

## TREŚĆ

Jan Dylík (reprint) Rozwój myśli badawczej w łódzkim ośrodku geomorfologicznym (resumé: Développement des recherches géomorphologiques à Łódź) .....	9
Danuta Dzieduszyńska Stan wiedzy o późnym vistulianie w regionie łódzkim (summary: State of knowledge about the Late Vistulian (Weichselian late glacial) in the Łódź Region) .....	25
Danuta Dzieduszyńska, Jacek Forysiak Sygnały zmian środowiskowych późnego vistulianu w archiwach biogenicznych regionu łódzkiego (summary: Signals of environmental changes of the Late Vistulian (Weichselian late glacial) in biogenic sediments of the Łódź Region) .....	37
Piotr Kittel Geomorfologiczne uwarunkowania lokalizacji osadnictwa na przykładzie doliny Rawki w Rawie Mazowieckiej (summary: Geomorphologic conditions of settlement location: case study in the Rawka River Valley in Rawa Mazowiecka) .....	49
Krystyna Milecka Wyniki analizy pyłkowej osadów organicznych z doliny Rawki (summary: Results of pollen analysis of organic deposits in Rawa Mazowiecka) .....	81
Daniel Okupny, Anna Fortuniak, Julita Tomkowiak Cechy denudacji w regionie łódzkim w późnym vistulianie w świetle chemicznych badań w osadach torfowiskowych (summary: Denudation features of the Late Vistulian (Weichselian late glacial) preserved in the geochemical analysis of the biogenic deposits of the Łódź Region) .....	89
Joanna Petera-Zganiacz Zapis procesów peryglacialnych i wień szczelin kontrakcji termicznej w południowo-zachodniej części poziomu katarzynowskiego (Polska Środkowa) (summary: Record of periglacial processes and age of the thermal contraction structures in the southwestern part of the Katarzynów Level (Central Poland) .....	101
Krystyna Turkowska Rozważania nad dziedzictwem myśli badawczej Jana Dylíka w Katedrze Badań Czwartorzędu w latach 1994–2012 (summary: Reflections on the legacy of research idea of Jan Dylík in the Department of Quaternary Research (Łódź University) between 1994–2012) .....	117
Jadwiga Wieczorkowska Walewice – niezrealizowany projekt Profesora Jana Dylíka (summary: Walewice – Professor's unrealized project) .....	129
Aneks Krystyna Turkowska Historia i główne problemy badawcze Katedry Badań Czwartorzędu Uniwersytetu Łódzkiego .....	139

## STAN WIEDZY O PÓŹNYM VISTULIANIE W REGIONIE ŁÓDZKIM

### ZARYS TREŚCI

Artykuł przedstawia stan rozpoznania paleogeograficznego późnego vistulianu w regionie łódzkim. Dla środowisk sedymentacyjnych: fluwialnego, stokowego i eolicznego, wyróżniono tendencje przebiegu agradacji i degradacji oraz scharakteryzowano zachowane dowody geologiczne i morfologiczne. Procesy morfogenetyczne zostały odniesione do globalnych, szybkich zmian klimatycznych okresu przejściowego plejstocen-holocen i zróżnicowanych warunków lokalnych. Zwrócono uwagę na niejednorodność stosowania terminu „późny vistulian”, zależnie od podziału stratygraficznego bądź dla obszarów glacialnych, bądź ekstraglacialnych. Podkreślono postęp, jaki dokonał się w rejestracji świadectw późnego vistulianu. W kontekście przyrastającej ilości danych z badań interdyscyplinarnych rysuje się możliwość konstrukcji regionalnego modelu rozwoju środowiska.

**Słowa kluczowe:** schyłek plejstocenu, środowiska morfogenetyczne, paleogeografia, chronostratygrafia, denudacja, agradacja

## STATE OF KNOWLEDGE ABOUT THE LATE VISTULIAN (WEICHSELIAN LATE GLACIAL) IN THE ŁÓDŹ REGION

### SUMMARY

**Abstract.** The article presents the palaeogeographical recognition of the Late Vistulian in the Łódź Region. For three sedimentary environments – fluvial, slope and aeolian – tendencies of aggradation and degradation have been identified and preserved geological and morphological evidences have been characterized. Morphogenetic processes have been related to global climatic changes of the Pleistocene-Holocene transition and varying local conditions. Attention was drawn to non-uniformity in the application of the term “Late Vistulian”, depending on the stratigraphical division, or to glacial or extraglacial areas. The progress that has been made in the registration of the Late Vistulian processes is emphasized. In view of the increasing data of interdisciplinary research, the construction of a regional model for the environmental development is possible in the nearest future.

**Key words:** Pleistocene decline, morphogenetic environments, palaeogeography, chronostratigraphy, denudation, aggradation

The article draws attention to the Vistulian decline in which there was a transformation from the periglacial realm into moderate conditions as well as to the environmental implications of the rapid climatic changes. Also, an attempt to show the important palaeogeographical role of the Late Vistulian in the Łódź Region in the light of recent stratigraphical and environmental interpretations was made.

The term Late Vistulian refers to different time framework. In the stratigraphical divisions for extraglacial areas, so to the discussed area, it is an equivalent of the “late glacial” that started from the Pomeranian Phase ice sheet retreat. On the basis of records from Central Poland, the Late Vistulian encompasses three warm units – Kamion Phase, Bölling, Alleröd – and three cool units – Oldest Dryas, Older Dryas and the longest and coldest, Younger Dryas (GS-1 in the Greenland stratigraphy).

