

KOMUNIKAT  
MIXED-PATTERN,  
COEXISTENT MULTICHANNEL RIVER SYSTEM  
OF THE UPPER BÓBR (CENTRAL SUDETES, SW POLAND):  
A FIELD EXPERIMENT AND GEOLOGICAL DATA

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Airphotos and new detailed topographic maps have demonstrated that the flat valley floor of intramontane basins of the upper River Bóbr catchment is not a featureless even surface, but reveals a subtle relief consisting primarily of a network of shallow floodplain depressions and almost flat or slightly convex-up interchannel or interdepression areas. The flat valley floors of the upper Bóbr and its main tributaries are known to be deforested at least since the Middle Ages (the 13th or 14th century) and actually are occupied by meadows, pastures, and cornfields. However, the relief is a natural or semi-natural feature and has not been developed as a result of the cultivation of the land.

In broad intramontane basins, the floodplain depressions constitute a network of anastomosing (*sensu* Schumm 1968) floodplain channels that divide and rejoin surrounding the almost flat interchannel areas. The channels are shallow (usually only several decimetres deep) and rather wide features (their width is difficult to specify because they have no distinct banks) underlain by cohesive topstratum deposits (Holocene mud and clay or alluvial loam). In plan, the channels vary from almost straight, through sinuous, to meandering. The flat interchannel areas may be classified as valley forms, i.e., the largest fluvial landforms that can exist in a given fluvial system (1st order fluvial landforms according to the author's own classification, Teisseyre, in press). Such landforms are characterized by a dimensionless length parameter,  $L/w > 7$  (where  $L$  = length and  $w$  = mean channel width as read from a topographic map). Personal inspection to the Bóbr

valley during the two highest floods (in July 1958 and August 1977, recurrence interval, R.I. = 80–100 years) has demonstrated that the extra-channel flow was channelized by the anastomosing network of the floodplain channels leaving the interchannel areas still emerged (Fig. 1).

In order to explain the origin of the floodplain channels a field experiment has been conducted in the Błażkowa study reach (1983–1985) and a number of long, continuous ditches excavated in the vicinity of Lubawka in connection with construction of pipelines and new sewage systems have been investigated (1988–1990). The results can be summarized as follows.

1° The floodplain channels may be attributed either to floodplain erosion or to infilling of abandoned anastomosing channels of the upper Bóbr. The latter variety seems to be more common. The floodplain channels attributable to floodplain erosion have been sculptured in the floodplain muds and alluvial loams by extra-channel (flood) flows. Genetically, the channels are connected with permanent crevasses existing in banks of the present-day Bóbr channel and develop as a natural extension of crevasse channels cut across natural levees. Field experiment has indicated that new crevasses and crevasse channels do develop rather quickly, as a consequence of several successive floods, particularly in the cold months of the year, owing to thermo-erosion and/or cryogenic soil erosion. By thermo-erosion is meant the process of erosion of a frozen soil (mainly cohesive topstratum deposits) occasioned by slightly warmed up thaw water ( $2 \div 5^\circ\text{C}$ ; Teisseyre, 1979, 1984, in press). Cryogenic

