How Boats Change: Explaining Morphological Variation in European Watercraft, based on an Investigation of Logboats from Bohemia and Moravia, Czech Republic

Submitted by Jason Samuel Rogers, to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Archaeology, September 2009.

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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ABSTRACT

This thesis examines questions regarding aspects of cultural change in prehistoric and early modern Europe, specifically the transmittal of skills, knowledge and technology. Dugout logboats from Bohemia and Moravia (Czech Republic) are used as proxy artifacts to make this transmittal visible. Boats in general and riverine watercraft specifically, are an unusual class of artifact, as they are neither completely portable nor permanently fixed in place. The movement of watercraft is restricted to a relatively narrow corridor through the landscape. The morphology and construction of logboats are reflective of skill sets and technological traditions. Pre-literate boat construction traditions and technology, spread through personal contact and experience, may thus be traced through close examination of the technical features of surviving examples. In many parts of Europe, however, dugout logboats remain an extremely uncontextualized category of artefact. Placing these vessels in their appropriate geographic, environmental, and human contexts helps us to understand their meaning and forms (and the behavior of their builders and operators). The geographic element of this investigation is especially significant, as the spread of information and skill sets in physical space is a main focus of the thesis. The Czech Lands sit astride one of Europe's main continental divides, and rivers originating on this territory flow to the North Sea, the Baltic Sea, and the Black Sea. Topographic conditions have funneled travel and transport in this region through the river valleys and across a few key passes or watershed boundaries. Water transport, far more efficient than overland haulage, was likely an important element in trans-continental trade and exchange. Analysis of the surviving logboats from this region indicates that different construction traditions prevailed in different watershed areas. These data also suggest a model explaining the mechanisms by which boats can change. Key elements of the model include an inherent conservatism of boat design; internal change, driven by social or environmental factors; and external change, adopted through the personal experience of the boat builder or operator. The model is subsequently tested against case studies of vessels from other regions of Europe, and other types of watercraft.

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CHAPTER ONE – INTRODUCTION

1.1 Introduction

This thesis is an archaeological examination of cultural change in Europe, specifically how elements of prehistoric and early historic skill, knowledge and technology were transmitted between physical locations in Central Europe. The significance of this transmittal goes far beyond the actual subset of artifacts used to demonstrate the mechanisms of transfer, as similar processes may be applied to much larger and more fundamental concepts. Knowledge, ideas, technology, skills and styles must be physically transmitted from place to place, and combine over time as the foundations for prehistoric, historic, and modern society and cultural identity. The mechanisms and practices of such transmittal depend on many factors and are generally poorly understood. Numerous explanations of cultural change have been proposed in the past, including migration, diffusion, cultural evolution, and functionalism. Interpretations have gradually shifted from theories that view culture change as one-sided phenomena with invading/dominating and subjected/receiving parts to models that focus on aspects of social identity and reciprocated forms of interaction. The challenge is now to broaden analyses of cultural change to cover processes that used to be explained in terms of migration and diffusion (cf. Trigger 2006:333).

The type of material culture used as a sample for this investigation is the dugout logboat, a ubiquitous class of prehistoric and early historic watercraft found throughout Europe. Logboats are a special category of artifact, movable although not portable, and whose construction and usage require specialist knowledge. These two elements of logboat construction and utilization will be explored in detail using samples from two distinct Central European river basins. Geographically, the investigation is focused on the two main watersheds of the Czech Republic, straddling the European continental divide. This region is in many ways a crossroads of transcontinental transportation and communication routes. Detailed descriptions of the research focus and further exploration of the reasons for the choice of this particular artifact class and geographic region are provided below.

Early theorists in archaeology such as Montelius (1903) and Kossina (1911) believed that cultures were a reflection of race and argued that similarities and differences in archaeological material culture correlate with similarities and differences in ethnicity (cf. Trigger 2006:237). The movement and spread of prehistoric cultures was thus equated with that of material artifacts attributed to a specific race or cultural affiliation (e.g. Childe 1950). Tracing the passage and extent of a culture was therefore a simple matter of plotting the distribution of various artifact types. V. Gordon Childe, the first archaeologist to articulate a comprehensive prehistory of Europe, made wide use of this approach when elaborating upon his fundamental concern: the relationship between prehistoric Europe and the Near East (Childe 1929; 1957) (Figure 1.1). Childe defined cultures on the basis of functionally interpreted artifact types, which could be placed in two major groups: local ceramics, ornamentation, and burial goods, all reflecting local tastes and therefore useful in identifying specific ethnic groups; and tools, weapons and other items of technology, which tended to diffuse rapidly from group to group. Major technological innovations thus diffused through Europe from their place of origin in the Near East. In later years, Childe turned away from the culture-historical approach and became more concerned with economic factors (e.g. Childe 1958).