Climatic conditions of the Late Vistulian are reconstructed in the Łódź Region from the palaeoecological data and geologic record. There are known only two palynological profiles covering the entire period, Witów and Żabieniec. Also from two sites, Żabieniec and Koźmin Las, chironomid-based quantitative inferences of mean summer temperatures are provided. This contribution is the first one based on this index for the Late Vistulian time available in Poland. The Late Vistulian morphogenetic processes took place under conditions of permafrost disappearance. Its reactivation in the Younger Dryas cold spell still remains in doubt. Studies

provide some basis for the conclusion that ice wedges might have been present and seasonal or at least local permafrost conditions are suggested from flat-bottomed involutions. The Late Vistulian left legible changes in the geology and landscape of fluvial, slope and aeolian sedimentary environments.

In river valleys this time period in the Łódź region is considered as dominated by tendency to erosion, which resulted in the morphological emergence of the Plenivistulian terrace. This erosion was responsible for transformation in the river network, such as the changes of a river course or the elongation of the valley axes due to headward cutting. The channel pattern and tendency shows diversity, depending largely on local conditions. The cooling of the Younger Dryas caused an increase in bedload and a tendency to intensified braiding or multichanneling or no change has been registered. In the valleys of Mroga and Warta Rivers aggradation resulted in the formation of the terrace step.

The leading hillslope process during the Late Vistulian was slopewash. The sedimentary archives point to the formation of the series of thinly laminated deposits that are the uppermost periglacial unit of the dry valleys of the region. In the Younger Dryas the material transported along a slope was accumulated on the snow, while a snow decay caused discontinuous disturbances of the series (so-called over-snow deposits). The most vulnerable for slopes processes were east- and north-facing slopes.

The Late Vistulian evolution of the aeolian sedimentary system is one of the best recognized in the region. The sands were derived from broad aggradational plains of Plenivistulian braided rivers, gradually drained as a result of a positive balance of erosion. Three phases of the formation of inland dunes: the initial phase completed with the accumulation of aeolian patches (Oldest Dryas), the main phase of the formation of parabolic dunes (Older Dryas) and the dune transformation phase (Younger Dryas). Deposition of sand in the form of aeolian hillocks was interrupted with the initial soil-forming processes.

## **SYGNAŁY ZMIAN KLIMATYCZNYCH PÓŹNEGO VISTULIANU W ARCHIWACH BIOGENICZNYCH REGIONU ŁÓDZKIEGO**

### **ZARYS TREŚCI**

W ostatnich latach znacząco zwiększyła się ilość danych będących źródłem informacji na temat środowiska późnego vistulianu. Jest to rezultat zwiększonego zainteresowania badaniami osadów biogenicznych, zawierających szczątki organiczne pozwalające na rekonstrukcję warunków środowiska przyrodniczego. Cennym naturalnym archiwum są te profile ze zbiorników akumulacji biogenicznej, w których zarejestrowana została zmienność tego okresu zarówno pod względem ekologicznym, jak i zróżnicowania procesów morfogenetycznych. W artykule przedstawiono stanowiska regionu łódzkiego posiadające najpełniejszą dokumentację, opracowaną w ramach badań interdyscyplinarnych. Zwrócono uwagę na możliwości rekonstrukcyjne parametrów środowiska, jaką dają poszczególne analizy paleośrodowiskowe. Wskazano na przewagę stanowisk Polski Środkowej, w stosunku do stanowisk strefy młodoglacjalnej, spowodowane wcześniejszym rozpoczęciem cyklu akumulacji biogenicznej.

**Słowa kluczowe:** naturalne archiwa, rekonstrukcja środowiska, badania interdyscyplinarne, paleogeografia, Polska Środkowa

## **SIGNALS OF ENVIRONMENTAL CHANGES OF tHE late vistulian (WEICHSELIAN LATE GLACIAL) IN BIOGENIC SEDIMENTS OF THE ŁÓDŹ REGION**

### **SUMMARY**

**Abstract.** In recent years, the amount of data, which yield information on the environment of the Late Vistulian, significantly increased. This is a result of increased interest of analyses of biogenic deposits, containing organic remains which allow to reconstruct past environmental conditions. A valuable archive are these profiles of biogenic sediments in which variation in terms of both ecology and morphogenetic processes has been registered. The article overviews these sites of the Łódź region which provide the most complete record and were analysed within the framework of interdisciplinary studies. Attention is drawn to the possibility to reconstruct environmental parameters that give the individual paleoecological analyses. It was pointed that the sites of the Central Poland have an advantage over those from the young morainic area, due to the earlier start of the bioaccumulation.

**Key words:** natural archives, reconstruction of past environments, interdisciplinary research, palaeogeography, Central Poland

Recent years have brought an increase in the amount of data from which the environmental reconstruction of the Late Vistulian can be obtained. Because of the location of the Łódź Region within the old morainic area, there is no lake deposits with well-preserved annual lamination, enabling the high resolution studies and reconstruction of environmental changes in calendar years. Signals of these changes for the Late Vistulian time are preserved in biogenic sediments of peatbogs and small, shallow lakes. Time resolution is here obtained by means of sampling compaction.

The article is focused on the review of the results obtained so far from interdisciplinary studies of biogenic sediments of peatbogs, fossil lakes and marshes of the Łódź Region, deposited during the Late Vistulian warming. These are:

- Witów site – the first in the region where interdisciplinary studies of Late Vistulian biogenic sediments were applied and to this day is of the basic importance to the palaeogeography;
- peatbogs in the Świętojanka valley where Late Vistulian lacustrine sediments are underlain by peat horizon;

- Rąbień peatbog located in a fossil depression closed by dunes, in which the complete Late Vistulian series is present;
- Ner-Zawada peatbog, with the overdepenning at the substratum, and lacustrine sediments resting on peat;
- Żabieniec peatbog located within the depression in the morainic plain, it contains whole Late Vistulian sequence of sediments;
- Koźmin Las site located in the Warta River valley, with in situ remnants of the Late Vistulian riparian forest.