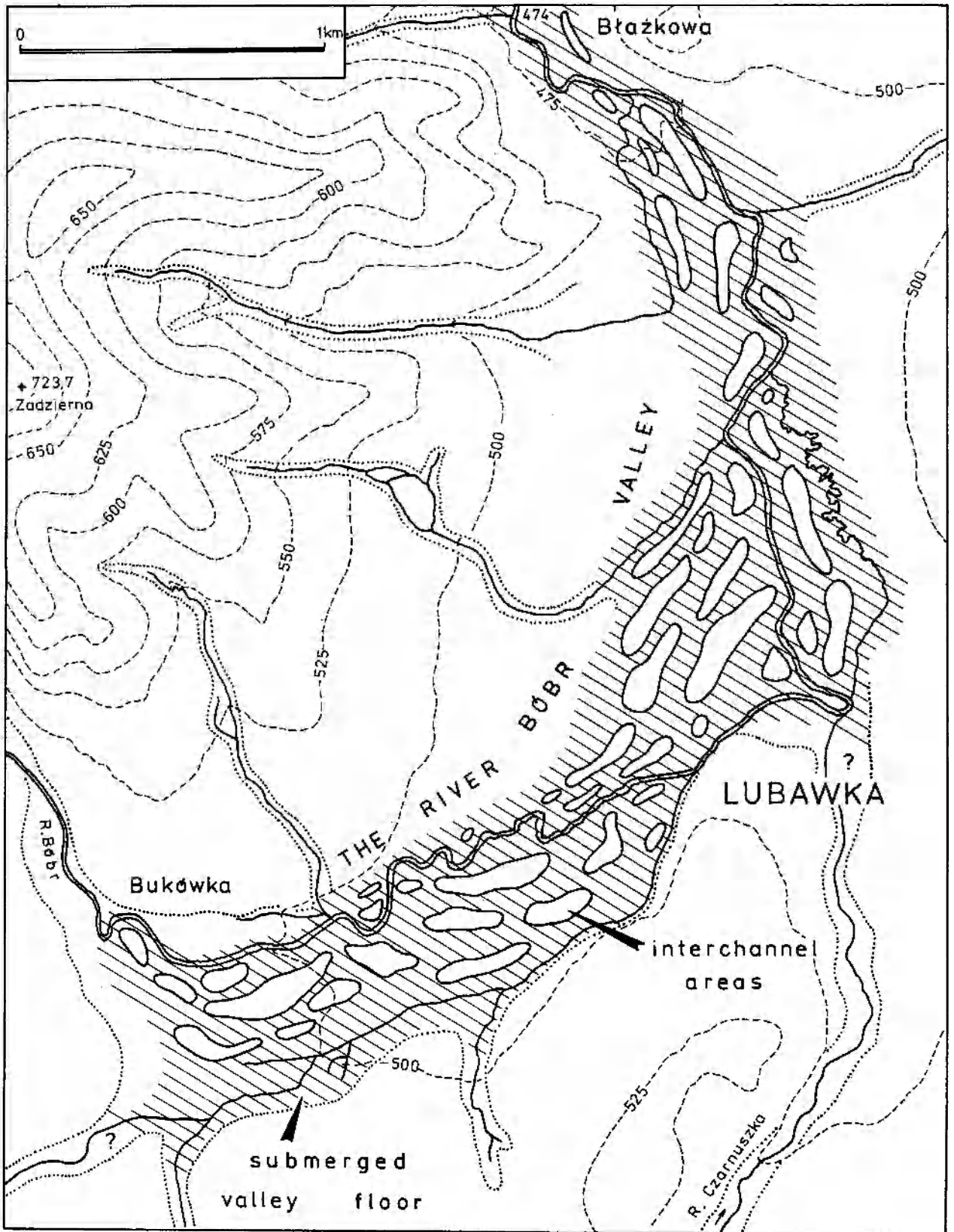
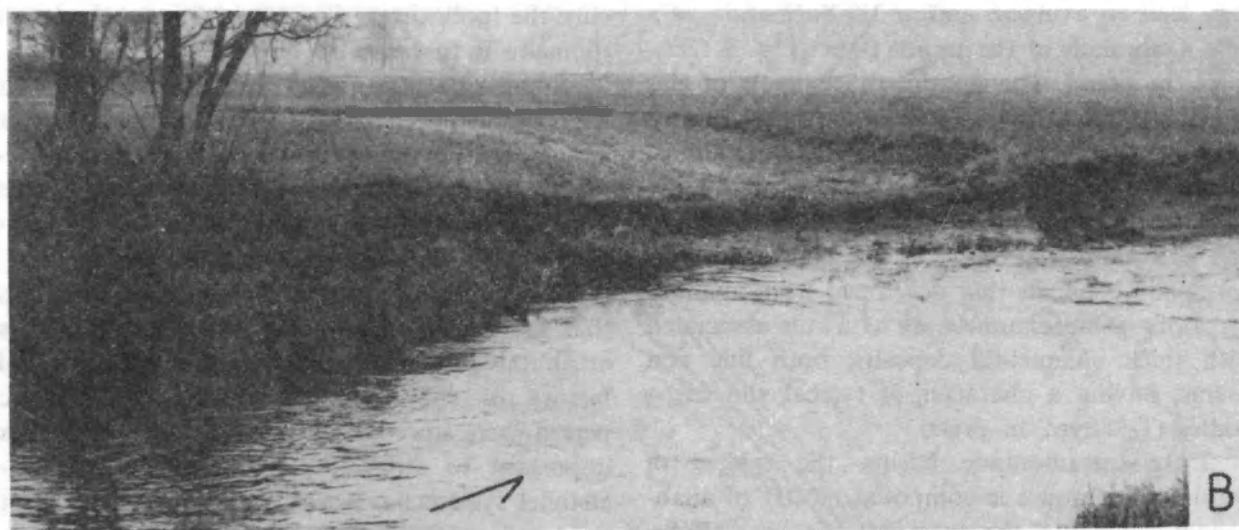


