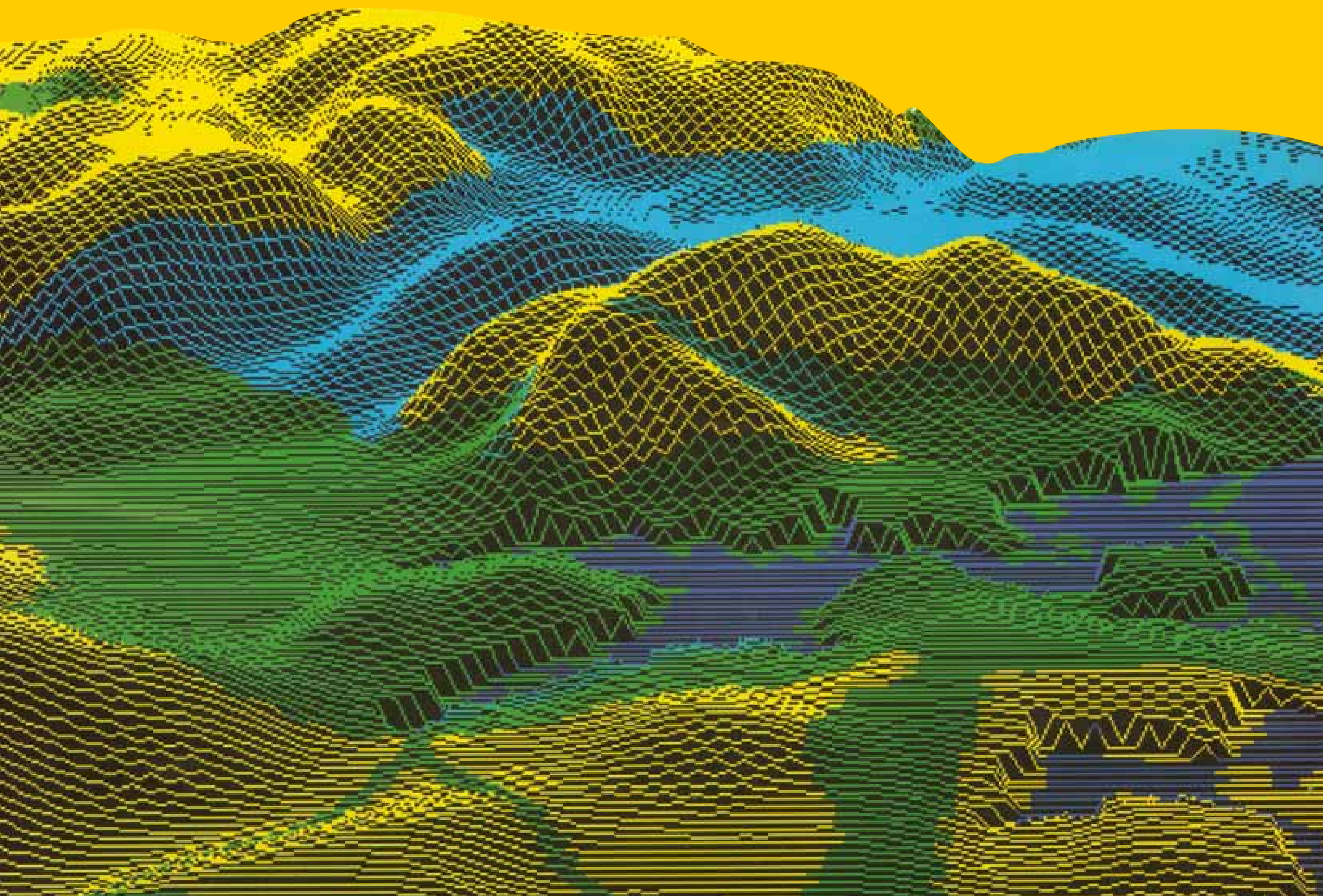

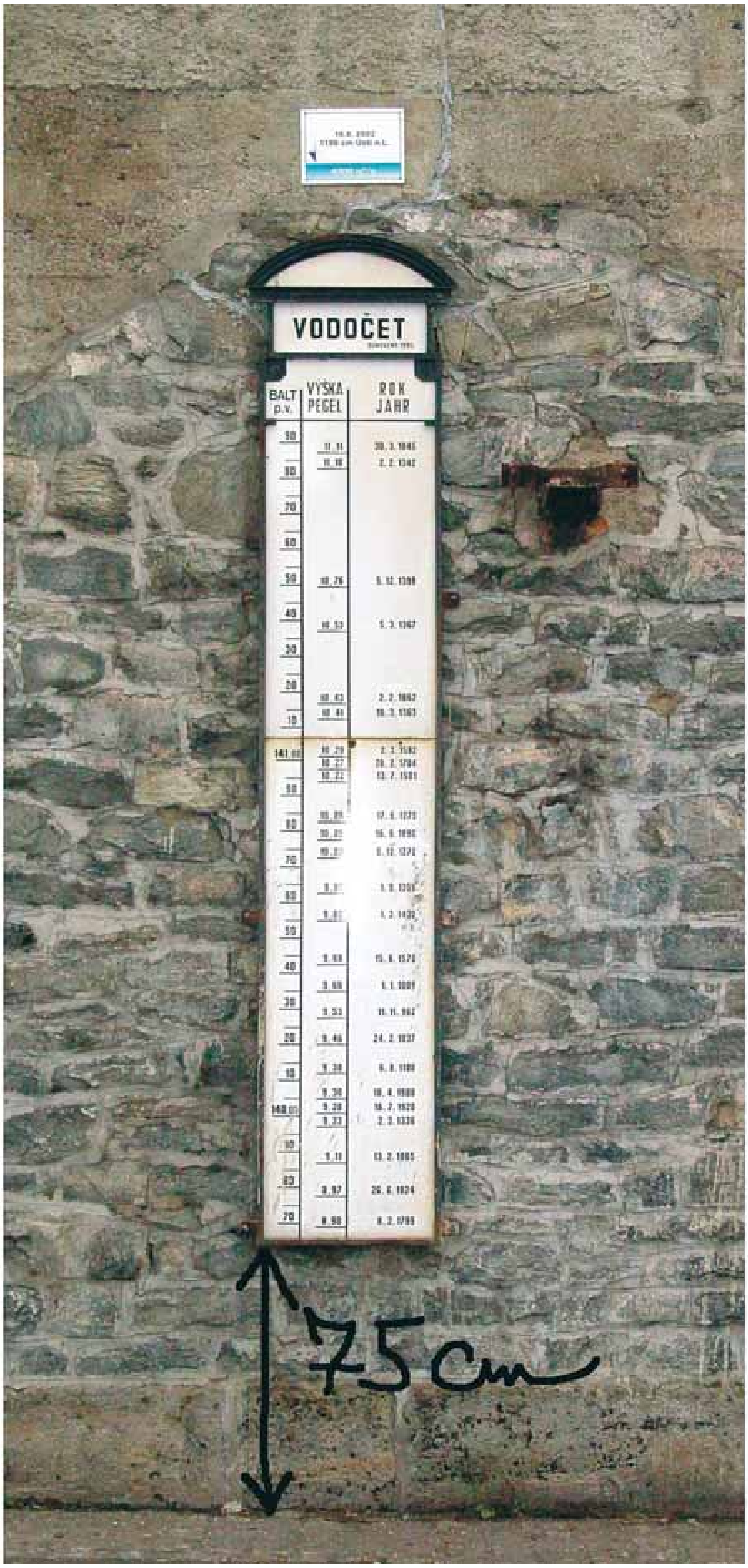

Fig. 9: Water gauge on the Labe River in Ústí nad Labem with the marking of historical floods (Photo: J. Šrejbr).
Illustration to J. Munzar's et al. paper

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REGIONAL GEOGRAPHY IS DEAD. LONG LIVE REGIONAL GEOGRAPHY!

Antonín VAISHAR, Margit WERNER

Abstract

The problems of regional geography as a geographical discipline are discussed in this paper. On the one hand, difficulties are seen to exist in the traditional descriptive character of education and, on the other hand, in methods of regional synthesis that are not clearly defined, especially in terms of relations between physical and human aspects of regions. The situation is further complicated by tendencies to refine specialisations in individual geographical sciences. The future of regional geography is seen as connected to the future of geography in general. Modern regional geography, in this sense, must not be a simple set of old and new findings from partial geographical sciences, but rather it must be a bridging geographical discipline dealing with regions and using specific methods, including GIS. Relations between the natural and social aspects of regional development are considered to be of key importance. The main objective of this paper is to define a relative balance between the specific features and the general characteristics of regions. It is necessary to construct a theory of regional geography, using the partial theories of regionalization, hierarchy of regions, regional typology, and partial synthetic approaches in geography.

Shrnutí

Regionální geografie je mrtvá. Ať žije regionální geografie!

Příspěvek diskutuje problematiku regionální geografie jako geografické discplíny. Obtíže jsou spatřovány v tradičním popisném charakteru regionálně geografického vzdělávání na jedné straně a v nejasných metodách regionálních syntéz, zvláště ve vztahu mezi přírodními a humánními aspekty regionů. Situace je komplikována tendencemi k prohlubování specializace v jednotlivých geografických vědách. Autoři spojují budoucnost regionální geografie s budoucností geografie jako takové. Moderní regionální geografie v tomto smyslu nesmí být pouhým souborem poznatků jednotlivých dílčích geografických věd, ale musí být vrcholnou geografickou disciplínou, zabývající se regiony a používající specifických metod včetně geografických informačních systémů. Za klíčové lze považovat relace mezi přírodními a sociálními aspekty regionálního vývoje. Hlavním cílem studia je vymezit proporce mezi specifickými jevy a obecnými vlastnostmi regionů. Je nezbytné vybudovat teorii regionální geografie při využití dílčích teorií: regionalizace, hierarchie regionů, regionální typologie, parciálních syntetických přístupů v geografii.

Key words: *regional geography, geography, regions, theory, methodology*

Introduction

Geography of regions was important already in the 17th century when it was of strategic interest to politicians and military leaders. In the beginning of the 20th century there came a boom in regional geography headed by the French school, with Paul Vidal de la Blache as the leading geographer. Up to the 1950s, regional geography was in a way the core of geography (Matthews, Herbert, 2004).

Regional geography was descriptive and dealt with everything that could be regarded as spatial within a region, geology and climate, as well as population and trade. In general terms, the region was considered to be the administration, nation, county/department or community. Sometimes a region was regarded as a physical one such as mountain area, drainage basin or monsoon region.

From the academic point of view, regional geography was looked down upon as not being scientific – it lacked general theories and models. This was most obvious after the Second World War when geography, first its physical part and later the human part, became incrementally nomothetic, dealing with facts and figures instead of being idiographic.

For some time regional science seemed to replace regional geography. Regional science was created by the American economist Walter Isard in the early 1950s. It employs formal neoclassical theory and rigorous statistical techniques to examine special issues on economics, geography and planning (Johnston et al., 1995). Regional science, however, gradually moved to the margins of human geography and became a discipline of its own.

So, while the regional science moved away from the geography, the regional geography is still an important subject at schools and universities. Area studies are other ways of handling a region. It is not the regional geography, but a multidisciplinary approach with usually very little of physical geography. Area studies often have their own centres, Centre for Latin American Studies and so forth (Unwin, Rose, 2004).

2. Regional geography and regions – some definitions

Regional geography can be perceived as a study of the geography of regions. According to Claval in his basic work on regional geography *"Regional geography thus rests on a certain way of interpreting the view of the world at two levels; it starts from the ground level, where it notes everything that characterizes the physical and living environment, the infrastructure created by people, their methods for making the best possible use of their lands and subterranean resources, in short all their activities. It continues by change of scale which reveals how component parts fit together to form fairly extensive wholes, which are the real objects it describes and explains. …. When we study territorial organization, we understand societies through their material foundations, ponder over their ecological basis, give our attention to the infrastructures essential to their daily existence, grasp the ebbs and flows that go through them and give them structure, and pause over the representations and symbols that give places their meaning. It is by way of regional studies that geographers today demonstrate that the discipline they practise is really a science of human beings and society."* (Claval, 1998). We might note that in order to deal with a region you have to work with both human and physical geography.

Knox and Marston (2001) presume that regional geography deals with the way by which unique combinations of environmental and humane factors create areas with characteristic landscapes and cultural attributes. Puskarz (2003) defines regional geography as a geographical discipline dealing with the synthesis of sciences on individual fragments of earth surface (regions) in terms of both their natural environment and anthropogenic activities including their consequences.

There are many other definitions of regional geography, but all might be summed up in "the study of regions" or as Haggett says: *"The branch of geography concerned with the analysis and synthesis of the earth's surface on a place by place basis"* (Haggett, 2001). Claval, Puskarz and Haggett add, however, new aspects to regional geography: *analysis* and *synthesis*, which means that regional geography is no longer a pure description. Hynek et Hynek (2004) identify 21 different regional geographies which emphasize different attributes, processes, structures and events. Their conceptual focus on creating regions ranges from the traditional outline via spatial science, core-periphery, assisted-, hyperspace-, intelligent regions etc. to sustainable ones.

Consequently, what is a region? Just any area but how the area is defined? According to the website of the US Ministry of Education, region is a territory encompassing places that have something in common. De Blij and Muller (1998) claim that regions have territories, boundaries and locations, classifying regions into formal, defined by a certain criterion, and functional, defined by spatial relations. However, Mead (1980) warned already a quarter of a century ago against the unhallowed notion of region which is sometimes understood to be territory of any kind.

One example, found in the textbook on Europe by Minshull, might illustrate the problem of definition: *"What is the Paris region? Is it the city of Paris, the Paris agglomeration with over eight million people, the Ile de France Planning Region which includes four departments and extends up to sixty miles away from the city, or the Paris Basin planning unit (…)? Alternatively, there is the traditional view of the Paris Basin in which the convergence of the Seine and its tributaries is the centre of a key agricultural lowland extending from the Loire to Normandy and from the Champagne scarplands to Picardie (…). This problem of definition may be examined by means of two themes which stress the economic value of the area in different ways: the scale and variety of agricultural production on the fertile 'pays' of the Paris Basin; the power of the city in attracting population and resources, and the planning problem which this has involved"* (Minshull, 1990).

The region might easily be defined from an *administrative* point of view. From a *homogenous* perspective it is more difficult since the boundaries can be questioned. Köppen's climatic zones are based on temperature and precipitation, fairly easy to define, but where does a mountainous region begin? Boundaries have, of course, been defined (e.g. Demek et al., 1971). But the boundaries may be more disputed than the ones presented by e.g. Köppen.

Even more difficult to define are the *functional* regions, and thus setting the boundaries. *"The number of different boundaries for any region is equal to the square of the number of geographers consulted"* (anon. in Haggett, 2001). *Regionalisation*, the making of regions, has almost become a field of science of its own.

According to Geography for Life (Bednarz et al., 1994) "Places are parts of Earth's space, large or small, that have been endowed with meaning by humans. They include continents, islands, countries, regions, states, cities, neighbourhoods, villages, rural areas, and uninhabited areas. They usually have names and boundaries. Each place possesses a distinctive set of tangible and intangible characteristics that helps to distinguish it from other places." … "Places change over time as both physical and human processes operate to modify Earth's surface." ... "Region is a concept that is used to identify and organize areas of Earth's surface for various purposes. A region has certain characteristics that give it a measure of cohesiveness and distinctiveness and that set it apart from other regions." The text then goes on dealing with formal regions, functional regions and perceptual regions. Perceptual region "is a construct that reflects human feelings and attitudes about areas and is therefore defined by people's shared subjective images of those areas."

Region is doubtlessly a subjective construction that depends on study goals, viewpoints of investigation and subjective imagination. It is an analogy to system used in the system theory which was recently massively applied also in geography. Nevertheless, after the demarcation of regions, the researcher explores objectively existing inter-relations.

3. Regional geography matters

In a globalized world we all need knowledge about our own region as well as about the country of the next-door neighbour and places far away. We need the knowledge in order to understand the living conditions of other people as well as in order to localize a new enterprise in a foreign country or to visit a distant country just as a tourist. Regional geography can give us a lot of relevant information. In his classical work on India and Pakistan Spate (1954) first deals with the subcontinent from a systematic point of view (physical geography, human geography, economy, religion and history). Then, based mainly on physical geography, Spate constructs regions at four different levels. Each region is described and analysed in a way that gives the reader a complete geographical knowledge of the area. In a way, a good book on a region based on regional geography equals a good fiction, only that geography is based on facts. Regional geography matters!

First and foremost regional geography has to be taught at schools. That means that regional geography has to be a discipline taught at universities. But how scientific is the discipline? In a way it is not more so today than before. There are no models and no theories but analyses and syntheses give the subject a more scientific character than just a description. And there are *new issues* to be dealt with under the umbrella of regional geography. In many cases geographers have to work together with people from other disciplines like history, anthropology, and religion, biology and geology. But the basis is in geography. Here some examples.

Within Europe, and especially within the European Union, regions seem to become more important than nations. One example is the statistically based NUTS regions. When dealing with regions, two issues become more and more important: *networks* and *competitiveness* (e.g. Nordström, 1998). The most obvious networking can be seen in the university world. Students take courses and networks are promoted especially within research. Remedy for overcoming barriers among individual EU member countries directly in the field is seen in euroregions (Peková, Zapletalová, 2005) which also function on the outer border of the European Union. When looking at the competitiveness of a region different geographical factors are to be considered as they are presented in "Porter's diamond" (Porter, 1998).