Presented sites are located in a variety of morphological positions and in different parts of the Łódź Region, which is advantageous from the point of view of palaeogeographical studies. Sites from river valleys or aeolian complexes or situated on plains offer slightly different, typical of a given morphological zone, course of Late Vistulian climatic changes and morphodynamic processes. The most valuable are these research carried out at the sites of the largest thickness of sediments (Żabieniec) or where the uniqueness of remains allows to carry out the overstandard set of analyses (Koźmin Las).

When accumulation is continuous, registration of chronological sequence of events verifies reconstructions based on partly preserved mineral series of other sedimentary environments subjected to erosion and denudation. Correlation of the results of interdisciplinary studies from the natural archives with geological and geomorphological evidence from other sedimentary environments, imposed on the regularities governing the evolution of the Łódź Region, leads to a detailed description of the functioning of the Late Vistulian environment and to recognition of the importance of this period in the morphogenesis of the last cold stage in the old glacial area of Poland.

## GEOMORFOLOGICZNE UWARUNKOWANIA LOKALIZACJI OSADNICTWA NA PRZYKŁADZIE DOLINY RAWKI W RAWIE MAZOWIECKIEJ

### ZARYS TREŚCI

Artykuł przedstawia wyniki badań geomorfologicznych warunków lokalizacji dwu stanowisk archeologicznych w Rawie Mazowieckiej położonych w dolinie Rawki. Ślady osadnictwa datowane są na obu stanowiskach na pradzieje i czasy historyczne, a główna faza osadnicza przypada na koniec okresu przedrzymskiego i wczesny okres rzymski. Stanowiska ulokowane zostały na piaszczystym i mułkowo-piaszczystym podłożu budującym terasę plenivistuliańską, w bardzo bliskim sąsiedztwie równiny zalewowej. Powierzchnie zajmowane przez osiedla były słabo nachylone – nie więcej niż  $3^\circ$ , zwykle ok.  $1^\circ$ . Istotna jest lokalizacja osiedli kompleksu w obszarze oferującym wysoką georóżnorodność. Przedstawiono zasadnicze etapy ewolucji i rozwoju doliny

Rawki w Rawie Mazowieckiej, a także relacje punktów osadniczych rozpoznanych okresów chronologicznych z elementami morfologicznymi doliny. Wykonano szacunki rozmiarów potencjalnej populacji, która była w stanie uzyskać dostateczną ilość produkcji roślinnej w warunkach pradziejowej gospodarki rolnej.

**Słowa kluczowe:** uwarunkowania lokalizacji osadnictwa, okres rzymski, pradzieje, dolina rzeczna, Polska Środkowa

## GEOMORPHOLOGIC CONDITIONS OF SETTLEMENT LOCATION: CASE STUDY IN THE RAWKA RIVER VALLEY IN RAWA MAZOWIECKA

### SUMMARY

**Abstract.** Paper presents results of research on morphologic conditions of location of two archaeological sites in Rawa Mazowiecka in the Rawka River valley. Settlement uncovered at sites is dated to the Prehistory and to the Historic Times with main chronologic phase dated to the Late Pre-Roman Period and the Early Roman Period. Sites were located on the sandy and sandy-silty areas of the Plenivistulian terrace in a very close vicinity of flood plain. Surface occupied by settlements were very slightly inclined – no more than  $3^\circ$ , usually ca.  $1^\circ$ . It is significant a location of settlements complex in the area offering a high geodiversity. The mine stages of evolution and development of the Rawka River valley in Rawa Mazowiecka are presented and also relation between settlements of recognised chronologic periods and morphologic elements of the valley. The estimation of size of the highest population, which could produce sufficient quantity of plant food in the prehistoric economy condition was undertaken.

**Key words:** conditions of settlement location, Roman Period, Prehistory, river valley, central Poland

Multicultural settlement complex in Rawa Mazowiecka is located in the Rawka River valley, on both sides of the wide valley floor. Settlement in subsequent periods willingly come back to the studied area, which proves its significant economic attractiveness of the settler. In the study of human-environment relations have long emphasized the connection of prehistoric and historic settlement areas to concave relief forms, especially to medium-sized river valleys.

Surface sediments were documented in a series of geological outcrops and soundings. Geological and geomorphological observations studies were continued during archaeological fieldwork at archaeological sites. In the valley floor, outcrop within a palaeochannels of the Rawka River were established. Deposits of sub-fossil palaeochannels were studied with lithology of deposits, geochemistry and pollen analysis. Some samples of organic sediments have been dated by radiocarbon method. Part of layers have been dated with archaeological method also. The filling of the palaeochannels of the Rawka River started from the beginning of Subatlantic Period (530–380 BC) and the Rylka River in the same time (620–400 BC). The topmost series of the palaeochannel fill with fragments of bricks have been deposited since the Late Middle Ages.

The Rawka Valley is clearly cut into the surrounding plateau of 165 metres of altitudes. Height differences between the modern valley floor and the surface of morainic plain reach 25 m. In the area of Rawa Mazowiecka, the Vistulian terrace reaches a large horizontal extent. Width terraces surrounded archaeological site no 3 is about 450–550 metres and site no 38 – less than 200 m. Terrace's average extends to the north. It reaches a altitude of 136–148 metres in the area of archaeological sites and its surface is inclined to the axis of the valley. Valley in this area is clearly asymmetric – the eastern slope of the valley is long and more gentle. The thickness of the deposits of Vistulian terrace reaches 10 m. The valley floor of the Rawka River and Rylka River is elevated today to about 135–135.5 m a.s.l. It is composed of Holocene and Late Vistulian deposits. Today the valley reaches 150 m width in the sites area and its width increases significantly towards the north, to more than 500 m and extends to the south of the archaeological sites and about 350 m.