Fig. 1. Anastomosis of the extra-channel (flood) flow in the Bukówka-Błażkowa intramontane basin, the upper River Bóbr catchment. Rising stage just before the peak flow on August 1, 1977,  $Q$  ca.  $80-90 \text{ m}^3 \text{ s}^{-1}$  (mean annual discharge is  $Q = 1.1$  to  $1.2 \text{ m}^3 \text{ s}^{-1}$ ). Note a system of shallow floodplain channels (hatched) surrounding interchannel areas (unpatterned)



**Fig. 2A.** Anastomosis of the extra-channel flow, lower part of the Miskowice Fan drained by the River Zlotna, after the August 1977 flood. The tree-lined channel of the lower Zlotna is on the right; note at least three or four interchannel areas surrounded by shallow floodplain channels. **B.** Crevasse and the crevasse channel on the left bank of the upper Bóbr, Błażkowa study reach, after the March 1983 flood. See Figure 3 for location. **C.** The same crevasse and the new crevasse channel after the March 1985 flood – a stage preceding potential avulsion and/or formation of a new anabranch of the Bóbr (see Fig. 3).

Photos by the author

soil erosion, on the other hand, attacks a soil which at the time of washing is not frozen but is characterized by a loose, porous structure resulted from multigelation processes (formation and disappearance of ground ice, needle ice, repeated freezing and thawing; Teisseyre, in press). Both the processes have been found to be very effective in a period from late February till early April. It has been possible to observe, during a three-year field experiment (1983–1985), the formation of a new crevasse and crevasse-channel eroded in alluvial loam owing to two low floods: in March 1983 and March 1985 (Fig. 2B,C). After the two floods, the new crevasse channel was up to 50 m long, 0.5–0.6 m deep and up to 12 m wide (Fig. 2C). The development of such crevasse channels may lead to avulsion and/or the formation of a new anabranch of the upper Bóbr (Fig. 3, Teisseyre, in press). The floodplain channels of this type may be distinguished on the basis of two conclusive criteria: they may be filled almost exclusively by cohesive, fine-grained overbank deposits and are unrelated to subfossil palaeochannels and their deposits. On the contrary, those floodplain channels that developed from abandoned Bóbr palaeochannels are as a rule associated with thick channel-fill deposits, both fine and coarse, having a character of typical shoestring bodies (Teisseyre, in press).