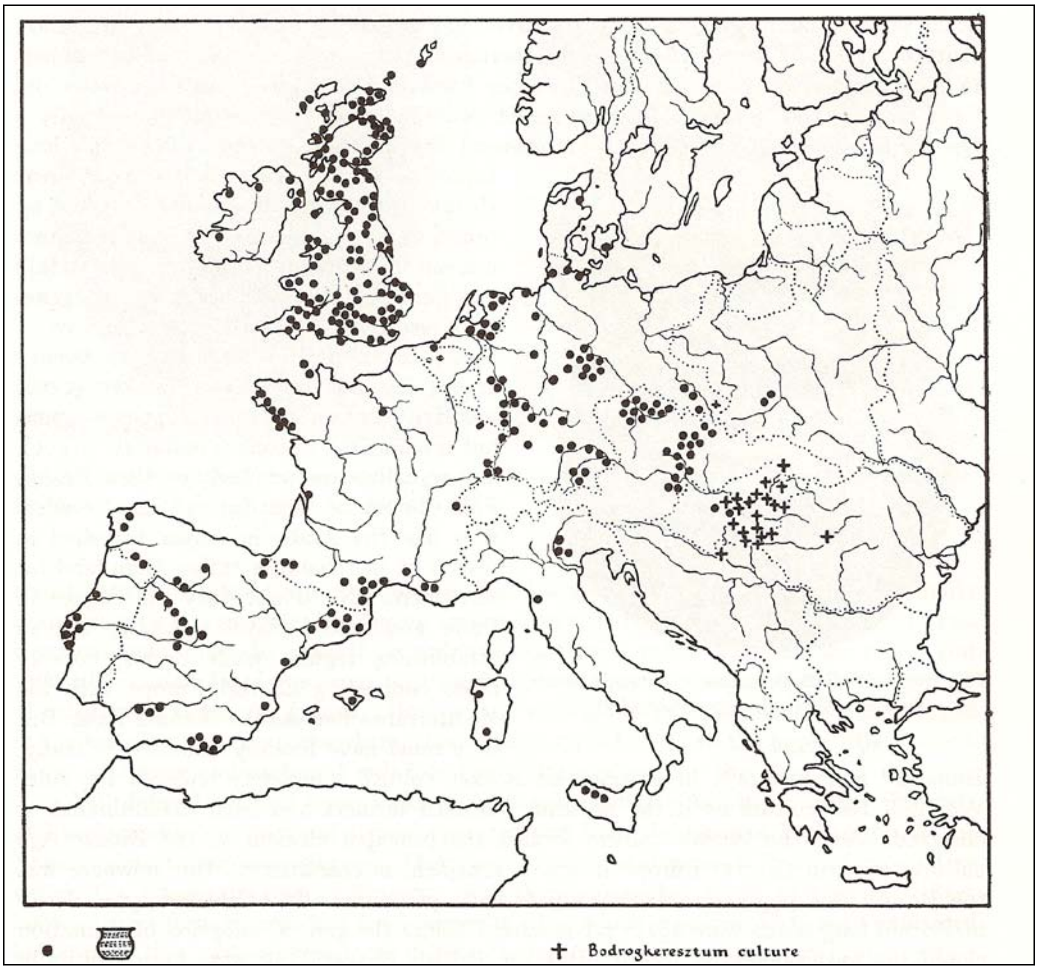


Figure 1.1 Map showing distribution of Bell Beaker and Bodrogkeresztur cultures, from V. Gordon Childe's *Prehistoric Migrations in Europe* (1950:131).

Advances in methodology, field techniques, as well as revised theoretical perspectives have helped to make much subtler interpretations possible. Sophisticated paleo-climate analysis, for example, allowed far-reaching interpretation of the connection between prehistoric climate and economy (e.g. Clark 1952) (Figure 1.2). Although the concept of a strict correlation between 'race' or 'culture' and a specific pottery or ornament is now regarded as a bad generalization, material culture is nonetheless a good gauge of the spread and adoption of technology as well as an indicator of trade and exchange (Scarre and Healy 1993; Sherratt 1997). This thesis takes the approach articulated by Helle Vandkilde (2007:19), that material culture in the form of archaeological remains are essentially fragments of human action (and hence of social activity) in the past.

Material culture and human activity are inextricably linked, and the connotations ascribed to material culture are very much dependent on the specific social and cultural context, as well as the local physical environment.

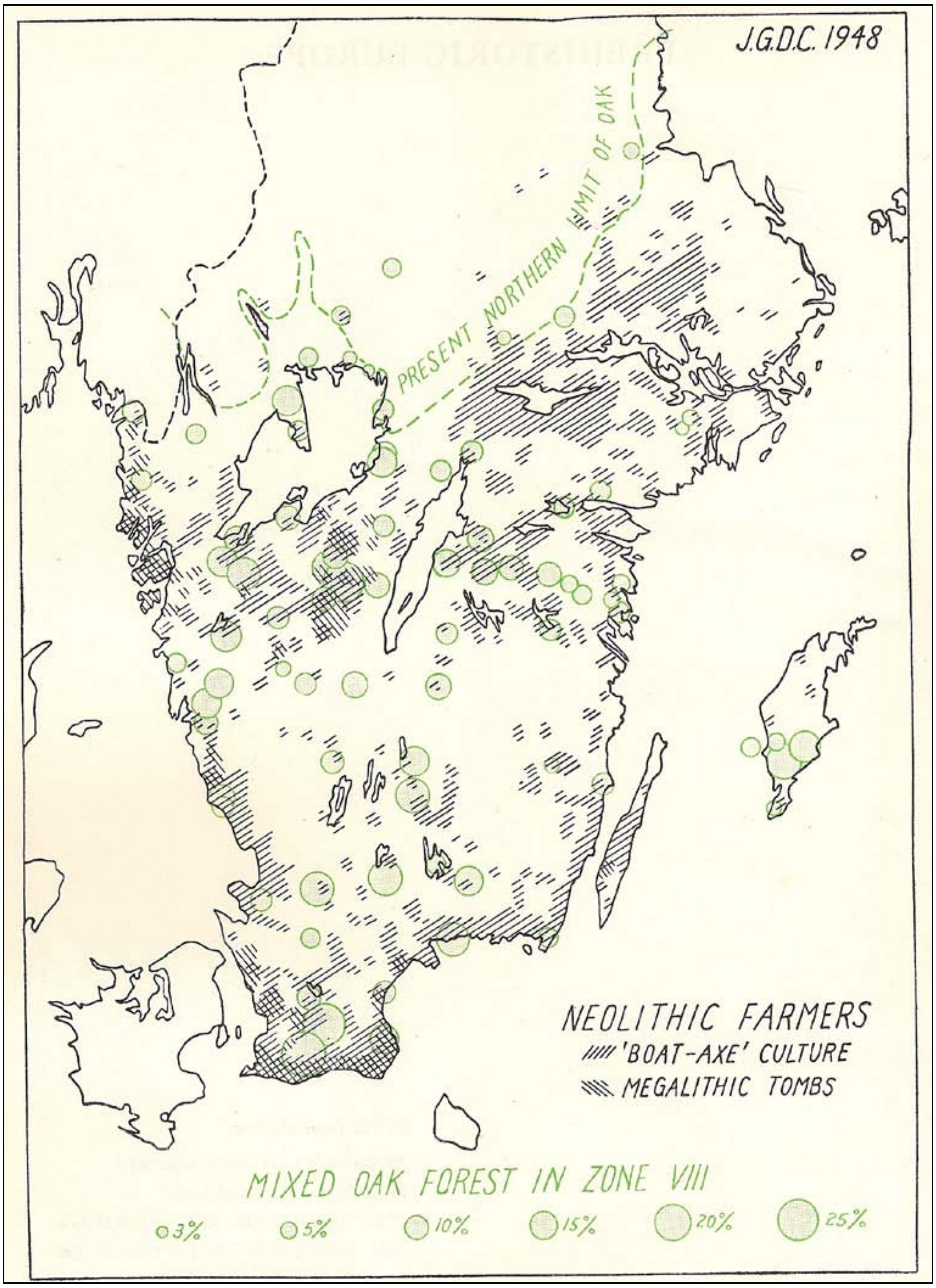


Figure 1.2 J.G.D. Clark's map of Neolithic settlement and Sub-boreal deciduous forest in south Sweden (1952:Fig. 1). Compare with Childe's map in Figure 1.1.