Analysis of the position of settlement points in relation to contemporary valley elements were carried out. Traces of episodic camps of hunter-gatherer populations of the Late Paleolithic were located on the high eastern valley slope (site no. 38), about 7–8 metres above the valley floor, formed by the meandering river. The valley floor was at an altitude of 134.0 m in the Atlantic Period and channels have been cut to about 3 metres in Late Vistulian and early Holocene alluvium. Episodes of settlement activity related to the Mesolithic population are connected with this period. Not identified deposits and forms that can be correlated with the Subboreal Period in which the settlement functioned the Funnel Beaker culture and Early Bronze Age people. In the pre-Roman Period and probably also in the Roman Period, in the valley floor a shallow oxbow occurred, filled by organic mud and peat. The valley floor was situated in the Roman Period at about 134–134.5 m a.s.l. and built with overbank sandy-silty deposits. Failed to confidently reconstruct the course of that time channels of Rawka River and Rylka River. Unable to locate also channel in the Middle Ages and in the Modern Era, it was able to proceed in the area of today's trough. Accumulation of overbank cover with thickness of 1.5 m and dated to the Modern Times resulted in a mounted and enhance the floodplain to about 135–135.5 m and covering of the ancient Late Vistulian low terrace. Modern control of Rawka River channel conducted in the 1824–1827 AD.

Settlement complex in Rawa Mazowsze was located in the area marked by significant geodiversity. Settlements were located on slightly inclined surfaces (up to 3–4°). Substrate of major parties of the prehistoric settlements built of sandy sediments. Site no. 3 was located on the surface of the Vistulian terrace formed of sand and gravel. Site no. 38 was established on the slope of valley and narrow part of the Vistulian terrace. The sandy and sandy-mud deposits of terraces and relatively shallow groundwater table create a favorable area for the cultivation of grain in the “light of agricultural” technology. The valley floor could be used in the horticultural crops. The undertaken estimation of size of the highest population, which could produce sufficient quantity of plant food in the prehistoric economy condition was based on morphologic analysis of surroundings of site no. 3. The size of population occupying area of Rawa Mazowiecka sites vicinity has been estimated on about 150–160 people.

Vistulian terraces created, especially in the old glaciated areas, exceptionally favorable conditions for locating prehistoric and early historic settlement. Sandy and sandy-mud deposits of terraces were excellent substrate for the cultivation of economic development. The settlement, which focuses on the slopes or on the terrace bend, obtain an easy access to the valley floors. Morphologically and geologically varied river valleys were, and still are, very attractive settler geodiversity area.

## WYNIKI ANALIZY PYŁKOWEJ OSADÓW ORGANICZNYCH Z DOLINY RAWKI

### ZARYS TREŚCI

Opracowanie dostarcza informacji dotyczących tła środowiskowego osadnictwa ostatnich około trzech tysięcy lat w dolinie Rawki w środkowej Polsce. Analizy archeologiczne osadów w dolinie rzeki wykonano w ramach prac ratowniczych przed realizowaną inwestycją budowy obwodnicy Rawy Mazowieckiej. Osady organiczne pobrane z profilu wykopu archeologicznego wykorzystano do badań metodą analizy pyłkowej. Pozwoliły one na odtworzenie roślinności w otoczeniu stanowiska badań oraz wyznaczenie faz aktywności człowieka.

**Słowa kluczowe:** analiza pyłkowa, dolina rzeczna, Rawa Mazowiecka, historia szaty roślinnej, antropopresja

## RESULTS OF POLLEN ANALYSIS OF ORGANIC DEPOSITS IN RAWA MAZOWIECKA

### SUMMARY

Abstract. This article gives environmental background of settlement within the last ca 3000 years in Rawka valley, central Poland. Archeological investigations were initiated before an expressway and ring road for the town Rawa Mazowiecka construction. Samples of organic sediments were taken from the archeological profile and used for pollen analysis. Palynological diagram shows vegetation development and revealed three phases of human impact.

**Key words:** pollen analysis, river valley, Rawa Mazowiecka, vegetation history, human impact

An archeological investigations were initiated before an expressway and ring road for the town Rawa Mazowiecka construction. Within the river valley traces of a few settlements were found dated for Przeworsk Culture (the most important one), early Middle Ages, Middle Ages and historical times. On the other slope of the valley traces of earlier human activity were identified: end of Paleolithic, Mesolithic, Neolithic and Bronze Age. Samples of organic sediments were taken in 2005 from the archeological profile and used for pollen analysis. It gives an environmental background of settlement within the last ca 3000 years. Two main stages of regional forest development were recorded: mixed, deciduous forest with oak, hornbeam and lime and then high proportion of pine forest. Local forest communities within the river valley consist of alder, elm, ash and willows (*Ficario-Ulmetum* Knapp 1942, *Salicetum albo-fragilis* R.Tx. 1955 and *Populetum albae* Br.-Bl. 1931). A record of abundant carrs and forests with high proportion of *Salix* and *Populus* were found in older part of the diagram. Younger layers of sediments accumulated during stronger human activity and less natural ecosystems functioning. Due to the presence of human activity indicators three stages of anthropopressure were recorded. In the first and second phases ruderal and pasture plants dominated. Third phase shows increasing role of cultivation, as pollen of cereals, in them a lot of *Secale* were found. C14 dating shows accumulation of analysed sediments from the third millennium BP up to historical times.