Tourism is a growing industry all over the world. When looking at material from different travel agencies you will find pleasant views, nice weather, lovely beaches, cathedrals, and so on. There might be a short note too on nasty insects and pickpockets. But many tourists want to know more, to have facts about the country they are visiting, not only the resort. Here regional geographers have a big task to provide relevant information. – If the Swedish tourists in Thailand by Christmas 2004 had learnt some geography of South East Asia they might not have been surprised by an earthquake in the region and they might even have understood the word tsunami and lives might have been saved. In fact though, the learning of tourism is based mostly on historical (archaeological, architectonical) or natural (biological, geological) knowledge. Geography vacated the field in this branch.

Earthquakes and tsunami lead us to *natural hazards and disasters*. The Boxing Day tsunami was natural. But the disaster was a human one. Combining, within regional geography, physical conditions with human activities we can discern areas that are more prone to disasters than other. And thus planning should follow. In 1997 (Morava R. and Odra R. watersheds) and in 2002 (the Elbe River basin), Czechia was affected by great floods that are considered disastrous. The flood itself is however a natural phenomenon that has been always forming the landscape. Floods become disastrous only in an interaction with human activities. On the one hand, people modify the course of high waters by their husbandry in the landscape, on the other hand they and their works become victims. This is a typical assignment for regional geography and the approach was used in the solution of the corresponding grant project (Vaishar et al., 2002).

In the autumn 2005 we could see the effects of the tropical storm Katrina in New Orleans and thereabouts. Then came Rita and there were other hurricanes hitting the Caribbean and Central America. The discussion was then focussed on *climate change*. We do not know if that was the reason for all the hurricanes but we know that we have a global warming and that we are likely to experience more extreme weather conditions with not only hurricanes but also heat waves and heavy precipitation resulting in floods. Geographers with the knowledge in both physical and human geography, regional geographers, have here a broad research field.

Additionally, the environment is a typical problem of interactions between humans and the nature. In geography which is directed to regional aspects of environmental issues, it is a task for regional geography. It is just regional geography which differs ecological and geographical approach of the environmental research. In contrast to the ecological viewpoints, geography points the active role of man and society in the human environment: environmental impacts of technology, environmental perception, environmental improvements.

Each of us has some *regional identity*, whether born in the region where you live, or being a refugee in the region. In order to accept other peoples' regional identity, to understand other peoples' ideas we have to learn about them, their former countries and living conditions. This might help ordinary people to fight the xenophobia that is increasing in many countries, not least in various European countries (Werner, 2003, 2005). It is also important to try to give immigrants a start on a new regional identity (Werner, 2005).

From regional identity there is just a short distance to nationalism and from there to conflicts and geopolitics. One instructive example of this complex we find in the Balkans, in former Yugoslavia. In order to understand we must study the physical and human conditions but not only. We also must add history, historical identities, and religion. Geopolitics is often about resources, and the power over the resources.

In addition, *regional geography* can also play a role in current conflict-free life for example in the issues of regional planning and regional policy. Regional policy will be either confined to the financial support of regions with high unemployment or it will be executed on the basis of the knowledge of interactions between natural resources, human resources, location factors and neighbourhood and geographical interactions in the regional system with the aim of starting in the given region the activities that can ensure its self-sustained functioning without subsidies required from outside.

4. A new way of dealing with regional geography?

Regional geography is often about comparing regions. But how do we compare regions of different size like Czechia and Germany or regions where there is an obvious centre – periphery situation like central and northern Sweden with e.g. the Netherlands. This is a task to be solved for the regional geographers. Another issue deals with the question of the necessity to have both physical and human or human and economic competence within each regional geographer or if there just needs to be a group of people. In order to get specialized knowledge all cannot be generalists, but it is so much easier to work together if most persons in the group have a basic knowledge in geography. Regarding the specialization of professional geographers at universities it appears that most employable for these purposes are paradoxically graduates from the teacher study of geography with the basic knowledge of entire geography and as a rule with the knowledge of one other subject such as history, biology, etc.

One problem with regional geography is the static scene that is produced. We can add historical data, but once a text is published you cannot work on future changes. Regional geography task is to present a region and to explain why it is like that, but also to explain why there is a change and perhaps also to predict changes. With GIS and various links on the internet regional geography has got a strong tool for updating maps and statistical information. We must also realise that in order to understand the changes within a region we also have to study actors and different ideas that have influenced the region from the outside. Another important research focus should be on the links between different regions in hierarchical as well as horizontal relations.

Regional geography often deals with likenesses. *"If we concentrate on differences and not on what is common we risk a weakening of the whole term region. … From this you should be able to conclude that regions to some extent are the chimera of researchers and statesmen and nothing else"*. This statement is not made by geographers, but by historians and researchers in arts, and ideas. It deals with the area east of the Baltic (Krenslins, Mansbach, Schweitzer, 2003). What is most interesting is the approach of using different *perspectives during different times*, and thus showing how the character of the region changes when the observer changes his perspective. – It is perhaps difficult for the geographer to change his perspective but it shows the importance of adding especially history and religion to regional geography.

Modern regional geography cannot be a mere summarization of the knowledge from individual partial geographical disciplines applying to a certain territory. Demarcation of regions must be logical and expressing functional links existing in that territory. And because there are many of such links in a concrete territory, there is also a lot of different natural, economic, administrative, cultural and other regions occurring within the same territory. The valuation of regions by means of regional geography must be nevertheless at all times complex and focused on interactions. Key importance is seen in understanding relations among individual elements of the geographical sphere. Most important of these are interactions between nature and society, or between environment and social development on the application plane. On a pedagogical plane, regional geography is not a question of memorizing data but rather a question of capability to derive logical conclusions from the known facts.

Should regional geography be a science, it must generalize its knowledge. It is a classical geographical problem of the relation between unique-specific and general characteristics of regions. With respect to the complexity of the geographical sphere and different nature of individual elements – natural, technical, economic, social, and also with respect to the interaction of regions with their surroundings, general regularities cannot be expressed in a causal way. The system of indicators and criteria classifying individual regions is an important instrument of their learning but it cannot by itself overcome the analytical part of the work. Indicators, criteria and accurate measurements can be used in partial geographical disciplines but not in the classification of regions as a whole. Relations that create quality are of primary importance. The preference of quantitative relations in geography has been passing through a period of criticism since the 1960s (Robinson, 1998).

The idea about a total comprehension of the issue, based on a systemic approach as on a formalized system, appeared unrealistic in the course of time. And it is a question to what extent such a total synthesis would be applicable in practice because practical solutions require a problem structuring. On the other hand, there is a range of partial steps of synthetic character, which do not look as a synthesis at the first sight. In our opinion, regional geographical syntheses are an open set of approaches considering regions to be a result of the combination of natural and socio-economic elements from various viewpoints and with an emphasis on various aspects of reality and purposes of its study. It can be claimed that the contemporary geography knows partial synthetic methods that are proven and effective.

5. Regional geography contra specialisation in geography?

Geographical practice at Czech and Swedish (and apparently not only those) universities is heading towards an ever more refined division into physical and human geography, and within the framework of the two to the specialization of individual partial disciplines. Within the framework of this specialization, communication outside geography sometimes prevails over communication with other partial geographical sciences. It seems that physical geography is affected by this specialization more than human geography.

To classify geography into physical and human ones is not the only possibility. To analyze urban and/or rural regions is one of other variants. Such an approach would ask for a relatively complex regional approach. Specifics of the respective subjects would be in different human impact on landscape evoking different feedbacks of the nature. The researchers would willy-nilly have to take into account all the width of geography and interrelations between individual geographical branches. As a result, investigation of urban and rural regions would be typically geographical with no risk to lapse into a deep specialization.

In this context, the issue of the future of regional geography is at the same time an issue of the future of geography as such. Geomorphology, hydrology, soil science, climatology etc. are not or need not be geographical sciences; they can exist – and in many a case they do exist - outside geography. A similar regional projection independent of geography is also sought by individual social and economic sciences. These individual sciences however also deal with interactions including interactions between natural and socio-economic elements. Agricultural sciences for example cannot do without soil science, study of tourism cannot do without the analysis of climatic, geomorphological and sometimes also biological aspects of the region, etc.

What is there left to geography? The answer seems to be quite clear: regional geography. Subject of modern regional geography are regions. Methods are regionalization, typology of regions, assessment of regions by means of partial syntheses, comparison of regions, prognosis of regional development on the basis of learning relations and evaluating analogies. Regional analyses are carried out as an instrument for syntheses, being subordinated to the purpose. Physical and human elements play a relatively equally important role. Such a scientific discipline is unambiguously the domain of geography and a basis for indisputability of geography in the system of sciences.

Problem is that such a regional geography hardly exists today. Internal conditions of geography for the development of regional geography have been rather worsening. Low competence of regional synthesis can therefore be a cause of not capturing trends in the progressive research fields such as environment, sustainable development, geographical information systems, regional planning, etc.

6. Conclusions

The subject of Regional Geography is region. It follows that Regional Geography deals with the theory of regions, regionalizations, analyses of regions hierarchy and generalization of regional relations. Interrelations between nature and society in the regional context are essential for analyses and syntheses. Regional geography is no longer the core of geography but it is still a very important part of the geographical discipline. Climate change, poverty, sustainable development and conflicts are some examples of issues where regional geographers should contribute with their knowledge and skills.

Regional research will certainly continue as the public order cannot be doubted. Question is whether the research would be in the hands of geographers or whether it would become a domain of regionalists. This is how geography could be deprived of another research focus – after environment, geographical information systems, spatial planning - and its position within the system of sciences and in the process of education would be further marginalized.

It is necessary to build a theory of regional geography with using the existing partial theories (theory of regionalization, typology of regions, theory of regions hierarchy, theory of partial geographical syntheses, etc.). The methodological apparatus of regional geography must be defended in relation to the methods of partial geographical sciences. Regional geographers have to investigate regions as case studies of general regional relations – not as individual and nonrecurring regions. This will enable generalization and comparison.

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THE GEOMORPHOLOGICAL TRANSFORMATION OF THE HODSLAVICKÝ JAVORNÍK BRACHYSYNCLINE (THE MORAVSKOSLEZSKÉ BESKYDY MTS., CZECH REPUBLIC)

Barbara ŽIŽKOVÁ, Tomáš PÁNEK

Abstract

An evaluation of the relationships between the specific geological structure of the Western part of the Moravskoslezské Beskydy Mountains and Quaternary relief formation processes, is examined in this paper. In the past, the origin of many landforms was associated with either the Tertiary planation or Pleistocene periglacial processes. Based on modern methods using a multidisciplinary approach, however, the area is now interpreted as a product of the selective denudation of flysch rocks. Deep-seated gravitational slope deformations (DSGSDs) are one of the more dominant processes shaping brachysyncline relief, namely its outer escarpment. As far as the morphometry is concerned, the area studied is one of the least exposed elevations within the Silesian unit, yet the slope failures are among the largest in the Flysch Carpathians. This proves that geological structure is the main factor determining the occurrence of DSGSDs in the Silesian unit of the Carpathians. In the Holocene, the slope failures greatly influenced the dynamics and morphology of river valleys, which is documented by several examples of valley damming by landslides.

Shrnutí

Geomorfologická transformace brachysynklinály Hodslavického Javorníku (Moravskoslezské Beskydy, Česká republika)

Příspěvek se zabývá hodnocením vztahu mezi specifickou geologickou strukturou a kvartérními geomorfologickými procesy, které formují georeliéf západní části Moravskoslezských Beskyd. V minulosti byla četným tvarům připisována geneze spojená s vývojem terciérních zarovnaných povrchů a s pleistocénními periglaciálními procesy. Na základě nejnovějšího výzkumu, založeného na multidisciplinárním přístupu, je však území interpretováno jako výsledek selektivní denudace litologicky pestrých hornin slezské jednotky, které byly během štýrské příkrovové fáze deformovány do podoby k JV ponořené brachysynklinály. Určujícím reliéfotvorným procesem jsou hluboké svahové deformace, které modelují zejména okrajový "escarpment" brachysynklinální struktury. Z hlediska morfometrie patří území k nejméně exponovaným polohám slezské jednotky, přesto zde nacházíme jedny z nejrozsáhlejších svahových deformací ve flyšových Karpatech. To je dokladem, že hlavním predispozičním faktorem svahových deformací ve slezské jednotce Karpat je geologická struktura. Svahové deformace měly v holocénu velký vliv na dynamiku a morfologii údolí vodních toků, což je doloženo několika příklady hrazení údolí sesuvy.

Key words:
Moravskoslezské Beskydy Mts., Hodslavický Javorník, flysch relief, morphogenesis of landforms, slope deformations, landslide control, Czech Republic

1. Introduction

The relief of the flysch Carpathians reveals very dynamic developments in its forms, connected with the exposed geological structure, Quaternary climate changes and human activity (Starkel, 1960, 1969; Margielewski, 1998a, 1998b, 2002; Margielewski, Urban, 2004). The use of new geomorphological, geological and dating methods has brought changes to the way in which the formation of this tectonic zone was formerly interpreted. The latest results put emphasis especially on the high intensity of denudation which has been shaping the relief of the flysch Carpathians since the Miocene up to the present day. In some parts of the Carpathians, the postorogenic effect of denudation reaches several kilometres in depth (Bíl et al., 2004; Krejčí et al., 2004). In the Štramberská vrchovina Uplands (in the vicinity of the area studied), the fission track analysis revealed a surface uplift and denudation to have totalled at least several kilometres since the beginning of the Miocene.

The Hodslavický Javorník mountain range (Fig. 1), which is the scope of this study, is located in the westernmost part of the Moravskoslezské Beskydy Mts. as a subsection of the Radhošťská hornatina Hilly land (Demek et al., 1987). Its elevations are among the lowest in the Moravskoslezské Beskydy Mts. and also its morphometry, namely the local relief and the mean slope gradient, is less

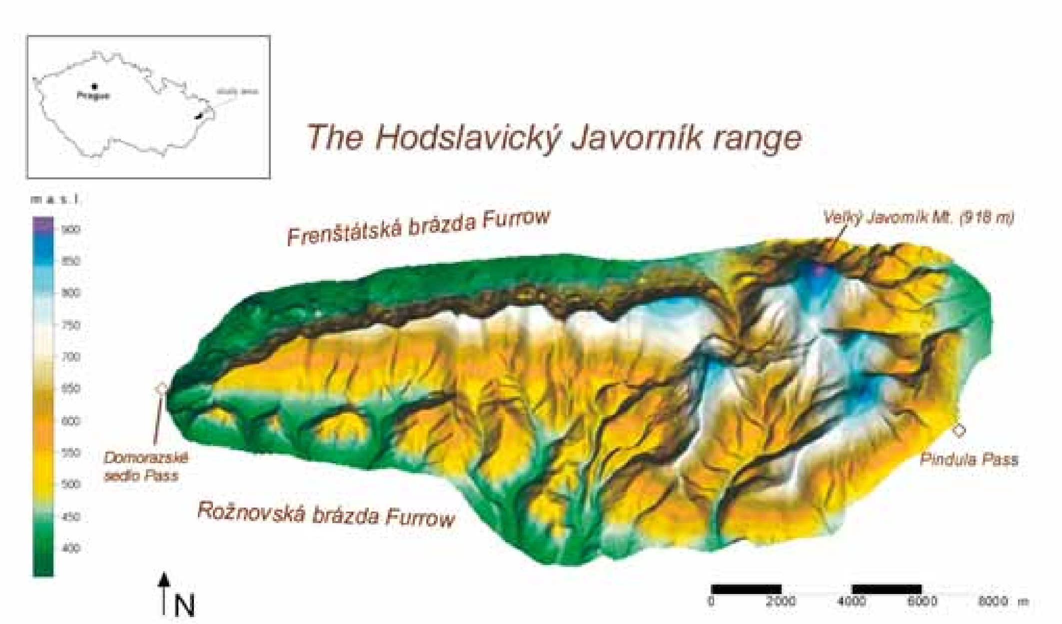

Fig. 1: Location of the Hodslavický Javorník range (Moravskoslezské Beskydy Mts.). Surfer 8

pronounced than that of the adjacent Radhošťský hřbet Ridge and the Lysohorský hřbet Ridge. A specific feature of the Hodslavický Javorník mountain range consists in its numerous slope deformations some of which are among the largest in the Czech part of the Carpathians.

The Hodslavický Javorník range relief is an interesting example of a shift in the geomorphological interpretation of the processes that have formed the flysch Carpathians. In the past, the origin of many landforms was associated with either the Tertiary planation or the Pleistocene periglacial processes (Buzek, 1972; Buzek et al., 1986). Recent research, however, has cast new light on these theories using a multidisciplinary approach, namely geomorphological mapping, morphostructural analysis, the evaluation of digital elevation models and slope deformation studies. This paper demonstrates that slope deformations are among the most important factors involved in the transformation of the Hodslavický Javorník brachysyncline.

2. Morphostructure

The geomorphological analysis of the Hodslavický Javorník area did not indicate any significant signs of neotectonic activity (e.g. shifts or major movements along the fault lines); on the contrary, it is the passive structure (the dip and strike of the rock strata) and paleotectonics that determine the character of the relief. At present, the landforms are shaped mainly by exogenous processes (compare with Harčár, 1976, p. 327).