2° In intramontane basins, the system of floodplain channels is composed mostly of abandoned channels of the anastomosing upper Bóbr. The abandoned channels are filled-up in part by cohesive overbank deposits (0.5 to 3.5 m thick) underlain by channel-phase deposits. The latter reveal features indicative of lateral accretion in a system of sinuous and/or meandering palaeochannels that date from the late Holocene (Teisseyre, 1984, in press). In plan, the deposits have been found to occur as typical shoestring bodies. Datable artefacts (mostly pottery fragments, Professor Józef Kaźmierczyk, personal communication, 1986–1989) seem to suggest that many if not all the abandoned channels were active in the historic period (here the last 700 years). The Holocene deposits are at least 3 to 5 m thick and are underlain by a thick bedset of gravels and sands interpreted as having been deposited by the bed-load ancient Bóbr, possibly during Late Pleistocene. The deposits, 10 to 40 m thick, have been examined in a deep foundation excavation dug to the true bedrock at the Bukówka Dam in a period 1978–1987 (Teisseyre, 1989, Fig. 1).

It is essential to stress that the system of anastomosing present-day floodplain channels has nothing in common with relics of the braided Late Pleistocene palaeochannels and cannot be interpreted as a surficial impression of these old palaeochannels replicated by the Holocene topstratum deposits. Excavations 2 to 4 m deep dug in the vicinity of Błażkowa and Lubawka (Fig. 1) have demonstrated that even a metre thick layer of the cohesive topstratum deposits does not replicate fluvial landforms existing beneath it irrespective of their age (see e.g., Teisseyre 1988, Fig. 15, 17). The opinion is supported by independent field (experimental) results indicating clearly that the floodplain deposition of fine-grained cohesive material tends to mask or obscure the (pre)existing floodplain relief rather than to make it to be more distinct.

Summarizing, it may be demonstrated that the Late Holocene coexistent multichannel river system of the upper Bóbr consists of two elements: 1° the present-day alluvial ridge of the upper Bóbr with the perennial sinuous or meandering Bóbr channel and its natural levees and 2° the anastomosing system of floodplain channels that are active only during floods and which is attributable to a complex erosional/depositional history of the floodplain during the historic period (here since the 12th or 13th century). It is important to stress that the coexisting multichannel system has developed simultaneously, at the medium time-scale (graded or modern time, Schumm and Lichty 1965), under conditions controlled at least in part by man, both directly and indirectly. On the contrary, the coexisting system of channels cannot be interpreted in a traditional manner as a successively developed braided/meandering (palaeo)channel succession. It is also evident that braided Pleistocene palaeochannels that are buried beneath the Holocene deposits, which attain a thickness up to 5 m, cannot be replicated by the cohesive overbank (topstratum) deposits.

Attributable to the multichannel river system is a phenomenon called by the author "anastomosis of the extra-channel flow" (Fig. 1, 2A; Teisseyre, in press). The phenomenon depends on channelization of the extra-channel flow by the floodplain channels and depressions in such a way that extensive interchannel areas are not submerged; during a flood they look like elongated interchannel areas of an anastomosing river. In the intramontane basins of the upper Bóbr, even high floods (R.I. = 80 to 100 years)