## **CECHY DENUDACJI W REGIONIE ŁÓDZKIM W PÓZNYM VISTULIANIE W ŚWIETLE CHEMICZNYCH BADAŃ OSADÓW TORFOWISKOWYCH**

### **ZARYS TREŚCI**

Przedstawiono charakterystykę geochemiczną wybranych torfowisk regionu łódzkiego (Ługi, Podwódka i Rąbień). Celem pracy jest określenie typów i natężenia denudacji w zlewni badanych zbiorników w późnym vistulianie. Miąższość udokumentowanych osadów biogenicznych wynosiła: 2,66 m (profil R-3), 3,0 m (profil Ł-1) oraz 4,75 m (profil P-1). Badania geochemiczne obejmowały oznaczenie podstawowych składników tych osadów, tj. materię organiczną, węgiel wapnia, krzemionkę terygeniczną i biogeniczną. Metodą spektrometrii absorpcji atomowej oznaczono pierwiastki pomocne w rekonstrukcji paleogeograficznej: Na, K, Ca, Mg i Zn. W analizie przemian typów denudacji zlewni, jakie panowały podczas depozycji osadów, wykorzystano wskaźniki geochemiczne odzwierciedlające najważniejsze zmiany w proporcjach oznaczonych elementów.

**Słowa kluczowe:** torfowisko, osady biogeniczne, geochemia, denudacja, Polska Środkowa

## **DENUDATION FEATURES OF THE LATE VISTULIAN (WEICHSELIAN LATE GLACIAL) PRESERVED IN THE GEOCHEMICAL ANALYSIS OF THE BIOGENIC DEPOSITS OF THE ŁÓDŹ REGION**

### **SUMMARY**

**Abstract.** The paper presents the geochemical description of selected peatlands of the Łódź region: Ługi, Podwódka and Rąbień. The aim of this study is evaluation of the type and intensity of the Late Wechselian processes in the peatland catchment. The thickness of the document biogenic sediments in the profiles analyzed was: 2,66 m (core R-3), 3,0 m (core Ł-1) and 4,75 m (core P-1). The objective of the geochemical analyses of the above peatlands was identification of basic components of biogenic sediments, i.e. organic matter, calcium carbonate, terigenous and biogenic silica. In the resulting solution, elements helpful in palaeogeographical reconstruction were identified by the method of atomic absorption spectroscopy: Na, K, Ca, Mg and Zn. The analysis of types of denudation in the catchment following geochemical indices reflecting the most important changes in contribution of marked elements.

**Key words:** peatland, biogenic deposits, geochemistry, denudation, Central Poland

This paper presents the results of geochemical analyses of peat sediments in three peatlands: Ługi (Warta River Valley), Podwódka (Szczerców Basin) and Rąbień (Łask Plain) (Fig. 1). The objective of the geological and geochemical analyses of the above peatlands was to reconstruct the denudation intensity. The works included:

- mapping of the biogenic accumulation reservoirs. Three biogenic sediment cores were also taken by means of an Instorf corer;
- sampling in laboratory conditions; the cores were divided into sections with a length from 1 cm (at high lithofacial differentiation of sediments) to 2.5 cm (in the case of homogenous sediment). A total of 393 biogenic sediment samples were taken from the cores: 153 from the core from peatland of Ługi, 96 from the core from peatland of Podwódka and 144 from the core from peatland of Rąbień.

The thickness of peat varied from 2,66 m (R-3 core), 3,0 m (Ł-1 core) to 4,75 m (P-1 core). Three hundred ninety three sediment samples were subjected to the following analyses: loss on ignition at 550 °C and the amount of carbonates by means of the Scheibler volumetric method. In this ash, the content of biotic and terigenous silica in the deposits was estimated by removing components soluble in HCl and KOH. For one hundred ninety sediment samples were determined five elements: Na, K, Ca, Mg and

Zn. The proportions of these compounds can be used to classify biogenic deposits and to reconstruct denudation change in the peatland catchment (Fig. 2). The analysis of transformations of type of denudation in the catchment occurring during the sediment deposition applied the content of mineral matter and lead, and the following geochemical indices reflecting the most important changes in contribution of selected elements. The relation of the content of sodium to potassium, and content of calcium to magnesium declared indicators of the type of mechanical and chemical denudation in the peatland catchment.

The chemical composition of the documented biogenic sediments permitted distinguishing of periods with increased allochthonous supply of mineral matter and lipophilic elements in the Oldest, Older and Younger Dryas. Deposition of the calcium elements constitutes a record of increased chemical denudation in the catchment in the Epe, Alleröd and Bölling warming.

**ZAPIS PROCESÓW PERYGLACJALNYCH I WIEK SZCZELIN KONTRAKCJI  
TERMICZNEJ W POŁUDNIOWO-ZACHODNIEJ CZĘŚCI  
POZIOMU KATARZYŃOWSKIEGO (POLSKA ŚRODKOWA)**

**ZARYS TREŚCI**

Przeanalizowano ślady środowiska peryglacialnego zapisanego w osadach, takie jak struktury kontrakcji termicznej czy poziom kamienisty. Badania przeprowadzono na stanowisku Rosanów położonym w strefie krawędziowej Wyżyny Łódzkiej, w obrębie poziomu katarzyńskiego. W budowie geologicznej stanowiska dominują glacialne piaski gliniaste, zdeponowane podczas stadiału warty, w których powstały różne struktury deformacyjne. Część struktur została zinterpretowana jako szczeliny kontrakcji termicznej z pierwotnym wypełnieniem piaszczystym. Typ pozostałych struktur określono jako dajki klastyczne. Analiza cech teksturalnych utworów budujących podłoże dla struktur kontrakcji termicznej oraz wypełniających te struktury pozwoliła na ocenę oddziaływania środowiska peryglacialnego na osady. Zastosowanie datowania termoluminescencyjnego nie okazało się pomocne podczas określenia wieku badanych osadów i struktur. Wiek klinów z pierwotnym wypełnieniem piaszczystym określono przede wszystkim na podstawie ich relacji z poziomem kamienistym.