In terms of its geology, the Hodslavický Javorník range is a tectonically autonomous part of the Outer Carpathian nappes, namely the Godula development of the Silesian unit (Menčík et al., 1983). The range is brachysyncline in shape with its longer axis extending along a WSW – ENE line (Roth, 1973a, 1973b). Except for the brachysyncline closure in the eastern part of the area studied, the range generally has a monoclinal structure with strata sloping southwards at a dip of approx. 16°. Both the slope gradient and the direction of the main ridges are determined by the structure, namely by the dip and strike of the rock strata. The relief of the Hodslavický Javorník range is typical of its varied erosional-denudational and structural-denudational landforms (see Fig. 1, Fig. 2 – see cover p. 4).

The rocks forming the relief range from the Upper Jurassic to the Oligocene in their age and include the following formations (Menčík et al., 1983): the Lhoty formation (greenish and grey claystone, with a thickness in the area of 160–250 m), the Godula formation (the Lower Godula Member: red-brown and green non-calcic claystone with insets of sandstone, thickness 200–350 m; the Middle and Upper Godula Members: greenish-grey, thick-bedded sandstones, thickness 600–800 m) and the Istebná formation (confined in the studied area to outcrops of the basal sequence of sandstone and conglomerate, thickness 140–200 m).

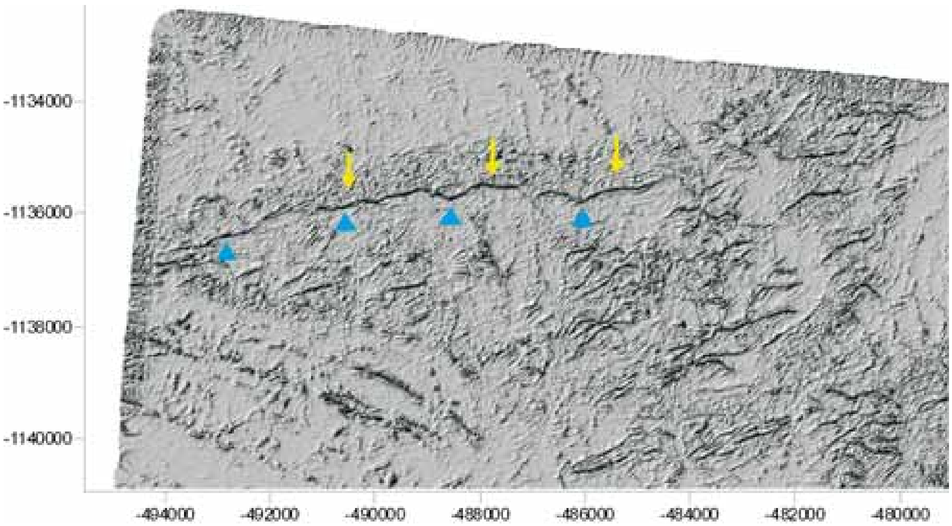

Fig. 3: The change of curvature in the N-S direction (angle 90°; Grid-Calculus-Curvature) visualises the areas of large slope deformations (yellow arrows) to the north of the main ridge as well as the W-E segments of the drainage pattern. The north-facing part of the outer escarpment of the brachysyncline is marked with light blue arrows. Surfer 8

Menčík et al. (1983) differentiate two types of normal faults within the studied area. The relatively older system aligned in a NNW–SSE direction most probably determines the course of the Hodorfský stream and partly also the Starozuberský stream; moreover, it is thought to be one of the factors causing the instability of some slopes (see landslides on the eastern hillside of the Ostrý Mt., Fig. 3, or on the south-western slope

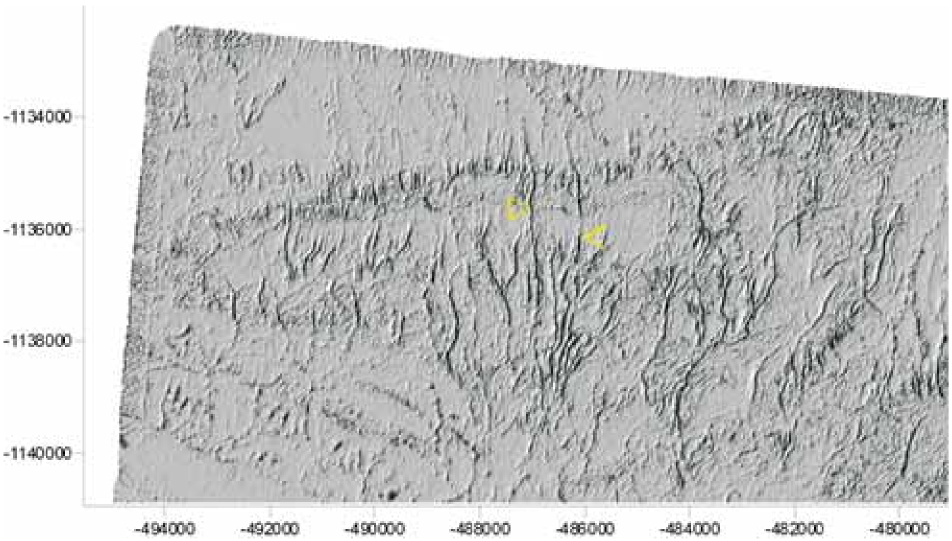

Fig. 4: The change of curvature in the W-E direction (angle 0°, Grid-Calculus-Curvature) clearly shows the N-S segments of the drainage pattern, often determined by the course of lineaments and fault lines (major lineaments are marked with yellow arrows). Surfer 8.

of the Krátká Mt.). The younger system of minor faults running in WSW–ENE and WNW–ESE directions is not that significant in the relief.

The tools of the „Surfer 8“ programme were used for the morphostructural analysis of the Hodslavický Javorník range. The calculation of the relief curvature (Grid – Calculus – Curvature) yielded some particularly interesting results. The visualisation of the change of curvature in the N–S direction clearly shows the areas of large slope deformations to the north of the main ridge, as well as the course of the E–W segments of the drainage pattern (Fig. 3). The curvature change in the E–W direction, on the other hand, suggests possible lineaments and fault lines affecting the morphology (Fig. 4), including the N–S segments of the rivers. Streams in the Hodslavický Javorník range form a parallel pattern determined mainly by the monoclinal structure of the brachysyncline.

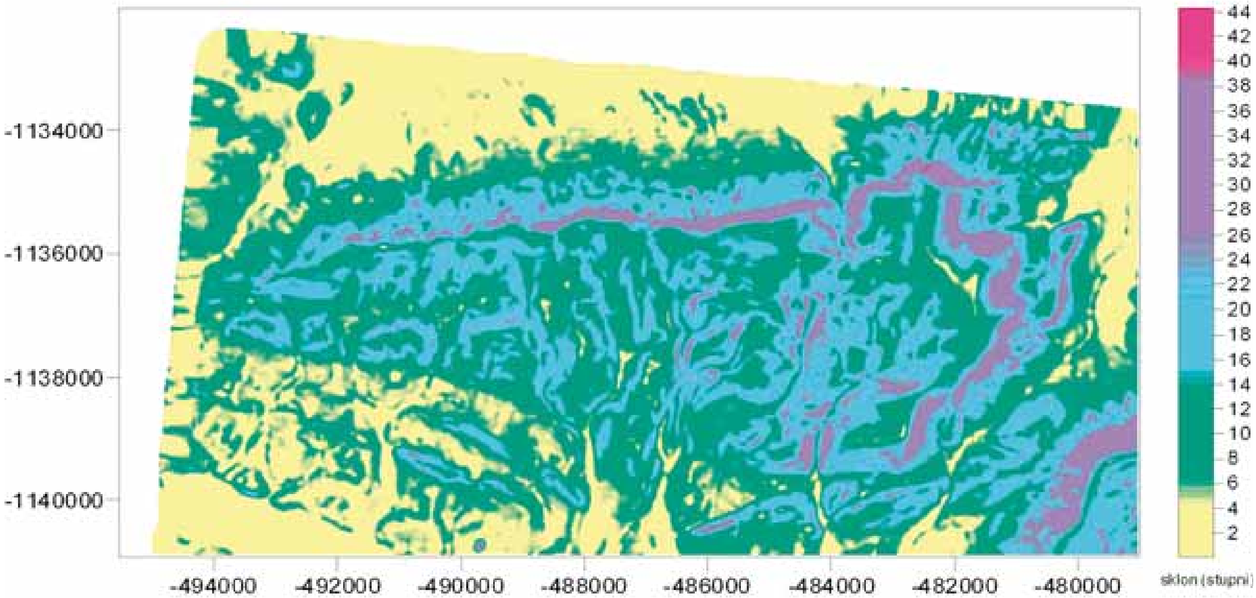

Fig. 5: The map of slope gradients in the Hodslavický Javorník range. Surfer 8

The analysis of the slope aspect shows an even distribution of values (10–12% in each category) with the exception of north-facing slopes that are more frequent (21.5%). The slope gradients (Fig. 5) most often fall into either of the following intervals: 5–15° (slopes parallel to the bedding planes) or 15–25 (35)° (erosional-denudational slopes and slopes along the brachysyncline escarpment).

3. Morphosculpture

The genesis of planation surfaces, their formation and extent are among the most frequently debated issues in the Western Carpathians. According to a number of studies, two levels of these surfaces could be represented in the Hodslavický Javorník range, namely the river and the mid-mountain levels mentioned by Slovak authors (e.g. Mazúr, 1964). The detailed geomorphological mapping refers to gently-sloping flats approx. 100–120 m above the valley of the Veřmířovský stream and the Jičínka River as possible examples of river-level planation. The interpretation of the broad ridge between the Velký Javorník Mt. and the Kyčera Mt. as a planation surface on the mid-mountain level is, however, more disputable. Contrary to earlier studies (Buzek et al., 1986; Buzek, 1972, 1987; Stehlík, 1964), these flats are currently perceived as structurally determined slopes situated along the gently-dipping bedding planes (compare with Kircher, Krejčí, 1999).

Generally, in the context of the current knowledge, some conclusions of earlier studies could be regarded as debatable. It can be assumed that the intensity of erosional-denudational and fluvial processes, accelerated by the high local relief, would destroy or greatly lower any potential planation surfaces (if we accepted their existence). In the polygenetic relief of the Hodslavický Javorník range it is necessary to assess the origin of the landforms critically and from different viewpoints, unlike some earlier reports whose conclusions are often one-sided (e.g. Buzek, 1972, 1987). For instance, the flat parts of slopes, referred to by Buzek (1972) as surfaces of the mid-mountain level of planation, are in most cases currently interpreted as parts of complex deep-seated gravitational slope deformations.

The passive morphostructure is a dominant factor in the relief formation of the Hodslavický Javorník brachysyncline. The dip and strike of the sedimentary strata as well as the rock strength determine mainly the distribution of the ridges and the slope gradient in the area studied (compare with Harčár, 1976, p. 323). The cross-section of the main axis of the Hodslavický Javorník range, outlined by the peaks of Trojačka, Dlouhá, Velký Javorník and Kyčera Mts., shows an apparent asymmetry of the slopes caused by the monoclinal structure of the range (the dip of the strata is approx. 16°). Numerous small ridges, more or less perpendicular to this main axis, are of erosional-denudational origin. The slopes of the Hodslavický Javorník range are covered by debris with occasional outcrops of rock beds; the areas of the gravitational slope deformations are typical of large block fields with sandstone boulders reaching up to 0.5–0.7 m in diameter.

The drainage pattern of the area studied forms an ordered, hierarchical system strongly determined by morphostructure (lithology, dip and strike of the strata etc.), by the course of the fault lines and by the high local relief. The consequent segments of the streams (i.e. those perpendicular to the strike of the rock strata) are dominant. Except for the brachysyncline closure in the eastern part of the area, they run predominantly in a NNW–SSE direction, as opposed to the subsequent streams, which are aligned from WSW to ENE.

River valleys of the Hodslavický Javorník range are commonly of a narrow V-shaped profile in their cross-section, due to the lithological and hypsometric characteristics of the area studied (homogenous bedrock with the prevalence of rigid and resistant rocks, high local relief etc.). Open V-shaped valleys occur only at places where the streams cut their way through rocks with very low strength (i.e. deluvial or proluvial sediments or claystone rocks). The drainage pattern, apart from streams and rivers, comprises also numerous rills and gullies (see Buzek et al., 1986) which are typical especially of the areas of the major gravitational slope deformations.

4. Slope deformations

Within the area of the Hodslavický Javorník range, slope failures are undoubtedly among the most significant geomorphological phenomena. The deep-seated gravitational slope deformations, by far the most common type, are among the important factors that formed the brachysyncline of the range during the Quaternary. Other types of slope processes that have been mapped include shallow landslides and debris flows, creep and occasional rockfalls.

The gravitational slope deformations of the block type are among the largest in the Hodslavický Javorník range. Their occurrence is determined mainly by the morphostructure and the lithology, where the relatively plastic claystone rocks of the Lower Godula Member - and partly also of the Lhoty Formation - underlie the rigid, thick-bedded sandstones and conglomerates of the Middle Godula Member (compare with Harčár, 1976). Due to the process of gravitational spreading, displacement occurs along the bedding planes and joints of the sandstone strata (compare with Margielewski, 2006). Individual blocks sink into the underlying, more plastic rocks that are deformed and create pressure folds (pressure ridges of Beetham et al., 2002) in the lower part of the slope (compare to Baroň et al., 2004). These processes are influenced mainly by the high local relief, flysch-bedrock structure (the presence of claystone insets within the rock strata), the existence of lineaments and faults (Margielewski, 2004, 2006) and the neotectonic uplift of the area (eg. Raczkowski et al., 1985; Zuchiewicz, 1998), followed by intensive fluvial erosion.

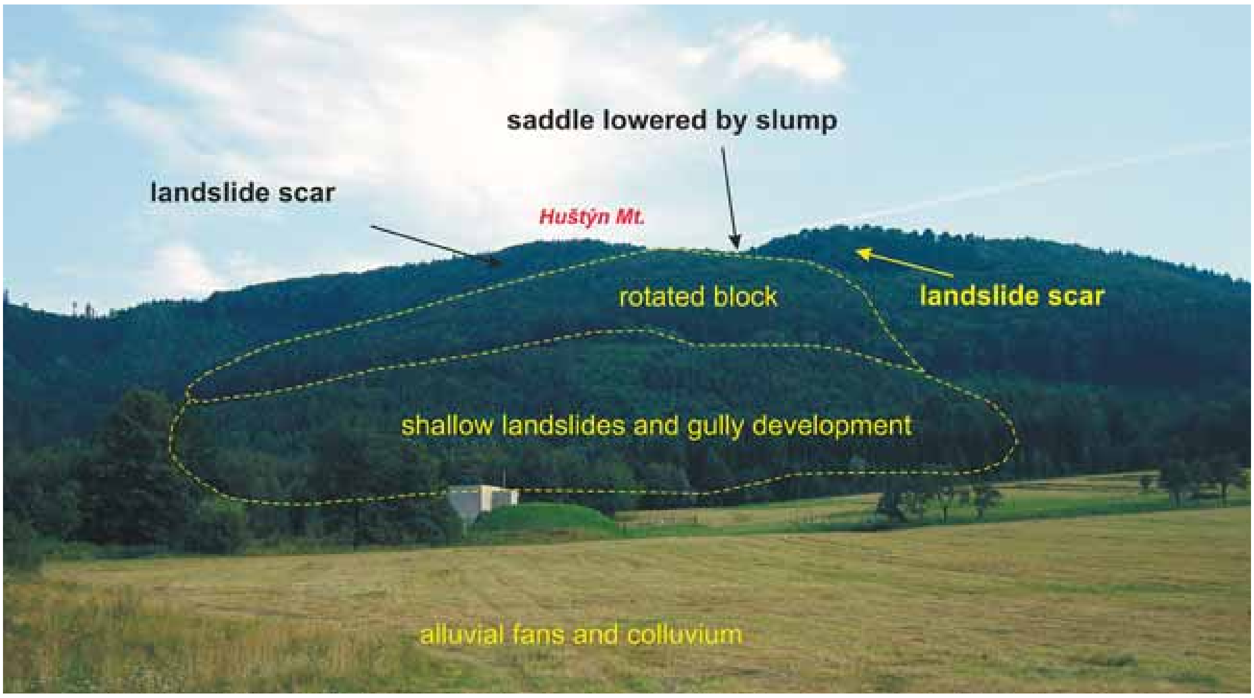

Fig. 6: General view of the north-facing Huštýn Mt. hillside shaped by a large rock slump (Photo: authors)

The deep-seated gravitational slope deformations (DSGSDs) are most typically situated on the outer slopes of the Hodslavický Javorník brachysyncline (i.e. to the north or east of the main ridge), following the escarpment of the sedimentary strata (almost continuously, except for the north-facing slopes of the Krátká Mt. and the Dlouhá Mt.). Moreover, they occur on the south-eastern and western slopes of the Kamenárka Mt. In most cases, clear landslide scarps have developed, with heights often exceeding 30 m.

The north-facing slope of the Huštýn Mt. is a typical example of a rock slump (Fig. 6). It is situated at the point of contact between the rigid, more fragile sandstone rocks of the Middle Godula Member, forming the upper part of the slope, and the underlying, relatively more plastic claystones of the Lower Godula Member. The development of the slope failure was determined especially by this difference in lithology and rock strength. The other triggering mechanisms include tectonics (the presence of a fault line at the locality) and hydrogeology.