European cultures developed along paths outlined by the spread and transmittal of technology, information, material assemblages, religion, and ideology (Helms

1988). Information and material exchange, both by land (Scarre and Healy 1993) and sea (Edmonds 1993; Cunliffe 2001) are documented archaeologically from the earliest periods of European prehistory. Ideas and objects were transferred over long distances across the continent, sometimes rooting and developing locally, sometimes rebounding and spreading back towards the places of origin. At the same time, this exchange facilitated (and often initiated) the major 'revolutions' of prehistory: agriculture, ceramics, metallurgy, and specific social structures (Renfrew 1993). It has also been suggested that one such revolution, the introduction of agriculture, was also responsible for bringing Indo-European languages (and potentially ethnicities) to Europe, probably from Asia Minor (Renfrew 1987; refined by Zvelebil and Zvelebil 1988). This remains a controversial proposition and the exact processes of transmittal and exchange are a source of much debate (e.g. Price 2000), but whether by diffusion, migration, indigenous adoption or some other means, the fact of long-distance transfer remains. The speed and directionality of transfer is not always constant, although for some periods it has been described as "explosive" (Sherratt 1997:17).

Recent research has shifted the focus towards reciprocated forms of interaction as sources of social and cultural change (i.e. Kristiansen and Larsson 2005). In this view, intercultural transfer is a prime catalyst in creating social transformation. Material culture, at once manifest and abstract, practical and symbolic, is a direct result of human activity (Vandkilde 2007:18). Subsistence, travel and communication were all related and interlocked activities, embedded in the social structure. Goods, skills, knowledge and customs were created and maintained, moved across the continent, absorbed and reinterpreted, both contributing to tremendous diversity as well as uniformity of material culture. As articulated by Sherratt (1997:28), the process of cultural transfer was evolutionary, "not in the

Spencerian sense with predictable stages of progress, but rather in the Darwinian sense of constrained genealogical paths with often unpredictable conjunctures and unexpected outcomes – which nevertheless, with the benefits of hindsight, show some regularities both of form and direction."

There are of course limitations to skills transfer. Environmental, social, and political factors may at times facilitate the spread of knowledge, and limit it at other times. The specific focus of this thesis (watercraft design and development) is no exception. Examination of the practice of boat design and construction allows an understanding of the larger processes, which encourage or limit the spread of knowledge and skills. A fundamental aim of this thesis (and, I believe, of European archaeology, cf. Trigger 2006:329) must be to explain aspects of uniformity and diversity in material culture. As noted by Colin Renfrew (1979:18), innovation remains among the least understood phenomena in European prehistory. There are also many closely related questions regarding the role of long-distance trade and exchange in creating disparate elements of culture as well as social structure. Understanding the circumstances under which inventions are made, and the social conditions in which innovations are adopted, will be stressed throughout this thesis.

A tremendous amount of scholarly effort has been directed at the topic of trade and exchange (e.g. Clark 1952, Renfrew 1969; Sabloff and Lamberg-Karlovsky 1975; Curtin 1984; Scarre and Healy 1993). Many researchers have stressed the importance of early palace cultures in the Aegean in the establishment of long-distance trade routes (e.g. Childe 1958; Kristiansen and Larsson 2005). Others emphasize local developments within temperate Europe, creating indigenous demand for luxury items (i.e. Milisauskas 1978:225). For purposes of this thesis, the origins of trade networks are not so significant as their influence and role in transfer of knowledge, skill, and technology: the dynamic practices of cultural exchange.

Early forms of exchange may have followed an organized structure such as those proposed by Renfrew (i.e. reciprocity, redistribution, market exchange, etc.) (1975:41-43). Curtin (1984:87-88) suggested a somewhat more fluid framework, where "contact between discrete cultures, partly through trade diasporas, led to spreading areas of intercommunication." Especially for earlier periods, trade and exchange likely developed according to traditional principles of kinship interactions and social obligations. Exotic imports and other valuable materials (for example Mediterranean shells, polished axes, amber, bronze and luxury items) circulated through social exchanges, presumably among individuals in elite positions (Wells 1984:29). The networks and contacts created via trade and exchange also provided first-hand experience of foreign items and facilitated opportunities to adopt innovative technologies.

1.2 Boats and Watercraft

Trade (and transmittal of information) at a distance requires transport. The potential means of conveyance or transfer are actually quite few. People can walk; use an animal for riding or traction; or travel in a boat. Options for transporting more than a small or modest cargo are even more limited. Boats, while not the only mechanism for travel, are certainly among the most important (especially for long-distance movement of bulky cargoes, and especially in earlier periods when roads were few, poor or non-existent).

There is a great deal of evidence for inland as well as coastal water travel in prehistoric Europe. The oldest potential boat fragment known from Europe is a carved antler interpreted as part of a skin boat frame, dating to the ninth millennium BC (Ellmers 1996a:12) (Figure 1.3). While this object may not be entirely convincing to the skeptical eye, there is other evidence for boat use in Europe by this time. Rock carvings dating to ca. 8000 cal BC from central Norway