**Słowa kluczowe:** szczeliny kontrakcji termicznej, analiza teksturalna, datowania TL, Polska Środkowa

**RECORD OF PERIGLACIAL PROCESSES AND AGE OF THE THERMAL  
CONTRACTION STRUCTURES IN THE SOUTHWESTERN PART  
OF THE KATARZYŃÓW LEVEL (CENTRAL POLAND)**

**SUMMARY**

**Abstract.** The occurrence of periglacial processes in the past is possible to reconstruct on the base of evidences such as thermal contraction structures or stone pavement. Textural properties of deposits can also deliver important information. Investigations was carried in Rosanów site, located on the Katarzyńów level – one of the levels of the edge-zone of the Łódź Plateau. In the study area sand till as host sediment of deformational structures occur. Some of the structures has typical features of the sand-wedge casts, the other were interpreted as clastic dikes. Textural analysis of the host sediments and deposits, which fill thermal contraction structures allow to evaluate impact of periglacial environment on deposits. Thermoluminescence dating of host deposits, infilling of sand wedges and covering aeolian sand gives very similar results, so the age of structures was establish by the indirect indicators.

**Key words:** sand wedges, textural analysis, TL dating, Central Poland

Thermal-contraction cracks are the most important evidence of permafrost occurrence. These structures have been reported all over extraglacial area of glacial periods in the Pleistocene. Nowadays it is possible to observe modified structures due to thawing of permafrost, such as ice-wedge pseudomorph or sand-wedge cast (thermal contraction structures with primary sand infilling). The most common are ice-wedge pseudomorphs, which occur in different types of sediments and geomorphological situations. The sand-wedges appear rarely, usually in the uplands and they are associated with the stone pavement, which is regarded as a level of stratigraphical significance. A lot of authors claim that the most favorable conditions for cracking and stone pavement formation occurred during the coldest period of Vistulian, and that phenomena was synchronous.

The study area is located in central Poland, about 15 km north of Łódź. The terrain was last time covered by the ice sheet during the Wartanian Stage. The Vistulian Glaciations was an ice-free period there. During the Wartanian, the edge-zone of the Łódź Plateau developed as system of step-like levels between the plateau and Warsaw-Berlin ice-marginal streamway. The edge-zone is built from glaciogenic

deposits, usually strongly deformed due to glaciotectonics. Moreover, the characteristic feature of the area is the occurrence of numerous dry valleys which cut the slopes of the levels and dunes developed in the surfaces of the levels. The Rosanów site is situated in the third level – the Katarzynów level, on altitude of 154,3 m a.s.l.

In the investigated site, on the depth of 1–2 m the sand till was documented. The glacial deposits in places are covered by about 1–0,5 m vary grained sediment, developed probably due to con-gelifluction. On the depth of several centimeters, continuous pavement occurs, which consist of gravels including large clasts, on the surface of some grains effects of wind-abrasion are visible. In the top part of the profile aeolian sand was documented. The aeolian unit is continuous and about 1 metre thick.

In the glacial deposits of the lower unit, large wedge-shaped structures occur with following features: very clear, not deformed outline, V-shaped and visible vertical lamination of infilling sand. This characteristic suggests that structures originated as wedges with primary sand infilling. One of the structures was interpret as composite wedge cast. The granulometric properties of deposit are typical for infilling of the sand wedges in Central Poland. Results of quartz grain abrasion analysis point to aeolian origin as well. In the investigated site numerous vertical clastic dikes occur. Thermoluminescence dating of host deposits, infilling of sand wedges and covering aeolian sand give very similar results, so the age of structures was establish on the indirect indicators, as relation to the stone pavement, and conclusion was supported by textural analysis of deposits.

## ROZWAŻANIA NAD DZIEDZICTWEM MYŚLI BADAWCZEJ JANA DYLIKA W KATEDRZE BADAŃ CZWARTORZĘDU W LATACH 1994–2012

### ZARYS TREŚCI

Rozważania odniesiono do koncepcji programowej Profesora Jana Dylika, przedstawionej w artykule *Rozwój myśli badawczej w łódzkim ośrodku geomorfologicznym*, którego przedruk rozpoczyna niniejszy zeszyt. Wybrano cztery tematy (geomorfologia dynamiczna, utwory pokrywowe jako świadectwo morfogenezy peryglacjalnej, kartowanie geologiczne i wykorzystanie map geologicznych do interpretacji paleogeograficznych oraz kartowanie geomorfologiczne i mapy geomorfologiczne w różnej skali), w zakresie których rozważono dowody kontynuacji i negacji idei Jana Dylika. Wykazano, że problematyka dominująca w okresie rozwoju łódzkiej szkoły peryglacjalnej w profilu badawczym Katedry Badań Czwartorzędu stanowiła już tylko jeden spośród realizowanych wątków. Sformułowany w 1958 r. program badawczy był kontynuowany na poziomie jego założeń ogólnych, rozumianych jako badania nad poligenezą rzeźby środkowej Polski. Aktualna pozostaje istota metod badawczych, określana przed laty jako geomorfologia dynamiczna, a obecnie oznaczająca wykorzystywanie coraz szerszego i nowocześniejszego wachlarza metod interdyscyplinarnych. Wyrażono opinię, że rozwój wiedzy nad zmieniającym się i zróżnicowanym przestrzennie środowiskiem morfogenetycznym obszaru jest proporcjonalny do upływu czasu.