Fig. 7: A view from the top of the scarp of the Huštýn Mt. rock slump down onto the gravitationally subsided block. This feature was misinterpreted in some of the earlier studies, described wrongly as a nivation cirque or a frost-riven cliff (Photo: authors)

The overlying sandstones act as ground water collectors, as opposed to the underlying claystones which are isolators. Many springs occur along this lithological boundary, resulting in slope destabilisation. The age of the Huštýn slope failure has not been specified yet, however according to dating results from other similar localities in the flysch Carpathians it is assumed to be of Holocene origin, with the lower parts of the slope also recently active.

To the north of the mountain top, the scarp of the rock slump is visible as a very steep rocky slope; the gently-dipping flat with an elongated mound below is a displaced block of the rigid bedrock (Fig. 7). Vertical movements resulted in the counter-slope rotation of this unit. The structure and the depth of the Huštýn rock slump can be approximated from the outcrops of bedrock that occur both on the steep scarp and on the surface of the displaced block. According to their morphology, the depth of the deformation is estimated to be in tens of metres; a more accurate information on the course of the shear surface could be obtained by using geophysical methods or boreholes.

The beds situated at the scarp of the rock slump have a dip of 10–15° southwards, whereas the outcrops at the displaced block dip at 20–35° to the south-east. From this evidence we can assume that during the process of vertical displacement and rotation (approx. 5–25° towards the main ridge line), the individual blocks were moved horizontally too, approx. 30–45° in an anticlockwise direction. The frontal part of the rotated block was subsequently deformed by relatively smaller and younger landslides.

The nature and the development of landforms situated on the northern slopes of the Hodslavický Javorník brachysyncline were often misinterpreted in earlier studies. For instance, Buzek et al. (1986) describe the steep rocky slope below the top of Huštýn Mt. as a typical frost-riven cliff and the elongated mould nearby as a protalus rampart. This concept is irreconcilable with the contemporary views of the relief formation in the flysch Carpathians, which are based on comprehensive research using methods of detailed geomorphological mapping, geological and geophysical analysis and the dating of landforms.

The present activity of the slope deformations is connected either with the scarps, where rockfalls were observed on the outcrops (eg. the Kamenárka Mt.), or with the lower parts of slopes. These are usually activated after significant heavy-rainfall events, such as debris flows and minor landslides that occurred on the south-eastern slopes of the Kyčera Mt. – Myší Mt. range in July 1997.

At several localities within the Hodslavický Javorník range, an interaction between slope deformations and river channels (namely valley damming) was examined. At first, the valley of the Jičínka river was blocked near Padolí, to the east of the Dlouhá Mt., where the 15 m high remnants of the landslide dam are still visible (the widened space of the valley behind it was used in the 1940s for building a small reservoir). At second, there is an interesting example of river damming to the east of the Ostrý vrch Mt., where the valley of the Čertoryjský stream was blocked by a landslide on the Ostrý´s Mt. eastern slope. The body of the landslide made an approx. 20 m high dam behind which a lake was created. Currently, the terrace of the Čertoryjský stream is covered by 1 – 1.5 m thick layers of clay sediments with numerous reduction horizons, which provide evidence for the existence of the former lake. Using the method of radiocarbon dating, the age of the lake was set at approx. 3100 BP (Subboreal). The collapse of the dam was accompanied by a major flood-wave which left an alluvial fan on the outside of the landslide accumulation (Fig. 8).

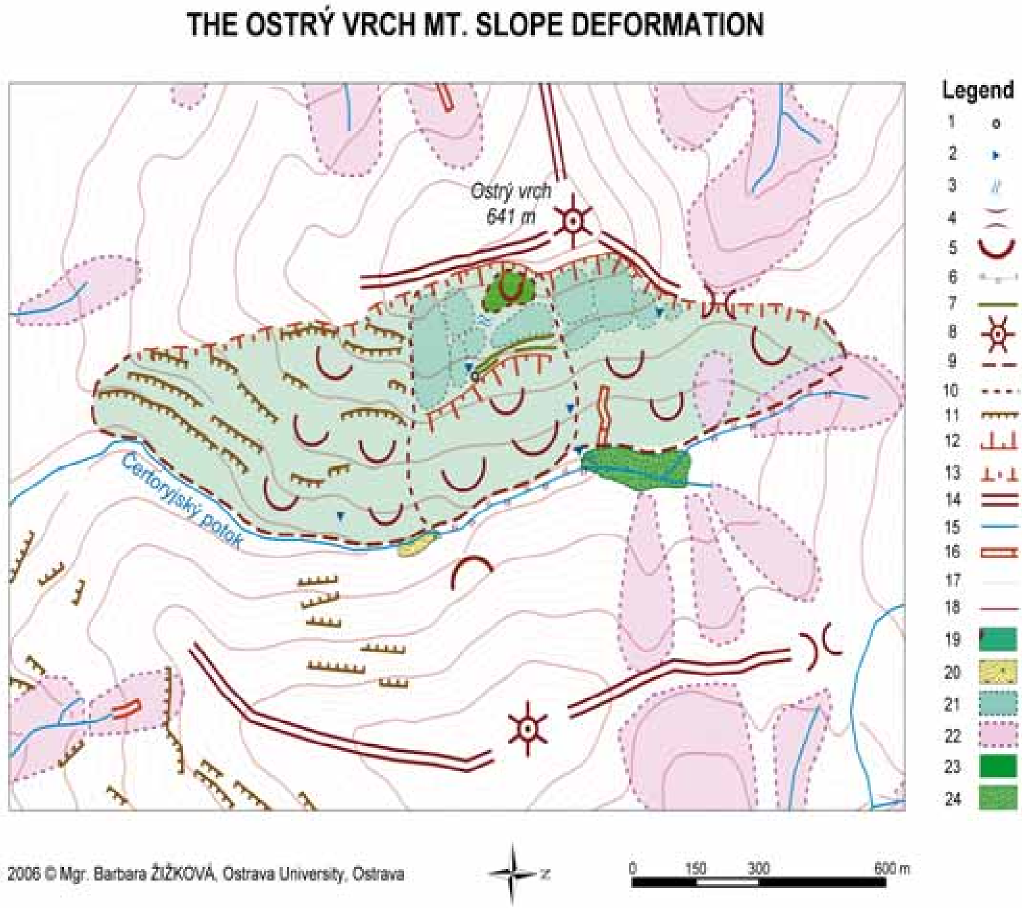

Fig. 8: The Ostrý vrch Mt. slope deformation. ArcGIS 8.3

Legend: 1 – pseudodoline, 2 – spring, 3 – wetland, 4 – saddle, 5 – small landslide (one side less than 50 m), 6 – permanent stream cutting deeply through deluvium, 7 – extensional trenches, 8 – denudational peak, 9 – landslide boundary, first order, 10 – landslide boundary, second order, 11 – slope discontinuity (step, terrace), usu. anthropically modified, 12 – landslide scarp, morphologically pronounced, 13 – landslide scarp, supposed, 14 – denudational ridge, 15 – stream, river, 16 – gully, temporary stream, 17 – contour, 5 m, 18 – contour, 25 m, 19 – landslide accumulation, 20 – proluvium, 21 – subsided block, part of slope deformation, 22 – hillslope hollow, 23 – debris flow, landslide recently active, 24 – fluvio-lacustrine sediments above the landslide dam.

5. Conclusion

The paper discusses selected geomorphic aspects of the Hodslavický Javorník range, reflecting the results of detailed geomorphological mapping, complemented by other analyses (such as radiocarbon dating, digital terrain modelling, structural-geological analysis etc.). Based on the synthesis of these results, some of the earlier interpretations of the landforms´ origin in the area studied have been changed, namely the extent of the potential levels of planation and of periglacial landforms.

Slope failures, shaping especially the outer part of the brachysyncline escarpment (ie. slopes that are not situated along the bedding planes of the flysch strata; compare with Baroň et al., 2004, p. 559), have been recognized as the main process forming the relief of the Hodslavický Javorník range. Surprisingly, although the relief energy of the range is among the lowest within the Silesian Unit, the slope deformations belong to the largest ones within the flysch Carpathians (eg. the deep-seated slope failures of the Huštýn and Kamenárka Mts.). This proves the importance of the geological structure as one of the dominant factors in the formation of the area studied (the landforms are thought to have originated from the selective denudation of the lithologically varied rocks).

Slope failures of various types occur within the Hodslavický Javorník range. Deep-seated gravitational slope deformations (DSGSDs) are most important as far as the total area is concerned, however, usually it is the other types of slope deformations (such as debris flows, slumps or rock falls) that pose a greater risk to the human society. The importance of DSGSDs both as a main type of geohazard and the activating factor of rapid slope processes can be observed in young orogenic areas throughout the world (eg. Agliardi et al., 2001; Bisci et al., 1996; Corominas et al., 2003; Dikau et al., 1996; Di Luzio et al., 2003; Glade et al., 2005; Michael-Leiba et al., 2003; Smith, 2001). The analyses of active landslide areas within the flysch Carpathians have proved, too, that DSGSDs, if present, are among the key triggering factors of shallow, young landslides in particular (eg. Baroň et al., 2004; Bajgier–Kowalska, 2000; Gorczyca, 2000; Mrozek, Raczkowski, Limanówka, 2000; Nemčok, 1982). Slopes affected by deep-seated slope deformations consist of morphologically unstable segments such as steep landslide scarps and rotated, gravitationally subsided blocks. Usually, such areas are typical of locally very steep slope gradients and outbalanced hydrogeological conditions, which can result in the activation of new landslide processes. In the area studied, slope deformations, along with floods, represent the main geohazard affecting human residences, infrastructure and economic activities.

Consequently, detailed knowledge of the structure, geochronology and mechanism of slope failures is essential for effective landuse planning and management of the areas affected by landslides (Smith, 2004). Therefore, the aim of current research is to acquire this knowledge by means of multidisciplinary approach, using geological, geomorphic, geochronological, geophysical and geo-information technologies (Agliardi et al., 2001; Baroň et al., 2004; Buccolini et al., 2002). Since several slope deformations within the Hodslavický Javorník range or its vicinity (Moravskoslezské Beskydy Mts.) were dated into relatively recent periods of the Holocene (Subboreal, Subatlantic), or even into the historic period of the Little Ice Age, their further development is not currently out of question, especially in connection with floods, increased fluvial erosion and changes in land use.

Acknowledgement

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CHANGES IN TIME AND SPACE OF POND FARMING IN THE AREA OF RUDY WIELKIE (POLAND)

Grzegorz JANKOWSKI

Summary

The development of pond farming in the area of Rudy Wielkie (Silesia, Poland) since the turn of the 14th Century, is discussed in this article. Originally, there were a very large number of ponds, but about 300 of them were destroyed during the Hussite wars in the 15th century. Research in this area, on changes in the pattern of water reservoirs in time and space, generally starts by analysing J. W. Wieland's map of 1736. The most important historical source is the German map Meßtischblätter von Deutschen Reiche of 1883-1923. The comparative analysis of archives and records collected during field research indicated the existence of 32 reservoirs, differing in size and function, and 32 objects of hydro-technical architecture, in the form of earth constructions (that is transverse dikes – damming water in reservoirs, and side dikes – keeping water in ponds).

Shrnutí

Časoprostorové změny rybníkářství v oblasti Rudy Wielkie (Polsko)

Příspěvek se zabývá rozvojem rybníkářství v oblasti Rudy Wielkie (Slezsko, Polsko). Rybníkářství v této oblasti sahá až k přelomu 14. století. V té době zde bylo velké množství rybníků, z nichž okolo 300 bylo zničeno během husitských válek v 15. století. Prvním zdrojem, který je možno využít pro studium změn rybniční sítě ve studované oblasti v prostoru i čase je mapa J. W. Wielanda z roku 1736. Nejvýznamnějším historickým zdrojem pro výzkum rybníkářství v této oblasti je však německá mapa Meßtischblätter von Deutschen Reiche z let 1883-1923. Srovnávací analýza archívních materiálů a záznamů sesbíraných v průběhu terénního výzkumu potvrdila existenci 32 nádrží různých velikostí i funkcí a 32 objektů vodní architektury ve formě pozemních staveb (příčných hrází pro hrazení vody v nádržích a bočních hrází pro udržování vody v rybnících).

Key words: *fish farming, stream-river ponds, rainfall-runoff reservoirs, Poland*

Introduction

The area discussed in this paper is situated in the western part of the Silesian Province. The region is often referred to as the Racibórz Land, which remained after the times it belonged to the Racibórz Principality in the past. The main axis of the region is undoubtedly the Ruda river, which determined the subject matter under discussion.

The reasons for development of pond farming in the discussed area should be undoubtedly sought in physical-geographical conditions (e.g. large areas covered with water during flooding or wet grounds), as well as in intense economical and social development of the whole Upper Silesia and Moravia.

Fish were basic food of monks and people subject to monasteries, and the rapid growth of cities in Silesia, Little Poland or even Moravia (especially from the mid-15th century, i.e. after Hussite and Hungarian Wars) favoured building ponds, both for secular and church needs. Another factor that stimulated pond farming was abundant and, more importantly, qualified manpower (initially these were extraneous workers – from the Silesia-Moravia border zone) that gradually became a specialized base for almost all area of southern Poland.

The said natural conditions played an important role in shaping the pond farming activities of those times. As numerous flooded grounds, river shoals and wet grounds were difficult to dry for being used for cultivation or grazing, the only way of husbandry was seen in ponds. Frequent floods were also the reason for building numerous ponds in river valleys, which could serve the retaining functions (besides the farming functions) as well. Damages to fish cultures in ponds that stopped or decreased the flood wave were definitely much smaller than those to crops from fields and meadows.

Fig. 1. Location of the research area in the Silesian Province

Pond types of old times

Both natural conditions and wealth of the owner or manager of a given area were elements that determined the location and type of a pond to be built. In monastery lands – similarly to all Upper Silesia – two types of ponds were most common. One of them included the so-called rainfall-runoff ponds (i.e. ponds fed by surface flow and rainfall water), built in depressions (frequently in forest meadows), which collected water flowing from the nearest surroundings and kept it for most of the year, thus creating areas that were useless as pastures or plough lands. With little expenditure of work and money, monasterial peasantry exploited such areas, mostly by creating small ponds fed mainly by water flowing from the neighbouring fields (such ponds did not have irrigating-discharging devices), although some ponds were also fed by a small watercourse. The rainfall-runoff ponds which did not have very favourable hydrobiological conditions, were used for farming so-called resistant species such as tench or crucian carp (Jankowski, 2001).

The other type of ponds included stream-river ponds. These were water reservoirs built in river or stream valleys, often as large pond complexes with dikes and sophisticated systems of hydrotechnical devices. Such ponds were fed naturally, by a flowing river, or artificially, through a system of channels. Frequently, such reservoirs were arranged in series (so-called chain ponds). Ponds of this kind required large expenditures and qualified manpower, or at least a professional building supervision. What was very important in the design of this type of ponds was a detailed measurement of the neighbouring grounds. Detailed guidelines for how to appropriately prepare grounds for such ponds were presented by O. Strumieński in his paper of 1573 (the paper was reprinted in 1987). This paper also provided valuable instructions regarding the construction of hydrotechnical devices of those times, such as water feeders, supply and bottom ditches, ice breakers, or outlet boxes, and recommended materials of which they should be made.

Large areas of stream-river ponds, advanced hydrotechnology and alternate farming made it possible to make a maximum use of hydrobiological values of these reservoirs and, consequently, to intensify the culture to a large extent. Carp was the main species, but breams, roaches, perches and even pikes were sometimes kept in carp ponds as well (Nyrek, 1987). Because the construction and maintenance costs were rather high, the stream-river ponds were in the possessions of monasteries.

Fig. 2: Example of a forest pond near Bargłówka (so called rainfall-runoff pond) (Photo: author)

Stream-river ponds, especially those built outside the main river courses, were later used also as energy stores for driving various machines. The whole hydrotechnical system (a pond along with the channel system) was constructed so that the gravitational downflow could drive a water wheel. Initially, this was an overshot wheel, and then, from the turn of the 17th century on, an undershot wheel which provided for a more efficient drive.

Fig. 3: Remains of stream-river ponds near Krasiejów (Photo: author)

Water power was used in sawmills and in the operation of all metalwork machinery such as forging hammers, bellows in smelting furnaces, blast furnaces or blow furnaces, ore stamps, rolling mills, wire-drawing mills, etc. (Radwan, 1963; Frużyński, 1997). Flour-milling was where water power had been used for the longest time.

Changes in time and space of pond farming in the Ruda catchment

The beginnings of pond farming in the Ruda R. catchment area reach back to the turn of the 14th century. That is when two biggest centers of pond farming were created; they were soon acknowledged and became the main fish suppliers for city markets such as Wrocław, Kraków, Opole, Brzeg or Racibórz. These centers were the Milicz region and the Rybnik-Pszczyna region (also known as the Rybnik-Oświęcim region). Fish farms subject to the Rudy Wielkie monastery could be regarded as belonging in two fish farming centers, namely those of Racibórz and Rybnik, which were part of the mentioned Rybnik-Pszczyna region (Nyrek, 1966). The number of ponds in Racibórz county as compared to the said region is presented in Tab. 1.