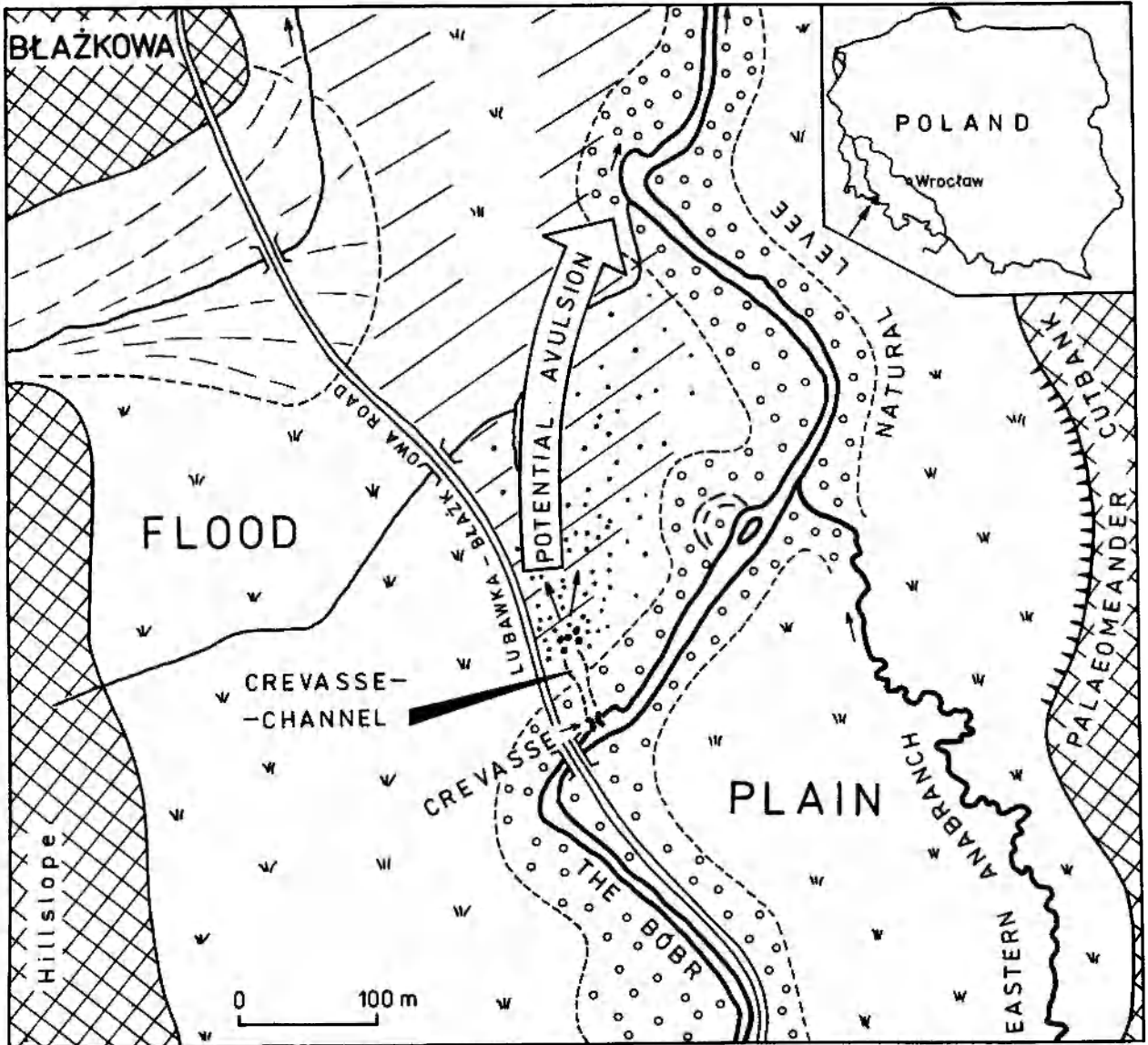


Fig. 3. Part of the Bukówka-Błażkowa basin showing location of the new crevasse and the crevasse channel illustrated in Figure 2. Note a new potential anabranch of the upper Bóbr. Hatched area was inundated during the low March 1985 flood.

are too low to submerge the areas. The phenomenon results in acceleration of the extra-channel flow and, in fact, leads to diminution in rate of floodplain accretion (aggradation). Also, it makes channel-fill deposits to be more silty, owing to an increase in velocity and turbulence of the channelized flow.

In gorge sections of the upper Bóbr valley, that are steeper than intramontane basins, the

multichannel system does not occur or is poorly developed. Before the last river regulation, at the beginning of the 20th century, these sections of the valley were occupied almost everywhere by a single meandering channel, commonly with truncated, contorted meanders.

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