**Słowa kluczowe:** geomorfologia dynamiczna, geomorfologia peryglacjalna, poligeniza rzeźby, metody badań czwartorzędu, badania interdyscyplinarne

## REFLECTIONS ON THE LEGACY OF RESEARCH IDEA OF JAN DYLIK IN THE DEPARTMENT OF QUATERNARY RESEARCH (ŁÓDŹ UNIVERSITY) BETWEEN 1994–2012

### SUMMARY

**Abstract.** Considerations are related to the conception of Professor Jan Dylik, presented in the article *Rozwój myśli badawczej w łódzkim ośrodku geomorfologicznym* (in Polish with French summary) from 1958, the reprint of which begins this volume. Four problems were selected (dynamic geomorphology, cover deposits as the evidence of periglacial morphogeny, geological mapping and application of geological maps to palaeogeographical interpretations, geomorphological mapping and geomorphic maps at various scales) for which the evidence of the negation of or the continuation of the J. Dylik's idea was considered. It has been shown that the leading issues of the Łódź geomorphological school were in the research profile of the Department of Quaternary Research only one of the tasks. Formulated in 1958 a research program was continued at the level of general principles, understood as the study of the polygenesis of central Poland relief. Research methods are still in use and refer to a dynamic geomorphology, but now it denotes the use of an wider and modern range of interdisciplinary methods. Expressed is opinion that the development of knowledge on the changing and diverse environment spatially morphogenetic environment, which is the heritage Professor Jan Dylik idea, is proportional to time.

**Key words:** dynamic geomorphology, periglacial geomorphology, relief polygenesis, Quaternary research, interdisciplinary studies

Consequences of research ideas of Professor Jan Dylik in the investigations carried out in the Department of Quaternary Research, headed by the author of this article in years 1994–2012, have been considered. As a starting point was a conception presented in the article *Rozwój myśli badawczej w łódzkim ośrodku geomorfologicznym* (in Polish with French summary) from 1958, the reprint of which begins this volume. Discussed are four, partly intermeshing problems: dynamic geomorphology, cover deposits as the evidence of periglacial morphogeny, geological mapping and application of geological maps to palaeogeographical interpretations and geomorphological mapping and geomorphic maps at various scales. Shown are both the evidence of continuation of ideas and examples of misunderstandings

and mistakes, which in the opinion of the author hamper their development in the future or even deny the legacy of Professor.

**Dynamic geomorphology** in the 1950's had wider range than now. It included an examination of currently running processes as well as reconstruction of a morphogenetic environment on the basis of correlative deposits and landforms, according to geological thought of actualism. Such understanding of geomorphology, taken by Jan Dylík from French studies, was adopted to research of the Łódź Region. It replaced the descriptive-deductive approach of traditional geomorphology. Conducted studies related to all three morphogenetic cycles distinguished within the concept of polygenetic nature of Central Polish relief, both glacial, periglacial and temperate morphogeny (Dylík 1953). Today it is obvious, although we are talking about the use of sedimentary methods.

**Cover deposits as the evidence of periglacial morphogeny** have become in the Łódź geomorphological centre the main focus of field research, conducted in accordance with the principles of dynamic geomorphology. Work on deciphering of periglacial morphogenetic environment was carried out at all levels – from graduate student works through PhD and habilitation, up to the “flagship” Professor Dylík's sites (e.g. Józefów, Góra św. Małgorzaty, Walewice). Analyses focused on periglacial structures, but most of all – correlative deposits (primary and secondary textural and structural features) and landforms (formed by denudation, erosion and accumulation). The theory of periglacial morphogeny of Central Poland was established (Dylík 1953). This new idea, intensive work and wide propagation of the obtained results contributed to its international success. In 1956, at the XX IGU Congress in Rio de Janeiro, Periglacial Commission was founded and Jan Dylík was elected its chairman (re-elections: 1960 – XXI Congress in Stockholm, 1964 – XXII Congress in London and 1968 – XXIII Congress in New Delhi). *Biuletyn Peryglacjalny*, founded in 1954, became the official organ of the Commission. Scientists began to talk about the Łódź periglacial school. Investigations carried out in the vicinity of Łódź, mostly in the so called edge zone of the Łódź Plateau, resulted in the identification of the genetic complexity of correlative deposits and also their facies diversity and stratigraphical variability. The obvious and understandable it has become discontinuous and even insular occurrence of cover deposits and existence of other evidences of fossil periglacial environment, such as different surfaces and denudational landforms of various type and extent.

After the death of Professor Jan Dylík, with the development of glacial studies, the discussion on the role of morphogenetic environments in the landscape of the Central Poland took place and the negation of the role of periglacial morphogeny appeared, which was probably due to emotional compensation of exposing its role in the previous period.

**Geological mapping (and application of geological maps to palaeogeographical interpretations)** within the works on Detailed Geological Map, scale 1:50 000 was performed at the Department of Quaternary Research for nine sheets (cf. App., Tab. 2). These works were an expression of the needs of the interpretation of the relief together with surface geology, inoculated from the first years of through the geological mapping at the scale of 1:300 000 (Dylík, Jurkiewiczowa 1950).

In the chapter a number of examples of research problems detected during the mapping was reminded (e.g. multichanneled river system, Eemian lakeland, distribution of peatbogs, distribution of dunes, changes of river pattern, contribution of particular deposits in the surface geology etc.).