	Number of ponds				
	end 18th century	beginning 19th century			
	large and small	Large	Medium	Small	Total
Rybnik-Pszczyna region	150	18	36	1,066	1,120
Racibórz county	19	5	7	320	332

Tab. 1: Changes in the number of ponds in the Racibórz county at the turn of the 19th century as compared with the Rybnik-Pszczyna region
Source: Ładogórski, T. (1954); Nyrek A. (1992).

The first written accounts on the Rudy ponds date back to the beginning of the 14th century. The documents mention an agreement on using the pond in Stanice and submitting the pond to the village administrator of Żernice. What proves a large number of ponds is the fact that about 300 ponds were destroyed near Rybnik during the Hussite wars in the 15th century.

The late part of the 15th century was another stage of the pond farming development. Ponds between Sumina and Zwonowice and in Zwonowice were created at that time. The profitability of fish farming is shown by the fact that starting from the mid-16th century, peasants were displaced and even fertile lands and whole villages had to give up to water. On average, about a half of the households in monasterial villages had their own, usually small, ponds, which were sometimes interconnected by a common watercourse.

Chronicles from the 18th century report the destruction of a large number of ponds by flood. A. Nyrek (1992) estimates that up to 900 ponds were operated near Racibórz. Most of them were destroyed and those still existing could be regarded as remains of the monasterial activities in Rudy. The total area of ponds in the former counties of Racibórz and Rybnik (in its Prussian part) in the mid-19th century (after the dissolution of the Rudy monastery) is presented in Tab. 2.

	Existing ponds (ha)	Dried-up ponds (ha)	Arable land (ha)	Total area (ha)
Racibórz county	406	1,793	64,607	83,841
Rybnik county	4	175	50,566	83,291
Rybnik-Pszczyna region - total	2,730	3,303	278,425	432,918

Tab. 2: Ponds and arable land areas in the former counties of Racibórz and Rybnik (Prussian part) in mid-19th century
Source: Nyrek A.(1966)

Studies on changes in the location of water reservoirs within the research area in time and space could generally be started in the early 18th century by analysing J. W. Wieland's map of 1736. The problem with assessing the earlier situation (in the 15-16th centuries, i.e. at the beginning and during the greatest boom of pond farming) was pointed to by A. Nyrek (1966).

J. W. Wieland's map presents the situation after the Thirty Years' War. The pre-analysis shows a greater use of the Ruda R. upper catchment and the Sumina R. catchment for pond farming activities. That must have resulted from a considerable forest coverage at that time (especially in the Ruda R. catchment). The best area for pond farming was the neighbourhood of Stanice, which was related to intense land clearing as early as in the 13th century and to the occurrence of more fertile soils (Panic, 1992).

In spite of detailed, as for those times, representation of all hydrographic objects, the scale of the map made it impossible to include all reservoirs (especially smaller ones – those below 0.5 ha) in its contents. It should therefore be assumed that the total area of reservoirs at the time of the map creation was larger than suggested by the present day's analysis of that particular cartographic material.

There are 5 water reservoirs in the research area distinguished in the said map; they were situated in the valley of Ruda R. and its tributaries, the Wierzbnik and the Potok z Buka (see Tab. 3). These were mostly dam reservoirs (ponds of the stream-river type), used for mills operation. An exception was the pond near Kuźnia Raciborska, damming water for an iron forgery.

Another cartographic item that was analysed was Christian von Wrede's map. In spite of a short time interval between the publication of Wieland's map and this publication, "Kriegskarte von Schlesien", of 1748-1749, is a significant source of new information regarding the research area. That was the time when Silesia went under Prussian control (1740), metallurgical industry was activated, and new iron smelting and processing plants were built in monasterial lands.

No	Location of the reservoir (city, stream)	Area (ha)
1	Rudy Wielkie, monastery pond	3
2	Brantołka, Ruda valley	7
3	Rudy Wielkie, Potok z Buka	2
4	Kuźnia Raciborska, Ruda valley	15
5	Paszki, Wierzbnik	4
	Total	31

Tab. 3: Water reservoirs of the research area in J. W. Wieland's map
Source: W. Majcherczyk (1998), supplemented and changed

The discussed reservoirs and the intensely developing Cistercian pond farming have their representation in that map. The number of reservoirs and the area of those existing before in the research area increased (e.g. the reservoir in Kuźnia Raciborska from 15 to about 21 ha, and in Brantołka from 7 to 23 ha). The functions some of the reservoirs served can be indicated by industrial plants represented in the map, e.g. the iron forgery and the mill at the reservoir in Bargłówka. New ponds appeared in the valleys of the Potok z Buka and the right tributary of the Wierzbnik. Water surfaces of these reservoirs did not exceed 3 ha (Tab. 4).

Due to their illegibility and impossibility of scaling them in detail, other two cartographic sources (Harnisch's map from the turn of the 19th century and *Urmeßtischblätter* of 1823-1828) can only be used to illustrate changes in the number and area of ponds in the research area.

No	Location of the reservoir (city, stream)	Area (ha)
1	Brantołka, Ruda valley	23.0
2	Rudy Wielkie, Potok z Buka	0.7
3	Rudy Wielkie, Potok z Buka	0.7
4	Rudy Wielkie, Potok z Buka	1.0
5	Rudy Wielkie, Potok z Buka	11.5
6	Kuźnia Raciborska, Ruda valley	20.9
7	Surroundings of Bargłówka, Valley of the right tributary of the Wierzbnik	0.4
8		2.7
9		4.1
10	Biały Dwór, Wierzbnik valley	2.0
11	Paszki, Wierzbnik	7.2
	Total	64.2

Tab: 4: Water reservoirs of the research area in Ch. von Wrede's map
Source: W. Majcherczyk (1998), supplemented and changed

It is only the German map *Meßtischblätter von Deutschen Reiche* of 1883-1923 that can be considered a base for a detailed analysis of the hydrographic situation. The preliminary assessment of water reservoirs in the research area shows a large number of small (up to 1 ha in area) reservoirs created in former clay extraction hollows operated for the needs of the nearby brickworks in Jankowice Rudzkie, Stanice or Rudy. Some of these clay-pits have remained until the present.

Large reservoirs did not exceed 5 ha at that time, except for two dam reservoirs in Kuźnia Raciborska and Górna

Huta, still used as energy storing reservoirs. Also, small reservoirs appeared in the village of Paproć. After the dissolution of the monastery, new owners paid much attention to the reconstruction and management of the palace park. As a result, three ponds were created with total area of about 3.5 ha.

No	Location of the reservoir (city, stream)	Area (ha)
1	Rudy Wielkie, Potok z Buka	0.81
2	Rudy Wielkie, Potok z Buka	2.50
3	Rudy Wielkie, Potok z Buka	0.25
4	Brantołka, Ruda valley	4.56
5	Rudy Wielkie, clay-pit (?)	0.06
6	Podbiała, Ruda valley	0.13
7	Paproć, Ruda valley	2.75
8	Paproć, Ruda valley	2.19
9	Rudy Wielkie, Potok z Buka	0.22
10	Rudy Wielkie, Potok z Buka	0.38
11	Jankowice Rudzkie, clay-pit (?)	0.19
12	Jankowice Rudzkie, Raczok valley	0.06
13	Raczok valley	0.06
14	Raczok valley	0.09
15	Raczok valley	0.19
16	Kuźnia Raciborska, Ruda valley	6.19
17	Górna Huta, Ruda valley	7.50
	Total	28.13

Tab. 5: Water reservoirs of the research area in the Meßtischblätter von Deutschen Reiche map
Source. Majcherczyk, W. (1998), supplemented and change.

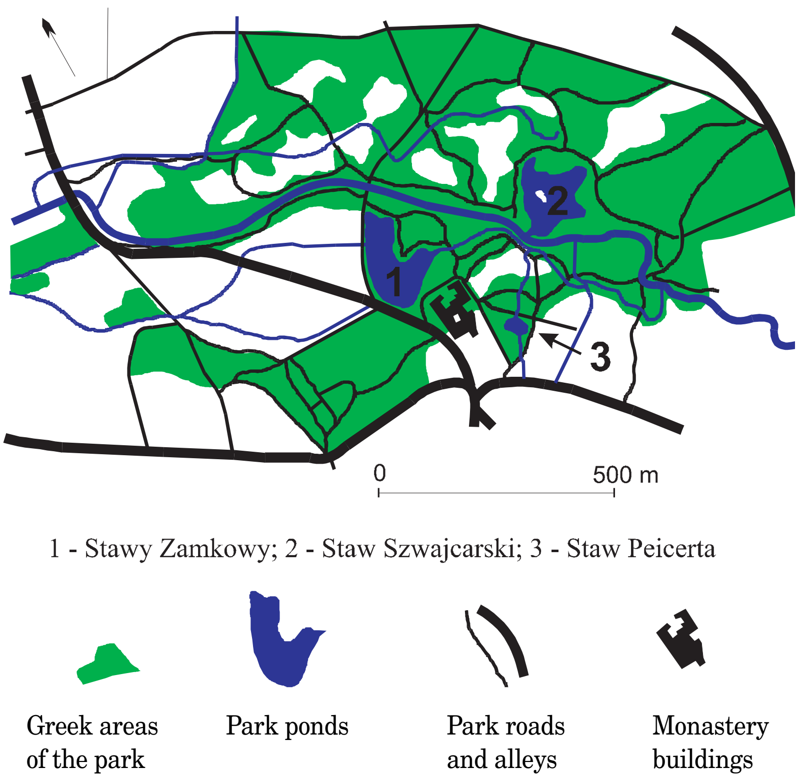

Fig. 4: Sketch of pond location in the palace park in Rudy Wielkie
Source: Own compilation

Summary

Summing up, the large contribution of Cistercians of Rudy in hydrotechnical management of the neighbourhood of Rudy Wielkie should be emphasized. The remainders of ponds or whole hydrotechnical complexes in the landscape can be admired even nowadays. The comparative analysis of archives and records collected during the field research indicated the existence of 32 reservoirs, differing in size and function (being in vast majority originally related to Cistercians' pond farming) and 32 objects of hydrotechnical architecture in the form of earth constructions (i.e. transverse dikes – damming water in reservoirs, and side dikes – keeping water in ponds). It should be kept in mind that all post-Cistercian hydrotechnical architecture has its deep explanation related to natural conditions. Numerous wetlands, frequent flooding and favourable surface features were the reason why it was pond farming that that was one of the main economic activities of the Rudy Wielkie monastery for many years, or even centuries. Another essential fact was the use of water resources for energy (in particular, for driving numerous monasterial manufactures and industrial plants), as well as for aesthetic purposes, as an important element of large-scale landscaping.

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HISTORICAL FLOODS IN CENTRAL EUROPE AND THEIR DOCUMENTATION BY MEANS OF FLOODMARKS AND OTHER EPIGRAPHICAL MONUMENTS

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Abstract

The floods that affected the Czech Republic and neighbouring countries in Central Europe in July 1997 and in August 2002, were considered extreme natural disasters. Most people were taken aback by them, as high waters of similar impact had not occurred for more than one hundred years – the nation's flood memory was lost. The objective of this paper, in terms of its historical and geographical focus, is to present a sample based on the original documentation of surviving traces of previously flooded areas, recorded in the field. The records on water level culmination marks on buildings and bridges, memorial plates and landmarks built to flood victims, are actually some of the infrequently-used types of information for the documentation and reconstruction of historical floods, which contribute to the restoration of flood history.

There are 33 examples of localities with flood marks or with other epigraphical relics from Central Europe documented in this study. Of those, the majority originate from the Czech territory, whilst the others are from Slovakia, Poland, Germany and Austria. In hydrological terms, ten of the 33 are situated in the Labe (Elbe) R. basin in Bohemia, four in the same river basin in Germany, and one in the Rhine basin in Germany. The Morava River watershed is represented by four localities, and the Danube R. watershed by five localities in Austria and by four in Slovakia. Finally, for the Odra(Oder) R. basin in Moravia or in the Czech part of Silesia, there are two localities, as well as one in Bohemia (Broumov / Stěnava R.) and two in Poland.

Shrnutí

Dokumentace historických povodní ve střední Evropě pomocí povodňových značek a jiných epigrafických památek

Povodně, které postihly Českou republiku i sousední státy střední Evropy v červenci 1997 a v srpnu 2002, představovaly mimořádné přírodní katastrofy. Většinu lidí tyto extrémy zaskočily, protože v posledních více než sto letech se takové velké povodně nevyskytly – došlo ke ztrátě povodňové paměti. Cílem tohoto článku historicko-geografického zaměření je prezentovat výběr ze vznikající originální dokumentace dochovaných materiálních památek v terénu na povodně v minulosti. Evidence značek kulminací vodní hladiny na budovách a mostech, pamětních desek nebo pomníků obětem je totiž jedním z méně využívaného typu podkladů pro dokumentaci a rekonstrukci historických povodní, který přispívá k oživení povodňové paměti.

Je dokumentováno celkem 33 příkladů lokalit s povodňovými značkami nebo jinými epigrafickými památkami ze střední Evropy. Z toho jich připadá na území České republiky 17, na Slovensko 4, na Polsko 2, na Německo a Rakousko po 5 lokalitách. Z hydrologického hlediska se jich nachází v povodí Labe v Čechách 10, v povodí Labe v Německu 4 a v povodí Rýna 1. Povodí řeky Moravy je zastoupeno 4 lokalitami, povodí Dunaje reprezentuje na území Rakouska 5 a na území Slovenska 4 lokality. V povodí Odry na Moravě nebo v české části Slezska se nachází 2, v Čechách (v Broumově na řece Stěnavě) 1 a v Polsku 2 lokality.

Keywords: *historical floods, floodmarks, epigraphical monuments, Central Europe*

1. Introduction

Disastrous floods that affected Central Europe in 1997 and 2002 represented natural extremes. Although similar flood disasters occurred in this region in the past, they are nearly forgotten for their rate of occurrence was low. While the 19th century experienced a number of serious floods in Central Europe, the 20th century was rather eventless, the fact being one of reasons that the historical memory in connexion with the occurrence of high waters was nearly lost, particularly in Czechia. The loss is however contributed to also by other facts such as devastation and removal of floodmarks and other epigraphical relics.

Apart from written records, historical floods are reminded by various types of material relics such as floodmarks and inscriptions documenting water level culminations reached during the floods or events related to the particular natural catastrophe. These can be found in the vicinity of water courses on river banks, buildings, bridges, etc. Special monuments were exceptionally built to remind some flood events and their victims.

Floodmarks are a part of the historical flood memory (.e.g. Petrow et al., 2003; Munzar, Ondráček, 2005). Their removal or devastation are partly responsible for the fact that many of historical flood events in Czechia were for ever fortgotten (Fig. 2a). They are being removed during demolition works and reconstructions of buildings or their façades. Floodmarks at other places are not maintained and renewed which gradually ends in their disappearance. A much greater attention to these monuments is paid for example in Germany or in Austria. It would be possible to mention a number of examples from German and Austrian towns where floodmarks are continually and carefully restored (Fig. 2b) namely on street corners or on walls of old buildings. It is often the case that they bear records of multiple floods or culmination water levels occurring at a given place within a lapse of several centuries. Specific floodmarks are those situated on railway bridges. In the late 19th century, the installation of floodmarks on bridges was obligatory in Austria. However, if the old bridges were replaced with new ones in the 20th century, the reminders of historical flood events disappeared with them.

Fig. 2a: Irretrievably disappearing floodmarks on the former mill in Hořín on the lower reach of the Vltava R. not far from the confluence with the Labe R. (Photo: L. Elleder)

Fig. 2b: Floodmarks in the town of Winningen on the embankment of the Mosel R., the left-bank tributary of Rhein, some 10 km before its estuary in Koblenz. On the right, director of German Bundesansalt für Gewässerkunde, professor V. Wetzel, second from the left Ing. Jan Kubát, deputy director of Czech Hydrometeorological Institute (Photo: BfG Koblenz)

The objective of this paper whose initiators are experts from the department of environmental geography at the Institute of Geonics, Academy of Science of the Czech Republic is therefore to present a choice from the newly emerging original documentation of these vanishing material evidences about the historical floods as viewed by historical geography. The historical flood memory of Central Europe is revived by findings of floodmarks from the Czech Republic, Slovakia, Poland, Germany and Austria (Fig. 1).

2. Classification and plausibility of floodmarks

Based on the study of a great number of floodmarks found in Germany and Switzerland, M. Deutsch (Univ. of Göttingen) and his colleagues worked out their following classification with four main groups (types) of marks:

Type A: Floodmarks such as simple notches or lines without any date or explanation. If no supplementary written sources exist, these marks cannot provide any useful information.

Type B: Floodmarks with a notch and a year of the flood event.

Type C: Floodmarks with exact dates and possible more details.

Type D: Special forms of floodmarks – not all of them may provide data on exact water level.

They may include inscriptions (e.g. mentioning the number of victims, injured and lost cattle), rhymes or chronograms referring to floods or memorial stones and monuments installed in towns/villages or outside them (Deutsch, 2000b; Deutsch, Grünewald, Rost, 2006).