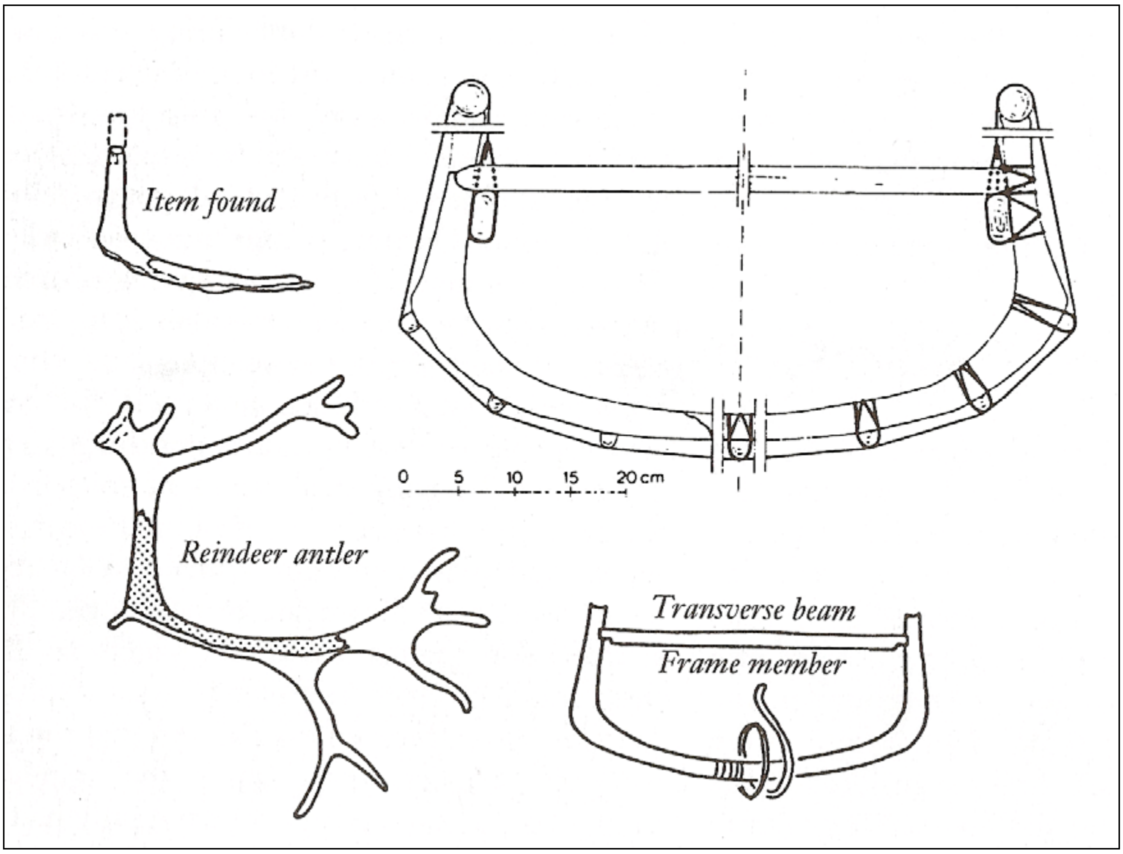


Figure 1.3 Reindeer antler fragment from Husum, Germany, interpreted as a Magdalenian-period skin boat frame element (Ellmers 1996a:12).

depict fishing and hunting from boats, and Ellmers (1996a:11-13) has also suggested that the invention of the needle during the Magdalenian (ca. 16,000 BC)[1] provided the essential technology for sewing a skin boat. The fishing settlement at Lepenski Vir (ca. 5800-4300 cal BC), the shell middens at Ertebølle, and the remarkable logboats and paddles from Tybrind Vig (ca. 3500 cal BC) demonstrate maritime adaptation and intensive use of coastal and riverine resources during the Mesolithic (Figure 1.4).

[1] All radiocarbon dates in this thesis younger than 10,000 BP have been calibrated using OxCal 4.0 and the IntCal 04 calibration curve (see Bronk Ramsey 1995; Bronk Ramsey 2001).

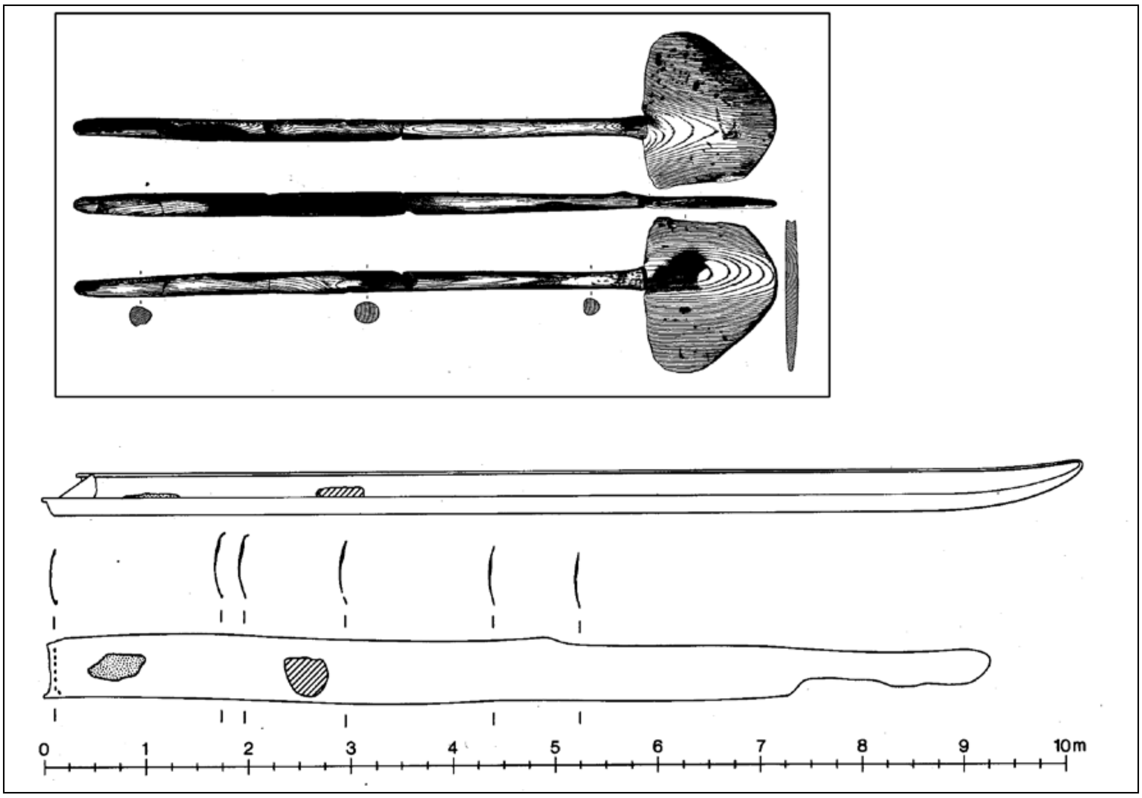


Figure 1.4 Mesolithic logboat and paddle from Tybrind Vig, Denmark. The boat was made from lime wood (*Tilia sp*.) and features an inserted transom at the stern end (illustrations from Anderson 1987).

The oldest known European logboat, from Pesse in the Netherlands (8270±275, or 7969-6568 cal BC), provides evidence of inland riverine navigation as well (McGrail 1987:86) (Figure 1.5).

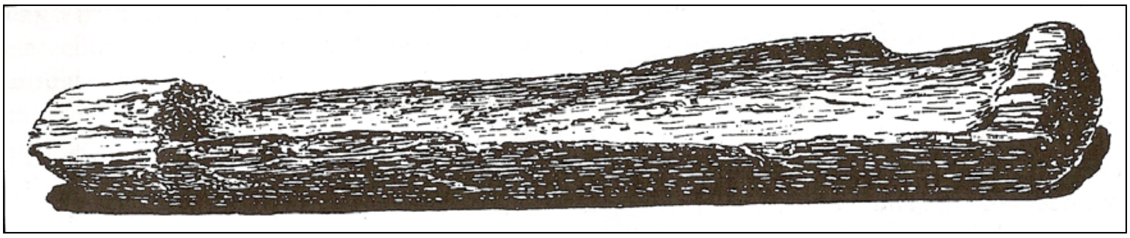


Figure 1.5 Europe's oldest boat, the dugout from Pesse in the Netherlands (Ellmers 1996a:15).

In the Aegean region, obsidian from the island of Melos is found in Neolithic sites on the Greek mainland (Renfrew and Aspinall 1990; Davis 1992), and Neolithic Impressed ware ceramics also appear to have been spread by sea (Cunliffe 2001:140). Bronze age sewn-plank boats were likely used to cross the English

Channel (Van de Noort *et al.* 1999; Van de Noort 2004), and sailing ships were in use on the Mediterranean by at least 3500 BC (Casson 1996:39).