Another issue is how to use the geological maps to palaeogeographical interpretations, which has significant limitations, in particular often overlooked by people who have never dealt with geological mapping. According to the author, misunderstandings occur, as a result of too literal understanding of the term “detailed” and not taking into account the fact that, in accordance with the instructions to the map, the surface layer of a thickness of 1.5 to 2 m is ignored. With detailed geomorphological or archaeological investigations, the picture from the Detailed Geological Map of Poland must be supplemented by additional large-scale mapping, taking into account the youngest series of a small thickness.

**Geomorphological mapping (and geomorphic maps at various scale)** as a systematic task was not performed at the Department of Quaternary Research; works in the first period of the existence of the Łódź geomorphological centre in the edge zone of the Łódź Plateau has not been finalized, and in other parts of the region have not been set. In the eighties, with publishing of the first sheets of the Detailed Geological Map of Poland, geomorphological sketches began to appear, which have become easily accessible basis of geomorphological and geological interpretations, ranging from student work to research studies on a large scale. Many of these interpretations are almost perfect illustration of warnings by Dylík (1958), ignored or probably not known by authors.

Geological mapping of the region was completed in the early years of this century, and thus the entire area was covered with geomorphological sketches made according to uniform principles included in the Instruction to the Map, scale 1:500 000. Although the comparability turned out to be apparent, due to the lack of other source materials covering the whole area, it was decided to complete 60 sketches and make the Geomorphological Map of the Łódź Region, scale 1:200 000 (Turkowska 2006). The fact that after half a century after the start of detailed geomorphological mapping of the area sketches made for sheets of the Detailed Geological Map of Poland have become the only possible basis of a geomorphological map of the region, should be considered a failure of geomorphologists from Łódź. At the same time, experience resulting in the implementation of the map entitles to categorical statement that the sketches are very difficult, and almost impossible to the consequent interpretation throughout the area, consistent, at the same time, with the original vision of an author and subordinated to rules of geomorphological map and hypothesis resulting from the analysis of the full achievements of Łódź centre and the individual research experience. Remark seems to be important in the context of ongoing work on a new edition of the Geomorphological Map of Poland, scale 1:500 000 and plans of geomorphological maps on a large scale, based on the sketches to the Detailed Geological Map of Poland, scale 1:500 000.

From the foregoing considerations, as well as the review of research topics carried out at the Department of Quaternary Research (cf. Appendix) it shows that the study of periglacial landforms and processes, which was the base of the existence of the Łódź geomorphological school, were in the Department only one of the threads, although their results were undoubtedly used for example in the palaeogeographical interpretations. The idea of Professor Jan Dylík was continued on a more general level. Opinion has been expressed that evidence of the heritage of the research idea of Professor Jan Dylík are interdisciplinary studies of morphogenetic environment and polygenesis of the relief of Central Poland conducted in the Department of Quaternary Research.

## WALEWICE – NIEZREALIZOWANY PROJEKT PROFESORA JANA DYLIKA

### ZARYS TREŚCI

Stanowisko Walewice, leżące na 10-metrowej terasie pradoliny warszawsko-berlińskiej, zajmuje ważne miejsce w dorobku naukowym prof. Jana Dylika. Występujący tam zespół bardzo licznych typów osadów vistuliańskich oraz struktur peryglacialnych stał się podstawą doniosłych wniosków paleogeomorfologicznych. Nagromadzenie kopalnych zjawisk na niewielkiej przestrzeni, rzadko spotykany stopień ich odsłonięcia oraz łatwy dojazd do stanowiska spowodowały powstanie projektu trwałej ekspozycji. Śmierć Profesora w 1973 r. przerwała początkową fazę realizacji tego zamierzenia.

## WALEWICE – PROFESSOR'S UNREALIZED PROJECT

### SUMMARY

**Abstract.** Walewice situated in the 10 m terrace of the Warsaw-Berlin Pradolina is one of the most significant sites influencing Professor Jan Dylik's work. A series of deposits and periglacial structures of the Vistulian enabled reaching some important paleogeomorphological conclusions. A large collection of fossil phenomena, a rarely occurring level of their uncovering, as well as accessibility of the site resulted in the creation of a project of permanent exposition. Professor's death in 1973 interrupted the realisation of this project.

**Key words:** slope development, periglacial structures, block of permafrost

Site Walewice is situated in Bielawy commune near Łowicz. Here, on a 10 m. terrace on the Warsaw-Berlin pradolina, where the Mroga River joins the Bzura River, Professor Dylik carried out in 1962 to 1969 investigations concerning Vistulian slope deposits. Cross-sections and large horizontal surfaces allowed the exploration of the fossil periglacial phenomena. Site Walewice was visited by many geomorphologists during international geomorphological conferences. It was presented especially during the Symposium of the Commission of the IGU in 1967. It was then when Professor used it for realisation of the following subjects:

- congelifluction and rhythmically bedded slope deposits; stone mantles; slumps and landslides; fluvial deposits;
- lobe and slope congelifluction; downwash; gravitational slope processes; development of interstitial ice and thermal erosion;
- climatic phases of Würm and morphogenetic processes corresponding to them;
- accumulation and denudation glacis, their surrounding area and dynamical relationships, cooperation of longitudinal and transversal processes; system of wandering water and thermal erosion.

The significance of Vistulian deposits and structures spread across a small area, the difficulty uncovering them all, as well as accessibility of the site (situated right by the crossroads) resulted in creation of a project of permanent exposition. The sand surfaces were to be hardened (following the method of Prof. Romuald Cebertowicz), before building an exhibition hall above them. Everything was already arranged, including a technical diagnosis of the terrain. Alas, Professor's death on July 7<sup>th</sup> 1973 interrupted the realisation of this project.