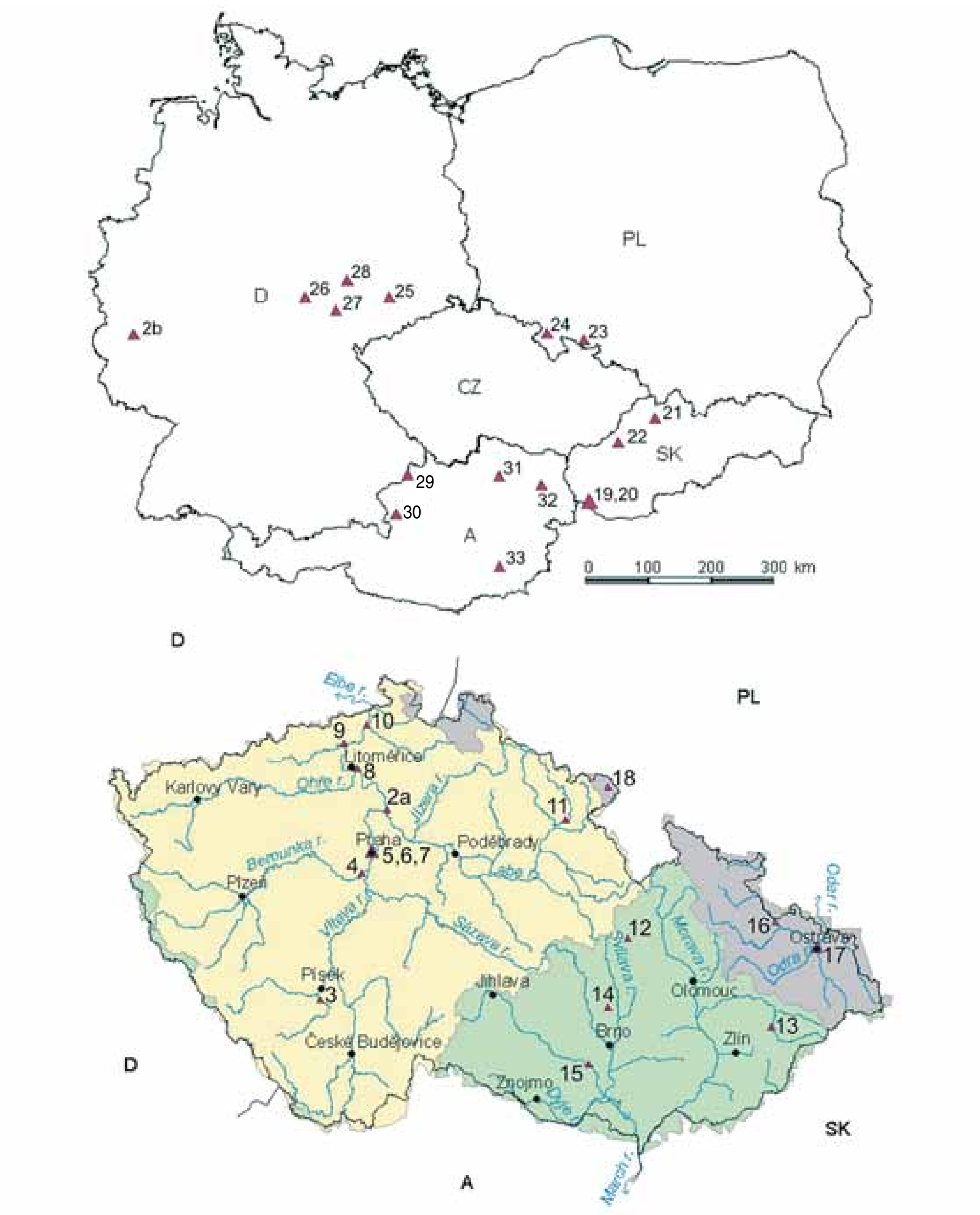


Fig. 1: Maps of the area under study show the position of floodmarks and / or other epigraphic monuments mentioned in the text. (In the Czech Republic: Labe / Elbe R. basin - yellow, Morava / March R. basin - green and Odra / Oder R. basin - grey.) The numbering of localities corresponds with the numbering of figures in the paper.

A rather frequent objection raised by some experts is that the informative value of marks is low or even zero if taking to account vast changes of the riverine landscape especially in the 19th and 20th centuries. Sometimes it is even possible to refer to possible transfers of floodmarks and/or to inaccuracies originating already from the time of their coming to existence. All these objections may be tangible and should be considered case by case.

Rejection of these historical material relics is however a gross mistake that many a time resulted in their falling into oblivion or their total disappearance. Because not even radical changes in the landscape show significantly in the value of these monuments. Said in simple terms, the less so the more significant flood is represented by the floodmark. In other cases it is also possible to apply the knowledge of river profile historical development and to judge whether the validity of the information can be extended to the present time. In any case, the marks provide data about the former condition of the landscape during floods and at least a relative information about the past times.

An eloquent example is the situation in Prague where a comparison of high water courses on the Vltava (Moldau) River in 1784, 1845, 1890 and 2002 showed that the culmination water levels in the core of historical monuments reserve in the profile of Charles Bridge can be compared with no greater problems. On the other hand, urbanization impacts reflected adversely on the right bank of the Vltava R. in Karlín town district where the discharge situation worsened due to river channel necking. This is why the culmination water level during the flood in August 2002 exceeded the floodmark from September 1890 on the historical building of Invalidovna (some 5 km below Charles Bridge) by three meters. Also, the vanished marks of disastrous winter floods in 1784 and 1845 were two and a half meter lower than the water level reached in 2002 (while the culmination at Charles Bridge was lower only by 75 cm in the first case and in the latter case only by 55 cm!).

In order to arrive at a more complex image of concrete floods and their impacts, it is necessary to know something about the development of the area in question and – if possible – to make a comparison of more profiles. It applies here, too, that any lost information should be pitied.

It follows that should the ancient water level marks be used for the reconstruction of historical floods, main aspects to be taken to account prior to further data processing are as follows:

Location: Is the water level mark found in the original position? Was it possibly moved during construction works?

Restoration: Was the floodmark renovated? May there be possible mistakes – for example when dates were transferred?

River condition: What was the condition of the river in former times? What is it like today?

3. Czech Republic

The irreplaceable role of floodmarks on buildings, bridges, etc. was called to attention already by J. Dlouhý in his work "Floods on Czech rivers" published after a disastrous flood in 1890:

"Those of technicians who were to determine the normal profile of a watercourse, be it for the purposes of construction work or bridge repair, or for the purpose of establishing road construction line and height will admit that floodmarks could be found only with difficulties or very rarely even if only 50 years old. Floodmarks had often to do with records produced by individual observers who doubted the data on water height themselves. Let the engineers working in rural towns situated on a water course ask themselves a question of how many floodmarks can be found there; only then they may realize how little attention has been paid to the issue, often to the detriment of communes and districts.

It is often believed that a public authority is responsible for keeping (water level) records ***but an entry in the water-gauging reports would not have the same effect as a floodmark on a building at a place open to public eye at any time*** *... How many houses have been built at places jeopardized by high water, how many bridges swallen by floods, how many flooded roads! ...*

After the last great flood on the Vltava River in Prague (in September 1890), the imperial-royal governorship and the royal town of Prague implemented numerous marks of (reached) water level height by tablets. Railway arranged for the placement of floodmarks on their objects if situated near the river. It is likely to be not generally known that the Ministry of Railways (in Vienna) issued regulations on how to make the high water marks on railway objects and that there were to be special records on water level elevations, floodmarks and river bed changes planned for all important bridges" (Dlouhý, 1899).

However, the above regulation issued by the Vienna Ministry of Railways in the late 19th century has not been found up until the present. There are all indications that any similar practice was not continued in the Czech Lands after the end of the Austrian-Hungarian Monarchy, which would suggest that some old railway bridges bear floodmarks only from the period before the year 1918. If some of these old bridges were refurbished or replaced later, the important data about the historical floods disappeared. It is therefore relevant to attempt at a register of all floodmarks that have been preserved until these days.

3.1 The Vltava (Moldau) R. basin and the remaining part of the Labe (Elbe) R. basin

Following examples from the emerging database of floodmarks will be presented with respect to the hydrological hierarchy of water courses.

The disastrous flood of 2002 in the Vltava River catchment area above Prague is documented on the example of two localities, namely by a high water stone in the village of Putim on the Blanice R., the right-bank tributary of the Otava R. The stone bears a culmination floodmark notch and a plate with the following text: *"This stone is erected to remind the greatest flood of 12 August 2002 and immense solidarity that followed after the flood"* (Fig. 3).

Very valuable for a comparison of historical flood events is the flood column in Černošice-Dolní Mokropsy on the bank of the Berounka R., the left-bank tributary of the Vltava R. at a distance of some 9 km from their confluence (Fig. 4), which is an unambiguous evidence to the extreme character of the flood disaster in August 2002 in the last 130 years.

The oldest water gauge on the Vltava R. in Prague was a relief ornamental sculpture known as "Bradáč" (Bearded Man). The blackened and water-worn head rising from a sandstone block is situated in the embankment wall approx. 3 m above the mean water level, in a close vicinity to the Monastery of the Knights of the Cross at Charles Bridge. Although the Bearded Man was not at the same place since the date of its origin (but it seems, that is practically at the same height), and the age of this water gauge is unknown either, flood records in old chronicles importantly indicate up to where the flood reached at this stone head during concrete flood events. An apparently first flood record mentioning the Bearded Man dates back to the mid-15th century with water reaching up "into the Bearded Man's nose" on 24-26 June 1445 (Elleder, 2003).

Nevertheless, as far as the flood memory is concerned, a certain drawback of the famous Bearded Man is seen in the fact that the water gauge has never been easily accessible and visible to Prague inhabitants, which disqualifies it from being a lasting reminder of big historical floods (Munzar et al., 2005). Fig. 5 shows the culmination point of disastrous flood in 2002 as compared with the level of the historical Bearded Man that got drowned during this extreme flood event.

A comparison of historical floods on the Vltava R. near Charles Bridge over a time lapse of more than 330 years is provided by currently inaccessible floodmarks (they can be seen only from a boat) on the wall of the Knights of the Cross Monastery (Fig. 6). Although the floodmarks from the Monastery do not represent a complete series since some of more important floods are missing there (e.g. those in 1712 and 1799), they bring a clear evidence about the priority of the last disastrous event from 2002, which surpassed the hitherto record of the winter flood in 1784.

Well accessible to public are on the other hand water culmination gauges of the two big floods on the Vltava R. (in September 1890 and in August 2002) on the building of Smetana Museum near Charles Bridge (Fig. 7), which are however very small and not placed above each other.

The area of relatively high importance for a comparison of historical floods on the Vltava River is that of its confluence with the Labe R., and the loss of a range of disappeared or disappearing floodmarks on the flour mill in Hořín (Fig. 2a) should be but regretted as there were some 30 gauges drawn there until recently, originating from the period of 1784-1956, which scaled off along with the plastering from the considerably devastated building.

In the Labe River basin under the confluence with the Vltava R. it is useful to mention a range of high water gauges on a house in Křešice near Litoměřice, documenting a period from 1821 (Fig. 8). The height of Labe R. water level during the flood of August 2002 is in the photograph shown only as a boundary line between light and dark plaster colours above the gate.

Fig. 3: The flood stone to commemorate the flood in August 2002 in the village of Putim on the Blanice R., the right-bank tributary of Otava, South Bohemia (Photo: E. Kallabová)

Fig. 4: The "flood column" in Černošice-Dolní Mokropsy on the bank of Berounka R., the left-bank tributary of Vltava, about 9 km from its mouth (Photo: L. Čech)

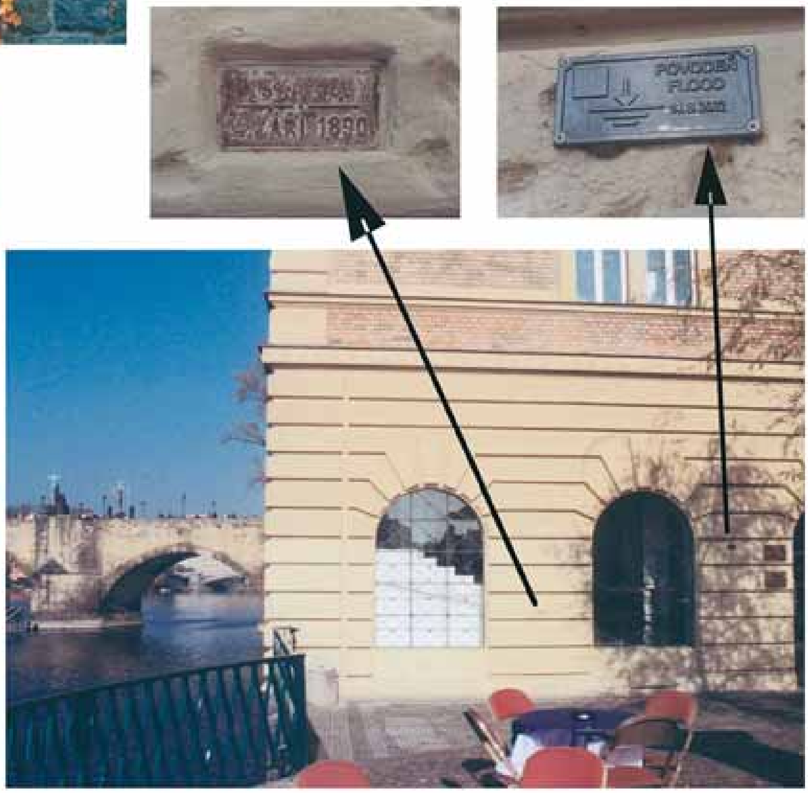
Fig. 5: The culminating flood of August 2002 as compared with the level of the historical Bearded Man on the embankment wall in Prague at Charles Bridge (Photo: L. Elleder and V. Kakos)

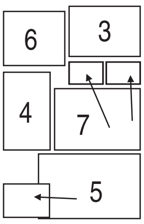
Fig. 6: A comparison of historical floods on the Vltava River in Prague on the wall of the Knights of the Cross monastery (Photo: L. Elleder)

Fig. 7: Culmination marks of floods on the Vltava River in September 1890 and in August 2002 on the building of Smetana Museum in Prague near the Charles Bridge (Photo: M. Deutsch)


14/VIII 2002
635 cm
28/II 1784
575 cm
29/III 1845
4/IX 1890
23/VI 1675
485 cm
17/III 1771
415 cm
19/VII 1736
365 cm
24/III 1717
17/VII 1750
321 cm


2002
1872
1941
1890
1940


ZÁŘÍ 1890
POVODEŇ
FLOOD


6
3
4
7
5

Although the water gauge in Ústí nad Labem – restored in 1995 – provides flood culmination data already from the 10th century (Fig. 9 – see cover p. 2), the data are hardly to be verified until the 15th century. A record water level of the Labe R. (1196 cm) recorded during the disastrous flood on 16 August 2002 was connected with an extreme discharge of 4700 m^3/s.

The collection of flood notches carved into the mansion rock in Děčín on the right-bank of the Labe River (Fig. 10) is of European importance although its current interpretation somewhat differs from the interpretation of records about floodmarks from the 19th century preserved in Děčín. A detailed study revealed that the oldest mark preserved in the original form is a signum from 1595. Since then all other floodmarks can be considered nearly intact, i.e. original. The signum of 1501 – distinct up to these days – is apparently a forge of the new era, originating from the period after 1845. A detailed analysis into the whole collection of floodmarks including the issue of the authenticity of older marks, namely those originating from 1118 and 1432 was made by O. Kotyza and L. Elleder (in Brázdil et al., 2005).

Concluding this chapter, the authors would like to mention example of a curious epigraphical relic from the Labe River basin in north-eastern Bohemia, situated on the embankment of its left-bank tributary (Úpa R.) in the cadastral area of Říkov near Česká Skalice (Fig. 11 – see cover p. 3). The stone monument bears a following inscription above the line indicating the reached water level: *"There used to be an apple tree at this place on which 10 home-folks of Říkov rescued their lives during the flood in July 1897"*.

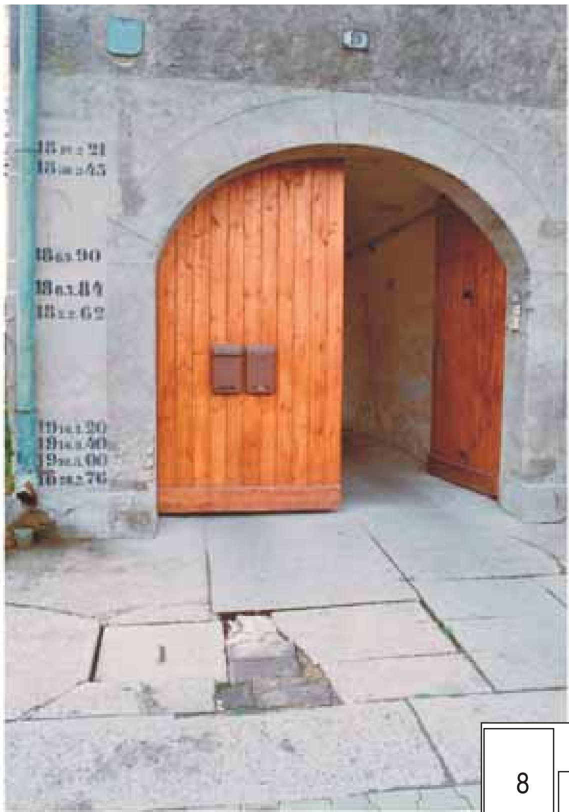
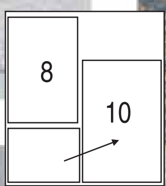


Fig. 8: Water marks on the Labe R. on a house in Křešice near Litoměřice. The culmination water level height in 2002 is apparent from the boundary of light and dark parging colours (Photo: L. Elleder)

Fig. 10: The Mansion rock in Děčín with the marking of historical floods on the Labe River (Photo: J. Kašpárek and www.decin.cz)



3.2 The Morava (March) R. basin and Czech parts of the Odra (Oder) R. basin

The documentation of material monuments from the Morava River basin will start with a profound but little known epigraphical relic. It is represented by two flood memorial plates installed in Moravská Třebová not far from the mansion on an old stone bridge across the Třebůvka River, the right-bank tributary of the Morava R. (Fig. 12). The complex is formed of a brick wall which splits into three sections of identical size, ending in a flat segment arch. The middle span contains a relief of Calvary. In the left span a stone plate commemorates the flash flood of July 1663 and the flash flood of September 1770 is commemorated by a stone plate in the right span.