Specific boat-building traditions and technologies can be traced geographically around Europe. An oft-cited example is the conceptual distinction between boats built 'shell-first' and 'skeleton-first' (Greenhill and Morrison 1995:47; McGrail 1987:5-6; although originally noted by Hasslöf 1958, as cited in Westerdahl 1992). Another clear dichotomy is the distinction between overlapping clinker hull planking (also called lapstrake, traditionally prevalent in Northern Europe), and carvel (flush-laid edge-joined planking, found in Southern Europe and the Mediterranean) (Figures 1.6 and 1.7).

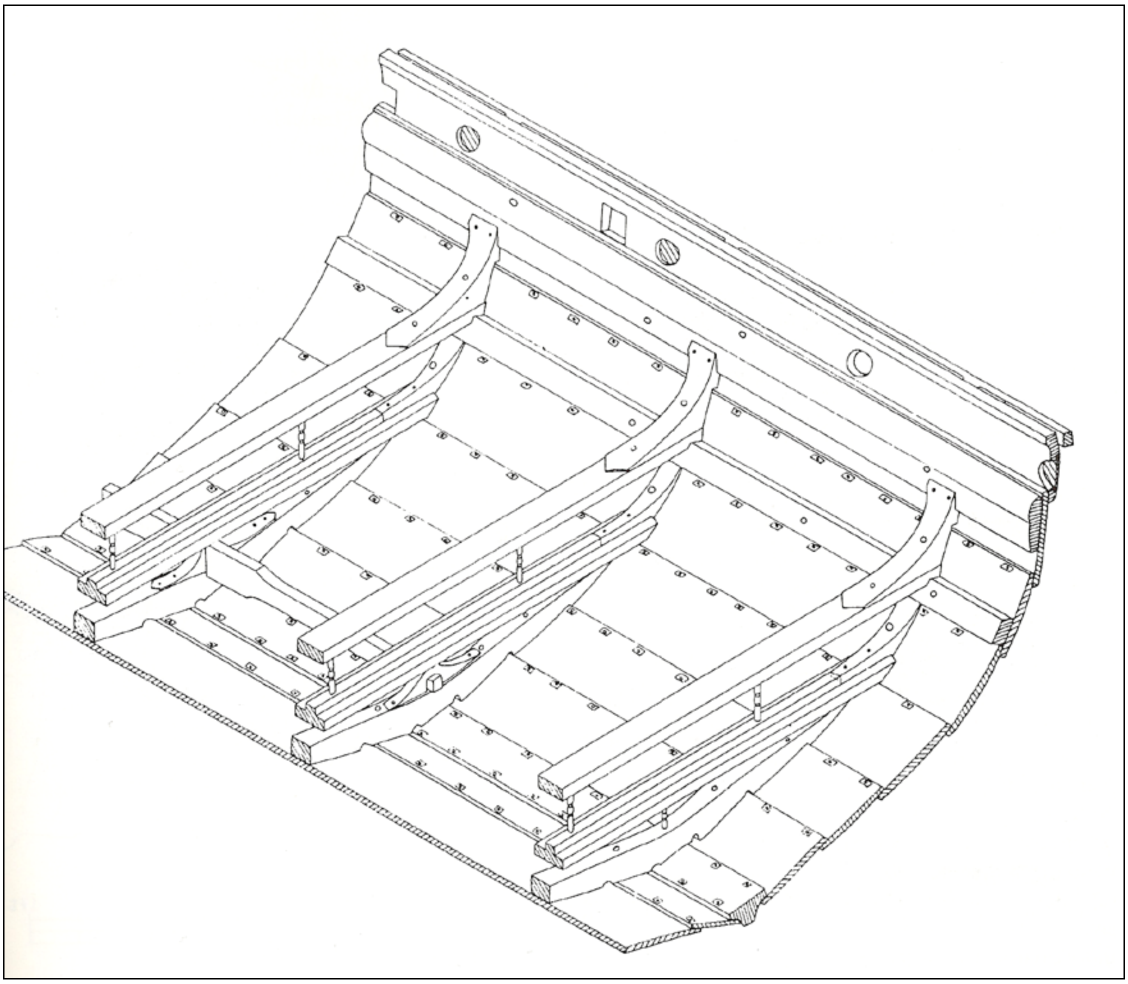


Figure 1.6 Lapstrake (clinker) hull planking. This is the Skuldelev (Denmark) warship (wreck 5), dating to around 1000 AD (Olsen and Crumlin-Pedersen 1978).

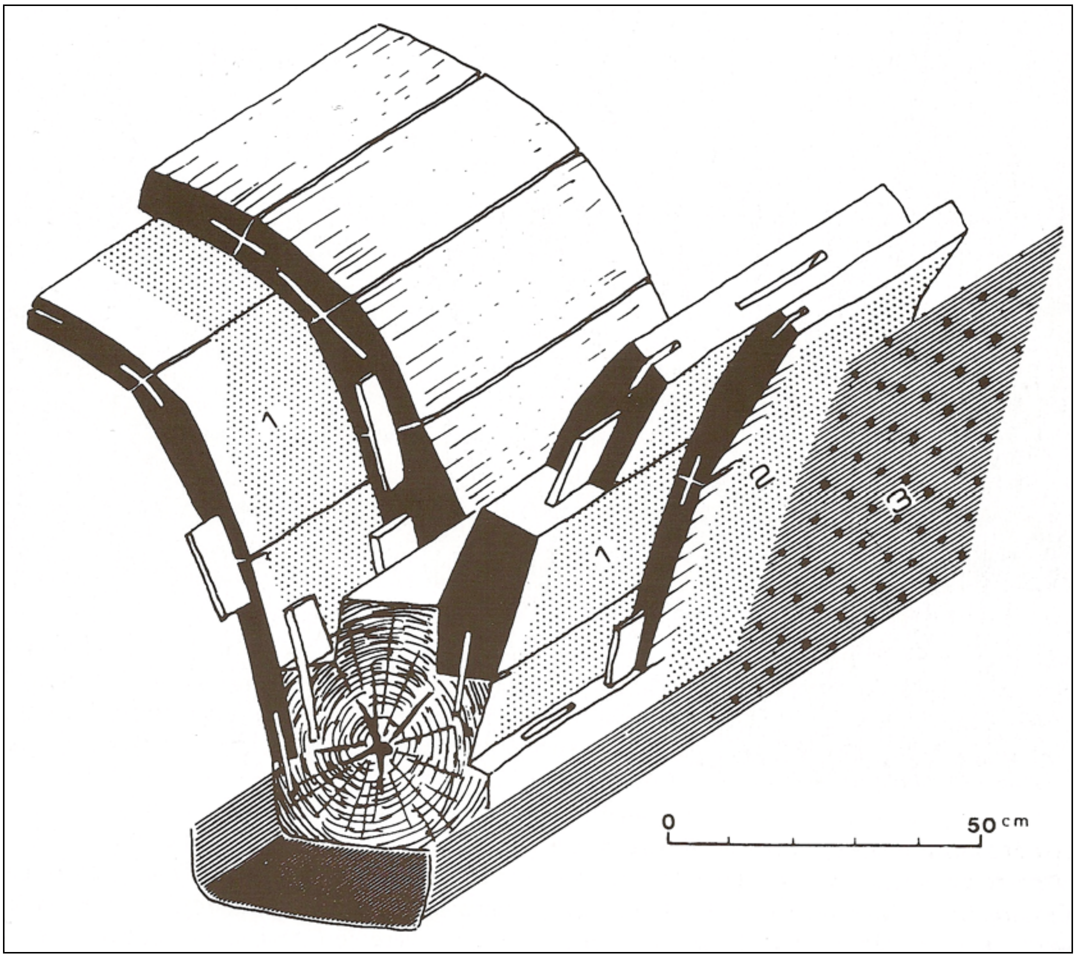


Figure 1.7 Keel and lower hull planking of the Madrague de Giens (France) vessel. The depiction shows typical Mediterranean style construction with flush-laid carvel hull planking joined with mortise and tenon joints. This vessel was a large Roman merchantman built around 50 BC (figure originally printed in Tchernia *et al.* 1978:86, reprinted in Casson 1996:45).

Merged technologies are also apparent, such as the 'Gallo-Roman' tradition, which adapted local 'Celtic' shipbuilding styles to the needs of the invading Roman armies and navies (see for example Arnold 1989; Höckmann 1983; and de Weerd 1991). Further geographic distinctions and regional specializations are extremely varied, reflecting tradition, skill and local environment among other elements. All boats have the same essential function – transportation of people and/or goods on the water – and yet there is a tremendous variety of vessel style, form, design and type. Construction styles change and evolve as new examples are seen and replicated, while proven or traditional styles are retained. Careful examination of watercraft construction and features can demonstrate development and adoption of styles, skill, and technology (Arnold 1985a; Gardener and Christensen 1996).

Boats and watercraft are an unusual class of artifact, in that they are neither entirely portable, nor are they fixed and immobile. Boats can travel; this is of course their main functional purpose. But they are restricted to a specific medium (water), and are almost always restricted to a specific environment within that medium (i.e. rivers, lakes, open seas, etc.). They cannot be moved very far from this medium without a good deal of trouble, and most are rarely or never removed from the water. Only the lightest or easily disassembled vessels can be portaged from one body of water to another without tremendous manpower (see Westerdahl 2006). Their construction requires skill and a large investment of time (potentially similar to building a house), yet they are not fixed to a single location. This combination of mobility and restriction, diversity and uniformity, is a theme that will be further explored throughout this thesis.

The specific type of vessel examined in this thesis is the dugout logboat. This form of watercraft is ubiquitous across Europe, with physical remains dating from the Mesolithic period until modern times. Numerous details of construction, craftsmanship, style and utilization reflect function, local and regional boat-building traditions, as well as cognitive aspects of vessel use. The occurrence and distribution of logboat styles and types can be used as evidence of the transmittal and adoption of information and technology. In this thesis, logboats from the sample area encompassing the two main watersheds in the Czech Republic will be examined and described, with comparative material from across Europe.

Beyond addressing the fundamental questions of knowledge and skill transmission, this work is intended to provide a comprehensive and up-to-date exposition of all logboats from the Czech lands. A comprehensive catalogue of all known and recorded finds is therefore a core element of this thesis. In addition to describing, cataloging, and analyzing early Czech boats, this work is also intended to provide a framework for theoretical investigation, applicable to watercraft from throughout Europe. If a model explaining the diversity of form apparent on Czech logboats can be developed, it will perhaps also be applicable to other types of vessels and to boats from other regions.

This thesis also examines the social role of the Czech Republic's inland watercraft. The technological focus of a field based on material remains is inevitable, and perhaps even more so in boat and ship archaeology, where technical details form the basis of interpretation. However, as early as 1965 J.G.D. Clark had stressed the need to address the social aspects of material objects, as well as treating prehistoric societies in a total ecological context (Clark 1965; see also Sherratt 1976). The symbolic, or cognitive, aspects of watercraft construction and use are a focus of this thesis. In this regard I follow the work of Christer Westerdahl, who suggests that function and symbolism are parallel factors (i.e., there are symbolic factors contained within the techno-practical function). In order to understand why people thought and behaved as they did, we must examine not only the functional and technical aspects of watercraft construction and utilization, but also the 'cognitive and symbolic' elements of building and operating boats. The vessels are used in this study as a proxy for understanding human behavior. Processes of formalized or ritualized behavior may explain elements of boat usage and especially deposition (cf. Van de Noort in press) apparent in the archaeological record. The vessels' contexts (social, cultural, and physical) are especially important in this regard and together provide a foundation for further examination.

1.3 Maritime Archaeology

This thesis is intended as a contribution to the field of maritime archaeology. As defined by Keith Muckelroy (1978:4), maritime archaeology is "the scientific study, through the surviving material evidence, of all aspects of sea-faring: ships, boats, and their equipment; cargoes, catches, or passengers carried on them, and the economic systems within which they were operating…" Inland craft are included in this definition, encompassing riverine and lacustrine environments as well as the sea. This sub-discipline has only developed within the last 50 years or so, and is thus a rather young and rapidly expanding area within the field of archaeology. A justification of topics and interest was perceived as necessary only a few decades back, for example the following quotation from Peter Throckmorton (1970:31-32): "…the study of ships and their cargoes, the sea paths they sailed and the men who sailed them, is surely worthwhile. A sailing ship, seen as an artifact, is one of the most interesting and beautiful of human creations. In it is concentrated the accumulated knowledge of half a dozen crafts through many generations. Like public buildings, ships are expressions of the societies that create them." George Bass described a more functional and practical reason for the importance of watercraft in human history: "The part played by ships in the story of man's progress cannot be overestimated…the reason for the great importance and antiquity of seafaring is a simple one. Wherever water is present, the most efficient method of moving materials in any quantity is by floating them in some sort of water craft" (Bass 1972:9).