The older of the two plates describes a disastrous flood caused by unusually severe torrential rains arriving on 7 July 1663 after 07.00 o'clock PM. The flush broke through the dams of the then fish ponds on the Třebůvka River. The flood wave at night from 7 to 8 July took away the suzerain sawmill in the valley, destroying the municipal fulling mill, a number of cottages and barns and causing a severe damage to the princely flour mill. Apart from a considerable material damage, the saddest balance was however the waste of 33 human lives.

The basin of the Bečva River, the left-bank tributary of the Morava R., has experienced dangerous and disastrous sudden floods since times immemorial. A huge flood event is documented from the times when the river had not been regulated yet (August 1854). At that time, the river flooded Dolní Město in Vsetín, 63 cottages were flooded of which 13 collapsed. The disaster is still reminded by a cross placed in the middle of the Dolní náměstí Square (Fig. 13). At a height of 165 cm on the scale line we can read: *"A.D.1854 on 19 August the flood raised up to the upper sign."* It should be added, however, that the culmination level was at that time considerably affected by the weir in front of the brewery from 1751, which contributed to gravel accumulation in the river channel and hence to a more frequent flooding of Dolní Město. Burghers had to go with their complaints to the Emperor, but the weir liquidation was not forced in even by argumenting about the disastrous impact of the flood when the Bečva R. raised up to 188 cm at some places in Vsetín. The situation was resolved 8 years later when a part of the disputable weir was swept away by another flood and the weir as such had to be removed.

Another type of the historical flood reminder in the Morava R. basin is the flood monument made of sandstone, built at a roadside in the southern part of Býkovice in the valley of the Býkovka R., the right-bank tributary of the Svitava R. (Fig. 14). It was erected to the memory of events from 12 July 1922 and the punch mark indicates the water level height in the flooded valley. This was an extreme flash flood caused by torrential rain with hailstorm on the Svratka R. and Svitava R. divide. Roads were destroyed, 8 bridges were taken away, houses were damaged or destroyed, fields washed-off, etc. Life victims recorded in Lomnice and Šerkovice in the neighbouring catchment of the Besének Brook, the left-bank tributary of the Svratka R. amounted to 4 and 1, respectively. The flood event was until recently also reminded by a mark on the house in Lomnička u Tišnova. (More detailed data on flood impacts directly from Býkovice where the above mentioned memorial is situated have not been gained so far.)

Two less usual floodmarks were found on the right bank of the Jihlava River, on the foot of a torso after the second stone pillar of the so called Ivančický viaduct situated on the original Vienna-Brno railway track (Fig. 15). The iron viaduct was erected in 1868-1870. Records on the abutment adjacent to the river are engraved into the concrete of joint between the blocks indicating that the high water level reached up to the line beneath the lower part of the letters. After the end of bridge construction (today replaced by a new bridge), a flood arrived on 11 March 1883 with water level culminating at 171 cm above the abutment foot (above the fourth block) and 419 cm above the normal Jihlava R. water level. The second, higher situated floodmark relates to the flood of 21 February 187(6?) – the last numeral of the date being unfortunately damaged due to the scaled-off joint material. In this case the water level reached a height of 207 cm above the abutment foot (above the fifth block) and some 455 cm above the river water level. (Another information of interest may be the fact that during the spring flood of 2006 it was only the first block in the abutment that was flooded, i.e. water level height was only 30 cm. The comparison is only of informative value with respect to the regime of the river and its discharges being affected by two water reservoirs built in the 20th century.)

The Odra/Oder R. is represented by a floodmark on the house standing on the left bank of the Opava R. in Ratibořická St. in Opava (Fig. 16 – see cover p.3). The stone plate indicates the Opava R. culmination on 11 July 1903, the tapewoman pointing to where the river water level reached in July 1997. These two most severe floods in the Czech part of the Odra R. catchment in the 20th century resulted from the long-lasting regional rains (Munzar, Ondráček, 2003).

The culmination water level height in the streets of regional capital Ostrava during the disastrous floodin July 1997 is documented by a floodmark on the house in Koksární St. in front of the Koksovna Svoboda coking

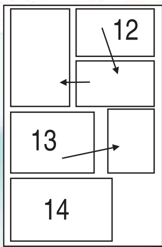


Fig. 12: The memorial flood plate on the bridge in Moravská Třebová commemorating the flash flood on the Třebůvka R., the right-bank tributary of Morava R. in 1663 (Photo: L. Komárek)

Fig. 13: The cross on the square in Vsetín with the high water mark on the Vsetínská Bečva R. from the summer flood of 1854 (Photo: J. and K. Kirchner)

Fig. 14: The flood memorial in Býkovice some 20 km north of Brno commemorating the flash flood in summer 1922 on the Býkovka Brook, the right-bank tributary of Svitava R. (Photo: M. Hrádek)

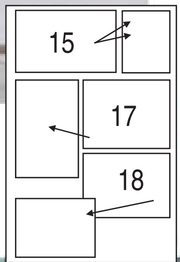


Fig. 15: Marks of two floods on the Jihlava river in the 19th century on the pillar torso of the so called Ivančický viaduct (Photo: M. Hrádek)

Fig. 17: A floodmark documenting the culmination of flood in 1997 in the town of Ostrava not far from the confluence of Odra R. and Ostravice R. (Photo: F. Pokluda)

Fig. 18: A stone plate marking high water level on the Stěnava R., the left-bank tributary of Nysa Kłodzka R. in the town of Broumov in East Bohemia in 1570 (Photo: K. Franze)

plant near the Ostravice R. and Odra R. confluence (Fig. 17).

The Odra R. catchment is also the finding place of an apparently oldest preserved authentic floodmark in the Czech territory, in the town of Broumov in Bohemia. It is installed on the corner of a relatively shabby corner house on the embankment of the Czecho-Polish cross-border Stěnava River, and relates to the extreme flood in the summer of 1570 (Fig. 18). The German inscription on a stone tablet with the scale line between the third and fourth line reads as follows: *"In the year 1570 on Saturday after Markéta [= 15 July] at about 3 o'clock at night the flood reached up to here"*. This historical flooding of the town was compared by J. Kremsa (1979) with the flash flood from the night from 17 to 18 June 1979. The comparison of the culmination water levels of the two floods showed that the latter high water surpassed the above mentioned hydrological extreme from the 16th century – documented by the high water mark on the house in Broumov – by 12 cm.

4. Slovakia

Several marks were found in the Slovak capital of Bratislava commemorating the ice flood on the Danube River in 1850 (Fig. 19). The disaster resulted from the blocked passage of ice and after a barrier developed in the profile of Vlčí hrdlo. The river was rapidly rising and on 5 February 1850 the town was flooded up to a water level corresponding to the gauge height of 1123 cm on the today's water gauge (139.66 m a.s.l.). Water and moving ice blocks caused a lot of damage on buildings along the river line. Historical records speak of 6 life victims.

A record flood in Bratislava in the observation period 1897-2002 became the flood of August 2002 during which the Danube R. level culminated on 16 August at the greatest ever recorded gauge height of 991 cm (Fig. 20) but at the third highest historical discharge of 10,370 m^3/s. (The discharge and gauge height in September 1899 and in July 1954 were 10,870 m^3/s and 970 cm, and 10,400 m^3/s and 984 cm, respectively.)

From the upper reach of the watershed of Váh R., the left-bank tributary of Danube R. downstream from Bratislava we would like to mention a little known reminder of the flood from 1848 on a mountain brook in the Malá Fatra Mts. that affected the village of Štefanová, today a municipal district of Terchová (Fig. 21). In the rock massif below the statue of Virgin Mary there is a stone plate with a notch under the fourth line of Slovak inscription reading as follows: *On 11 June 1848 Ištvánová was flooded and 14 local citizens were drowned. Water reached up to this height. This is a gift from the citizens of Terchová to the centennial jubilee of the event.*

From the middle reach of the Váh R. basin a flood from the end of August 1813 is documented by the memorial plate in Trenčín (Fig. 22), whose inscription consists of the following chronosticum: VIgesIMA sexta aVgVstI fataLes *VnDae eXCreVerant hVCVsqVe – 1813* – the translation of which is as follows: on 26 August 1813 the fatal waves reached up to here. The height was indicated by hand. On the existing tablet it is a horizontal notch at a height of 101 cm above the pavement. The mentioned flood event affected also a larger part of neighbouring countries in Central Europe, being to a considerable extent analogical to the situation in July 1997 (Munzar, 2001).

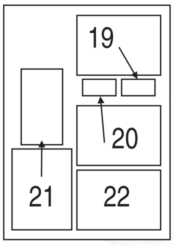
5. Poland

There is a number of floodmarks that have been recently presented in literature from the Polish territory. Most of them were apparently found on the Wisla River in Krakow (Bielański, Fiszer, 1997; Grela, J. et al., 1999) or in Toruń (Makowski, Tomczak, 2002). Floodmarks on the Warta R. in Poznań are mentioned in the monograph by A. Kaniecki (2004). Our study shows that the information on floodmarks and epigraphical relics in the Odra R. basin are insufficient so far – either because they have not been preserved or due to the fact that there was nobody in this part of Poland to systematically deal with their documentation. This is why we present examples only from this watershed.

An interesting epigraphical monument is the inscription on the memorial cross and monument in the village of Jarnoltówek situated south of Glucholazy, a town not far from the Czech-Polish state border (Fig. 23). It reminds the flood on the Zloty Potok Brook on 6-8 July 1903. The cross bears an inscription indicating that the material monument was erected near the local church to the memory of Her Heighness German Empress and Prussian Queen Augusta Victoria visiting Jarnoltówek shortly after the flood in 10-15 July 1903 in connexion with the detection of damages incurred. It should be added that the long-lasting rains and floods affected at that time a relatively large area of Central Europe, namely the Odra River basin. The above mentioned floodmark with the date of the Opava River culmination on 11 July 1903 in the town of Opava (Fig. 16 – see cover p.3) relates to the event. The flood in July 1903 is to a considerable extent an analogy to the flood disaster of July 1997 (Munzar, Ondráček, 2003).

Other reminders of historical floods on the Nysa Klodzka River can be found in the town of Klodzko, in the side body of the Franciscan church of the Assumption of Virgin Mary (Fig. 24). There are three dates of historical flood events recorded there: 1938 (when water reached 183 cm above the floor), 22 June 1783 (flooding height

Fig. 19: The mark of water level reahced during the ice flood on the Danube R. in February 1850 on the corner of Laurinská and Uršulinská streets in Baratislava (Photo: P. Roštínský)
Fig. 20: The limnigraphic station on the Danube R. in Bratislava with a tablet showing the height of water level culmination during the flood in August 2002 (Photo: P. Roštínský)
Fig. 21: The flood of 11th June 1848 in the drainage area of Varinka R., the right-bank tributary of Váh R., which hit the settlement of Štefanová is commemorated by this tablet on the rock (Photo: E. Kallabová)
Fig. 22: The mark in Trenčín commemorates the flood on the Váh R. in summer 1813 (Photo: P. Chrastina)



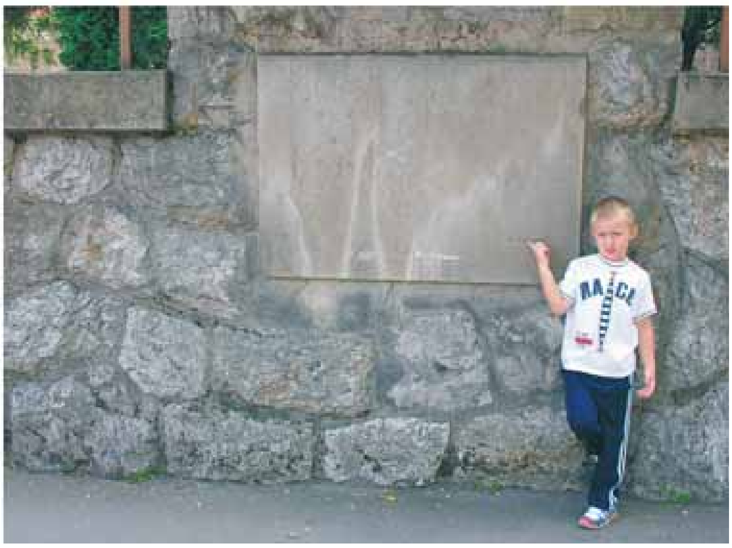
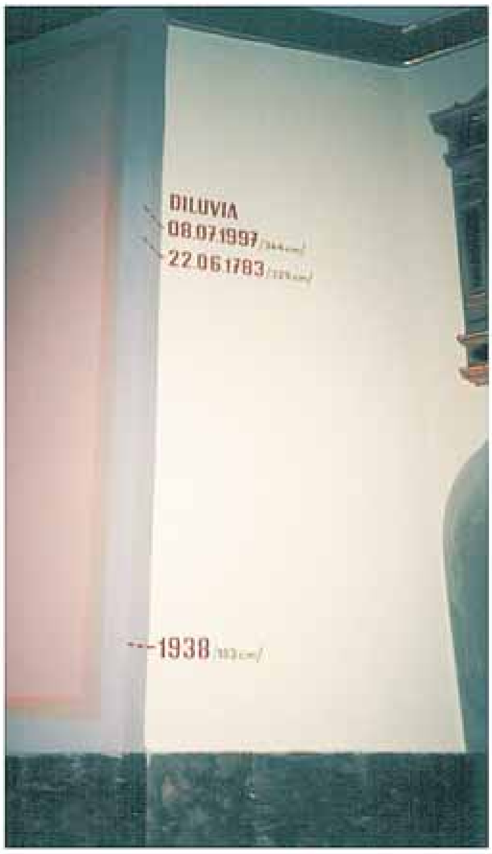
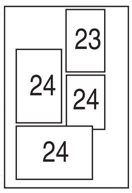


Fig. 23: The memorial cross and monument in the Polish village of Jarnoltówek commemorate the flood on the Zlotý Potok Brook in 6-8 July 1903 (Photo: M. Hrádek)

Fig. 24: The Franciscan church in the Polish town of Klodzko, in whose interior there are marks of three historical floods on the Nysa Klodzka R. in 1789, 1938 and 1997. The last disaster is commemorated also by the text on a memorial plate on the wall of the adjacent Franciscan monastery (Photo: A. Kolářová and J. Munzar)





of 329 cm), and 8th July 1997 with the culmination of 344 cm.

The last flood disaster is also reminded by a memorial plate on the wall of the Franciscan monastery on a square near the church. The inscription in Polish and English reads as follows: *"AD 1997 July 7th Klodzko was destroyed by a disastrous flood. Seven inhabitants died. Many other lost their entire property. The flood destroyed many historical buildings, water and power supply installations as well as other facilities. Efficient help was offered to the town by the government of the Kingdom of Sweden, represented by the prime minister Göran Persson. The inhabitants of Klodzko express their thanks to everyone who helped them in the spirit of solidarity."* The extreme flood of July 1997 is further illustrated by floodmarks from the town of Opava in Fig. 16, and from the town of Ostrava in Fig. 17.

6. Germany

Germany is one of countries that hold in esteem their history, the reminders of natural disasters being no exception. For example Glaser and Hagedorn (1990) found more than 60 floodmarks when documenting the flood disaster of 1784 in the studied part of Germany (mostly in the basins of Main, Rhein up to Cologne and partly also in the Danube R. basin). In his monograph "Klimageschichte Europas" (2001) R. Glaser pays a great attention to these floodmarks in the passages on historical floods. The systematic searching and documentation of floodmarks in the German section of the Elbe River has been carried out mainly by M. Deutsch (e.g. Deutsch 1996, 1997, 2000, 2002a, 2002b; Deutsch, Grünewald, Rost, 2006).

An example of the collection of floodmarks tracing the culmination points of historical floods for a longer period of time are those made on a house near the bridge documenting high waters on the Mulde River affecting the town of Grimma in the period from 1771 to 13 August 2002 (Fig. 25).

A rare type of the material monuments is the flood column situated in the watershed of the Unstrut River, the left-bank tributary of the Saale R., near a local road connecting the villages of Gehofen and Ritterburg (Fig. 26). In the same river catchment there are floodmarks documenting two flood disasters in 1784 and 1799 affecting the town of Freyburg (Fig. 27). House No. 32 in the Wasserstrasse St. bears a floodmark documenting the water level from February 1784 at a height of 35 cm above the today's street level, and some 70 cm above it, directly below the window, there is a mark for the culmination level of the Unstrut R. in March 1799. Historical floods on the Saale River that affected the town of Halle are documented by varios floodmarks. One old mark is situated for example on the so called „Stone-Mill/Steinmühle" (Fig. 28).