Muckelroy, in laying the theoretical foundation for maritime archaeology, refined and expanded on the ideas of Bass, Throckmorton and others. His explanation is worth quoting at length:

> In any pre-industrial society, from the upper Paleolithic to the nineteenth century A.D., a boat or (later) a ship was the largest and most complex machine produced. At Starr Carr, the Mesolithic site in Yorkshire excavated by Professor Grahame Clark, none of the artifacts discussed in the report would have rivaled in terms of size, variety of materials, or construction time the skin-craft whose existence the excavator has postulated. At the other end of that timespan, the eighteenth century First-Rate naval ship, with its hundred-plus guns and crew of over 800, exceeded several times over, in numbers of constituent artefacts and in quantity of power harnessed, the largest machines used on land for transport, manufacture, or mining. But such a dominating position for maritime activities has not been limited to the technical sphere; in many societies it has pervaded every aspect of social organization…in many societies past and present, seafaring and fishing folk have formed a distinct sub-culture, alongside the more generally recognized urban and rural groups. In these ways, and countless others besides, the course of human history has owed not a little to maritime activities, and their study must constitute an important element in the search for a greater understanding of man's past" (Muckelroy 1978:3).

In the past several decades, maritime archaeology has evolved into a global undertaking, with investigations around the world. The discipline has, however, often been focused on the technical aspects of boatbuilding, or indeed on the technology of underwater and maritime research. Investigations of social aspects of maritime archaeology, while more prevalent in recent times, are still outnumbered by those focusing on technological aspects. Seminal investigations have typically been directed towards coastal or oceanic sites (i.e. the Cape Gelidonya, Yassi Ada, and Kyrenia wrecks, the *Wasa*, the *Mary Rose*, and the Skuldelev vessels). Prehistoric inland watercraft, and the people who built and used them, are also a (perhaps under-investigated) piece in the larger puzzle of past human maritime activity.

Dugout logboats, once neglected as a source of knowledge regarding the development of early watercraft, have increasingly been seen as worthy of serious study. Logboat studies have been pursued with new refinement and sophistication in recent decades, beginning with Seán McGrail's (1978) landmark study of the logboats of England and Wales and followed by Arnold (1983, 1996), Mowat (1996), Ossowski (1999) and Fry (2000). Some researchers (for example Johnstone 1980; Casson 1991; Greenhill and Morrison 1995) have suggested that the monoxylous dugout is the ancestor of all wooden planked vessels. Although this proposition is by no means unanimously accepted, maritime archaeologists now acknowledge that detailed and comprehensive study of logboats can be a fruitful step in understanding the development of all ships and boats.

Methodological approaches to the study of early watercraft have progressed as well, from early attempts at simple typology, to more recent quantitative and performance-based analyses. A logical further step in the development of logboat studies, that is the development of an understanding and placement of the vessel within cultural and social contexts, has been somewhat neglected. These vessels can illustrate development and changes in design, uniformity and diversity of features, ultimately leading to an improved understanding of the spread of knowledge, technology and material culture. Thus, this thesis aims to explore new dimensions in the archaeological study of logboats by situating these craft in their cultural and social contexts.

To some extent this work follows from my MA thesis, completed in 2004, which examined logboats and early riverine navigation from the Czech region of Moravia. In that thesis, I studied and analyzed all Moravian logboat finds, including those known only from literary or other sources, as well as surviving boats. Thirteen vessels were presented, of which eight are still in existence. These were catalogued, drawings were included when available, and circumstances of discovery and conservation were described. Analysis consisted of descriptions of the natural and human contexts of the vessels, as well as quantitative performance analysis of six vessels, where enough data existed to perform the necessary operations. The MA thesis also contains chapters on construction techniques and methods for dugout logboats, and a summary of established analytical methodologies. The thesis concluded that riverine transportation in Moravia was of great significance from early prehistoric until modern times, and that the Moravian Gate corridor was an important communication route throughout prehistory. Moravian logboats were sophisticated vessels, some capable of carrying great loads, and over a tremendous span of time these boats contributed greatly to the economic prosperity and well being of the communities that constructed and used them.

The present investigation, although building on past research, is more just than an expansion of the MA thesis. Firstly, data and conclusions presented in previous work have been updated on the basis of fresh information (particularly newly obtained absolute dates). Secondly, the study area has been enlarged to include vessels from the region of Bohemia (approximately twice the size of Moravia), thus encompassing the entire territory of the modern Czech Republic. Thirdly, the evidence has been contextualized within a broader cultural and historical European framework. Results gained from the study of the Czech vessels are compared with case studies from around Europe. Lastly, and perhaps most significantly, I am applying the results of analysis to a much larger question, that of skills and technology spread and transmittal across Europe. The theoretical basis has thus been considerably expanded and shifted to focus more on the cultural and social implications of watercraft building and usage, proceeding from an understanding of the human and environmental contexts, and from quantitative analysis of the vessels themselves.

All field work was undertaken in the Czech regions of Bohemia and Moravia, however, archaeological data and case studies from neighboring lands are crucial for purposes of comparison and contrast. There are several reasons for my choice of this geographical focus; the most important being the lack of recent research and study of logboats from the Czech Republic, my experience in the region and my knowledge of the Czech language. Across Europe, a tremendous body of work has been undertaken documenting logboats from various regions, for example Great Britain (McGrail 1978; Mowat 1996; Fry 2000), Denmark (C. Christensen 1990), France and Switzerland (Arnold 1996), Russia (Okorokov 1995), Germany (Hirte 1987; Pflederer 2002; Weski 2005), Poland (Ossowski 1999), and others. At least one study (Lanting 1998) examined all dated European logboats. These data have generally been available in English, French, or German. In this regard, the Czech Republic has long been a gap in our knowledge base. Work in the Czech Republic (and the former Czechoslovakia) has generally been published only in Czech, and unfortunately rarely reaches a wider scientific audience. Czech logboats are as yet un-contextualized, and thus have not realized their full potential for our understanding of past cultures and behavior. This thesis is therefore intended to provide the most up-to-date information on Czech logboats, and to disseminate information on these vessels to a wider audience.

A further aim of this thesis is to advance logboat studies a step beyond descriptive data collection and quantitative analysis. A detailed technical understanding of vessel construction and performance is an essential part of the process. However, the next step must be to connect those details with human behavior, with the people who built and used the boats. An attempt has consequently been made to place the vessels within a deeper social and cultural context, by examining the skills and needs of the communities that built and used them, and the boats' significance as vehicles of long-distance trade, transport, and communication. In this I build again on the work of Christer Westerdahl, especially his concept of the ‘maritime cultural landscape’ (1992; 2008), applying it to this specifically inland context (here termed a ‘riverine cognitive landscape’; see discussion in Section 2.4). In understanding the formalized or ritualized activities of the boats’ builders and operators, I have also borrowed from Robert Van de Noort’s investigations of prehistoric vessels from around the southern North Sea basin (2004; 2006; in press).

This thesis seeks to explore transmittal of skill, information, technology and ideas in an archaeological context. A small sample set – dugout logboats from the Czech Republic – is used to explore mechanisms and paths for such transmittal. In the process, the socio-cultural, economic, political, and ritual contexts of these watercraft are also examined. These vessels were meaningful to prehistoric communities not only for their role in local transportation and resource extraction, but also as vehicles of long-distance exchange and communication. We can understand the significance of these vehicles not only through examination of exotic material culture, but especially by examining the vessels themselves as they display evidence of skill and knowledge, dedication of community resources and patterns of usage and dispersal. Specific boat-building styles and traditions are apparent, and while some features are geographically widespread, others are restricted to specific regions or watersheds. The resulting uniformity and diversity reflects the processes of knowledge and skill-set transfer, apparent in construction styles and vessel features (Figure 1.8).