The collection of floodmarks from the Pillnitz manor house near Dresden is very important for the chronology of historical floods directly on the Elbe River (see e.g. U. Grünewald in Munzar, Deutsch, Elleder, 2005).

An example of innumerous floodmarks preserved in the Rhein River basin may be a set on the house situated on the Mosel R. (the left-bank tributary of the Rhein R.) embankment in Winningen (Fig. 2b). The small town is situated about 10 km upstream the confluence of these rivers in Koblenz.

7. Austria

Diligent care paid to the material reminders of floods in Austria can be documented for example by marks in the town of Schärding on the Inn River (Fig. 29) providing an evidence of high waters occurring in 1598-1954 (Strobl, Haimerl, 2003).

The epigraphical relic from Salzburg (Fig. 30) is a report from 1580 about the plague epidemic in May 1571 and devastating flood disaster in July 1572. The German inscription on the marble plate reads among other things as follows: *In (15)72, exactly on 5th July, the rain started at 3 o'clock in the morning. Until the day 8 in that month the rain had lasted seventy hours without a break and a bridge was totally destroyed, 13 houses and stables were washed away. Salzburg suffered a great damage. And the Salza(ch) River was running so strong that it rised above this stone ...*

In the catchment of the Kamp R., the left-bank tributary of Danube R., there is a floodmark on the mansion flour mill in Grafenegg showing the water level culmination in 1803 (Fig. 31) that was not tided over even during the summer flood of 2002 (Wiesbauer, 2003).

A relatively large amount of historical floods on the Danube River from different localities in Austria is documented by photographs in the publication *Beiträge zur Hydrographie Österreichs*, Heft 9 from 1908. Although the volume was devoted to the protection of Vienna from floods on the Danube R., it surprisingly does not contain a single photograph of floodmarks situated in the Austrian capital. A table mentions the existence of 3 floodmarks from 1830 (of those 2 floodmarks in the area of Augarten Park and 1 floodmark in the 9th district in Badgasse), surprisingly enough, none of them has been aligned.

Fig. 25: Flood marks for various historical floods at a bridge of German town Grimma on the Mulde R. (Photo: D. Haase)

Fig. 26: A flood column replica between German villages Gehofen and Ritteburg in Thuringia on the side channel of the Ustrut R. with the marking of three historical floods (Photo: M. Deutsch)

Fig. 27: Flood-marks in Freyburg / Unstrut R. (Germany, Saxony-Anhalt) shows the catastrophic water level during the winter-floods in 1784 and 1799 (Photo: M. Deutsch)

Fig. 28: The old Stone-Mill (Steinmühle) in Halle / Sa. (Germany, Saxony-Anhalt) with the reminder of disastrous flood on the Saale R. in August 1661 (Photo: M. Deutsch)

The ice flood that affected Vienna at the turn of February and March in 1830 after the extremely hard winter in 1829-30 was a Central European phenomenon and one of the greatest ice floods on the Danube R. in the 19th century (Munzar, 2000). However, it showed that there is another floodmark of this disastrous event, on the corner house of Leopoldauer Platz Square and Elpedauerstrasse St., in the town district of Leopoldau (Fig. 32). The water level height indicated by the flood mark is situated at approx. 170 cm above the pavement.

The last example from the Austrian territory is a marble tablet from the centre of Graz, in the Mariahilferstrasse St. 9 (Fig. 33) which documents the Mur R. to have had flooded the house situated at a distance of nearly 100 m from the river during the flood on 8th June 1827.

8. Conclusion

The paper documents a total amount of 33 examples of localities with floodmarks or with other epigraphical monuments from Central Europe, of which 17 were found in the territory of the Czech Republic, 4 in Slovakia, 2 in Poland, 5 in Germany and 5 in Austria.

In hydrological terms, 10 of them are situated in the Labe (Elbe) River drainage area in Bohemia, 4 in the Elbe (Labe) R. basin in Germany, and 1 in the Rhein R. watershed. The Morava River catchment area is represented by 4 localities, the Danube River drainage area being represented by 5 localities in the Austrian territory and by 4 localities in the Slovak territory. The Odra R. catchment in Moravia or in the Czech part of Silesia contains 2 localities with floodmarks or other epigraphical relics, in Bohemia (Broumov/Stěnava R.) 1 and in Poland 2 localities.

Particularly valuable are localities with records on multiple floods occurring at a greater time span. At these places it is possible to to make a certain comparison of the respective culminations (e.g. marks on the wall of the Knights of the Cross Monastery in Prague or in the town of Grimma on the house near the bridge across the Mulde River).

Very important for the reconstruction of historical flood events are floodmarks originating from the period before the beginning of hydrological measurements. A question arises in this connexion about the measure to which floodmarks from more places, relating to an actual flood event, contribute to demarcate the territorial reach of the flood.

This original documentation of historical floods by means of floodmarks and other epigraphical monuments from the viewpoint of historical geography has been continued at the present time by field research etc. A special emphasis is put on cross-border flood events on the Labe (Elbe) River, the Odra (Oder) River and in their drainage areas. However, the documentation works proceed only very slowly, namely in the territory of the Czech Republic, as old floodmarks scattered in the terrain and preserved until today are revealed more or less accidentally. It would be certainly desirable to gradually align all disclosed historical floodmarks in order to find out culmination water gauge heights in the historical times. This is however the matter of another stage of research if funds to support it can be found.

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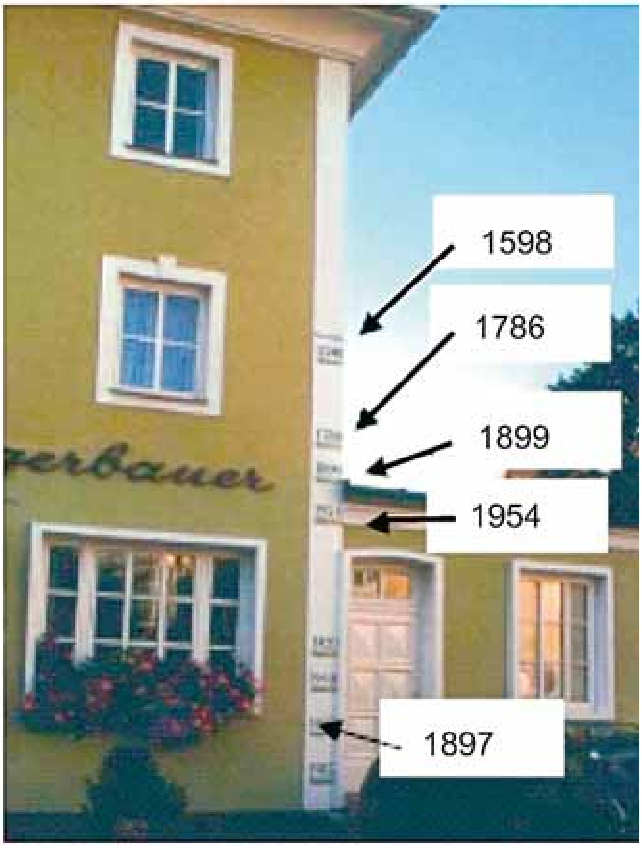
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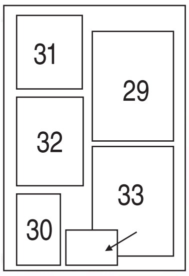
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Fig. 29: Floodmarks on a house in the Austrian town of Schärding, commemorating historical floods on the Inn River (Photo: T. Strobl and G. Haimerl)

Fig. 30: An epigraphic monument from the Austrian town of Salzburg, commemorating the flood disaster on the Salzach R. in July 1572 (www.salzburg.gv.at)

Fig. 31: The lower arrow on the manor mill in the Austrian village of Grafenegg shows the flood culmination in 2002; the upper arrow shows the water level height on the Kamp R. during the flood in 1803 (Photo: H. Wiesbauer)

Fig. 32: The water level of Danube R. during the ice flood on 1st March 1830 reached to approximately 170 cm above the pavement in Vienna-Leopoldau (www.wien-diashows.com)

Fig. 33: There is a mark in the Austrian town of Graz that shows the Mur R. water level to have reached a height of 88 cm above the present street level during the catastrophic summer-flood on 8th June 1827 (Photo: A. Prettenhofer)

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PROJECT SOCIO-SPATIAL CONSEQUENCES OF DEMOGRAPHIC CHANGES IN EAST CENTRAL EUROPEAN CITIES

Scientific project[1], supported by the Volkswagen foundation, will be realized in the period of May 2006 – April 2009. The main theoretical approaches of the project cover: theories of the European City, modernization theory related approaches, the more divergence and persistence emphasising institutional and milieu-oriented counterparts, the theory of the second demographic transition and socio-geographic district development models. The aim consists in evaluation of consequences of the post-socialist transformation for cities in East Central Europe, impact of changes in demography and households on the whole pan-European urban development and their relevance for East Central Europe.

The following questions amongst others should be answered: How far can the development of East Central European Cities be classified with the pan-European context? Where are the similarities, where the differences? How can the latter be explained? What relevance has the much cited demographic change for the urban development in East Central Europe?

The cancellation of the compact city due to urban sprawl, brownfields, socio-spatial differentiation and globalization effects is the prediction of future urban development in Europe. It shows that the post-socialist change within this process does not lead to a total convergence or to a difference of the development patterns in comparison to Western Europe. It rather creates elements of change, persistence, continuity, breaks, pre-socialist, socialist and post-socialist patterns. The question of convergence or divergence has therefore to be answered differently for different areas.

Significant and irreversible demographic changes are registered within European societies that are characterized through the unprecedented low level of fertility coupled with the increased expectation of life in advanced ages. It evokes the change of household structures as well as increasing importance of international migrations. This change impacts substantially on development in European inner cities.

It is at present completely open how the inner-city old-built up areas – under the conditions of consolidation, post-socialist property structures and actor constellations on basis of the whole city and residential area-level as well changing demographic structures – might develop in the future. Questions that should be answered in this context are e.g.: Do similar demographic and social selective revaluation and replacement processes emerge like in Western Europe and East Germany? Are there alternatives to social segregation, whether in the form of gentrification or poor neighborhoods? Which household- socio-structural and generation diversity is possible in those areas? What role play path dependencies on a small scale level?

Following hypotheses were formulated: (1) Within the inner-city old built-up areas of East Central European big cities, change in structures concerning inhabitants and households can be found. In the future, the trend of a stronger presence of new household types will continue. This process has in the relevant cities a uniqueness due to the national and local context. (2) Old built-up areas show a greater flexibility of the constructional structures and the associated possibilities of use four housing, work and every day life. That makes them attractive for new household types. (3) Of crucial importance for socio-spatial and demographic changes in the mentioned areas are the property-related structures that influence the scope for actors. (4) The interference of transformation-related changes, real-socialist persistence and a return to pre-war patterns can be proved on the meso-level of the residential areas in demographic,

[1] No. II/81150

socio-structural, property-related and symbolic respect. (5) Because of the specific background it can be assumed that in the present and the future independent, from Western experiences deviating tendencies and development patterns for inner city residential areas in post socialist cities in East Central Europe can be identified. Models for urban development processes that are related to the European level are to be extended and modified accordingly.

Case studies were chosen: Łódż and Gdańsk in Poland, Brno and Ostrava in Czechia. Other big cities in both the countries form a comparable frame. Thus, the analysis will have national and metropolitan level as well as the level of selected city parts. International conference concerning the project is to be prepared for April 2008.

The consortium is lead by the UFZ - Centre for Environmental Research Leipzig/Halle Ltd. Other participants are: Queen Mary University of London, Institute of Geography and Spatial Organization of the Polish Academy of Sciences Warsaw, University of Gdansk, Ethnological Institute of the Czech Academy of Sciences and the Institute of Geonics of the Czech Academy of Sciences.

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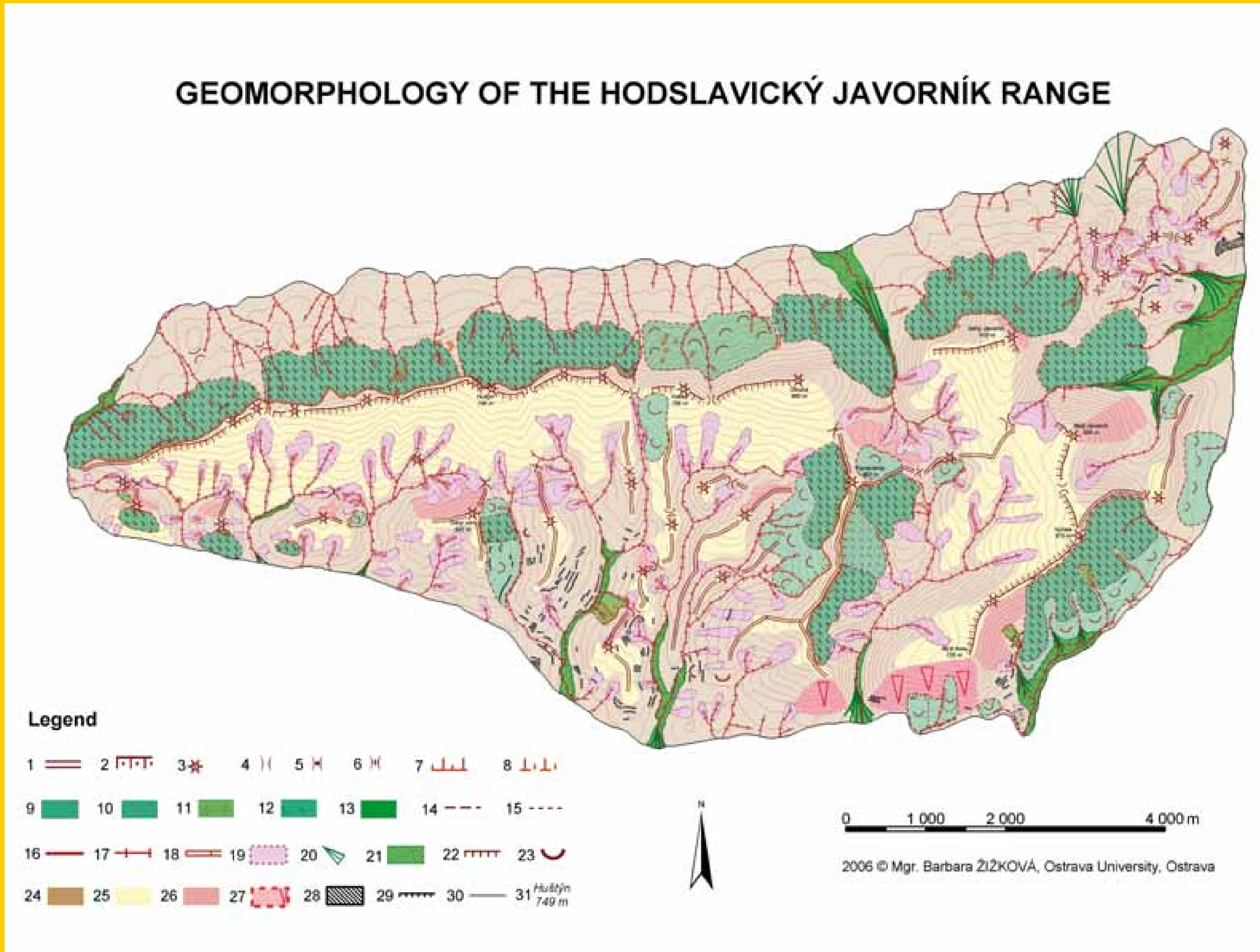
Fig. 11: The memorial near Říkov in north-eastern Bohemia on the left bank of Úpa R., the tributary of Labe R., commemorating the flood in summer 1897 (Photo: J. Habermann). Illustration to J. Munzar's et al. paper

Fig. 16: A comparison of floods in 1903 and 1997 on the Opava R., the left-bank tributary of Odra R., on a house in the town of Opava (Photo: V. Dlabola). Illustration to J. Munzar's et al. paper



Legend:
1 – erosional-denudational ridge
2 – monoclinal ridge
3 – denudational peak
4 – saddle (unsorted)
5 – saddle (windgap)
6 – saddle (dislocated)
7 – landslide scarp (morphologically pronounced)
8 – landslide scarp (supposed)
9 – landslide accumulation, not specified
10 – deep-seated gravitational slope deformation of the block type
11 – bulging
12 – creep
13 – debris flow, landslide recently active
14 – landslide boundary, first order
15 – landslide boundary, second order
16 – permanent stream, wide-open valley
17 – permanent stream, usu. cutting through bedrock, sharp V-shaped valley
18 – gully, temporary stream
19 – hillslope hollow, dellen
20 – alluvial fan
21 – fluvial accumulation, alluvium
22 – scarp of individual blocks, pronounced in relief
23 – small landslide (one side less than 50 m)
24 – erosional-denudational slope
25 – structurally-determined slope
26 – slope located at the outer escarpment of the brachysyncline
27 – slope along a fault line
28 – anthropically-transformed area
29 – agrarian terrace
30 – contour (25 m)
31 – label of a peak

Fig. 2: Geomorphological map of the Hodslavický Javorník range. ArcGIS 8.3
Illustration to B. Žižková, T. Pánek's paper.