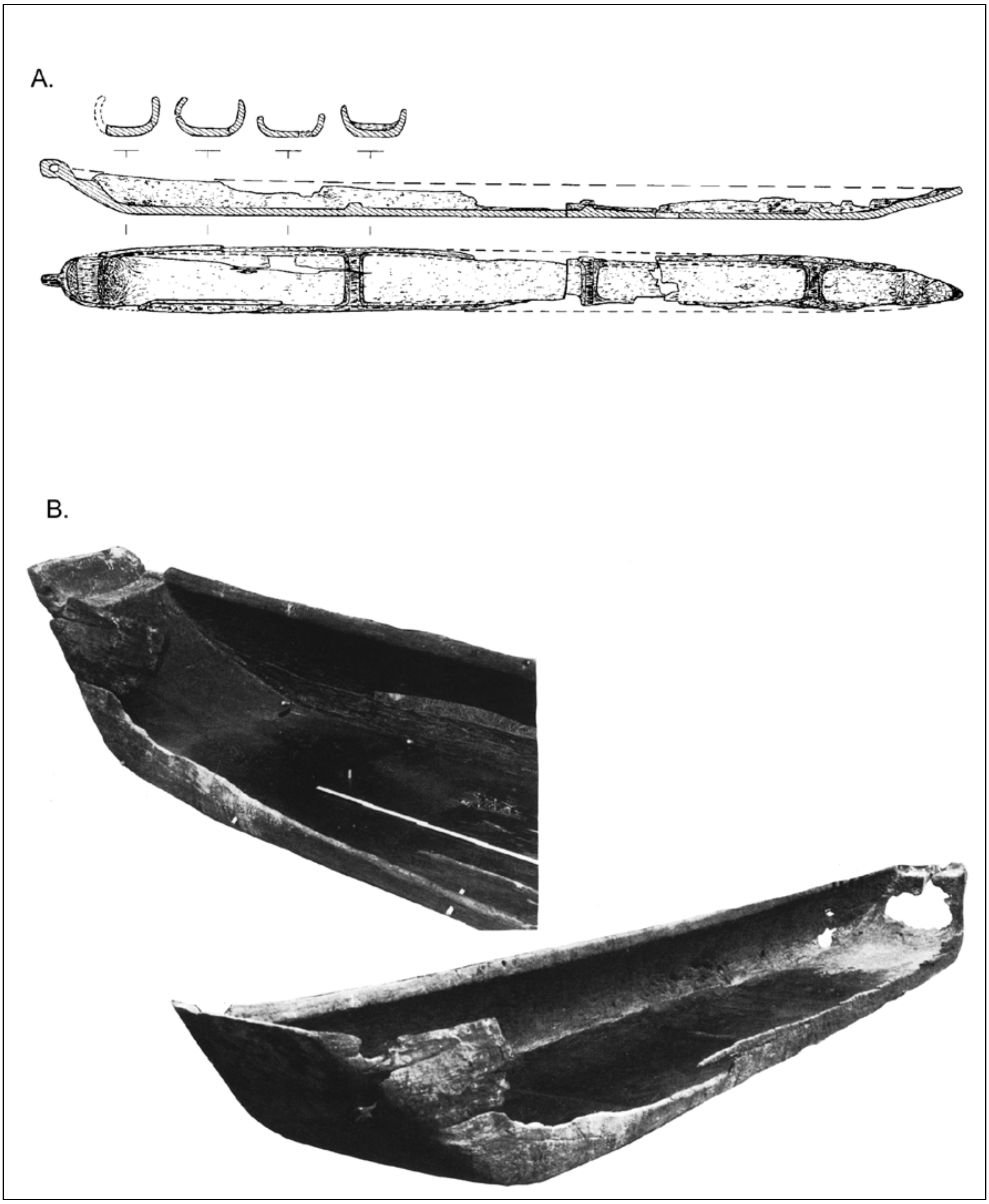


Figure 1.8 Examples of widely varying dugout logboat morphologies. Both vessels are from Switzerland: A) The Cudrefin logboat, dated to 2045±60 (330-80 cal BC) has three transverse ridges crossing the floor, and pointed or oval bow and stern with a horizontal perforation; and B) The Beinwil am See logboat, dated to 450±30 (1410-1480 cal AD), with rectangular sloping bow and stern, and smooth undivided interior (from Arnold 1996).

Boatbuilding is a dynamic process, akin to sculpting. The builder must have a clear conception of the final product before beginning construction. The way in which the boat is built, and the features that the builder chooses to incorporate are results of conscious choice, and are visible in the remains left in the archaeological record. The limited portability of boats, and their restriction to narrow zones in the landscape make them especially useful as indicators of local and regional skill sets. The details and distribution of various boat construction techniques can thus be used to trace patterns of transport, trade and exchange, technological traditions, and information transmittal. Specific research questions of this thesis are described below.

1.4 Research Questions

This thesis will explore the following interrelated research questions, which will be explicitly addressed in the concluding chapter (Chapter 7).

- Despite the limiting nature of the parent material, there is tremendous diversity and variety in the morphology and physical characteristics of Czech logboats. There are many factors that work towards uniformity in boat design (tradition, conservatism of builders, etc.). Uniformity on a local scale is the norm. However, there are significant changes over time and over geographical space, resulting in the diversity apparent in the archaeological record. What are the parameters that determine uniformity and diversity? Can geographically (or chronologically) localized traditions of Czech logboat construction and usage be ascertained through analysis of technical and functional features?

- Boats, although movable vehicles, are by their nature and function limited to a specific environment (waterways such as lakes, rivers and seas). Inland watercraft have a range of motion that on a large scale is restricted to a specific watershed or catchment area. Cultural layers concentrated along rivers within specific watersheds comprise a ‘cultural landscape’ or ‘cognitive landscape’ for these vessels (*sensu* Westerdahl 1992). Can analysis of the vessels’ physical and social contexts elucidate an understanding of the ‘riverine cognitive landscape’?

- Informed by the results of the above analyses, can Czech logboats be used as proxy artifacts for understanding elements of the processes by which material culture as well as knowledge and skill were dispersed and adopted across Europe? What are the implications for information transmittal and exchange? What are the parameters that determine uniformity and diversity of the watercraft themselves?

- Do the processes observed and described for Czech logboats apply to watercraft from other regions of Europe? Do these processes apply for other types of boats? Other types of material culture?

1.5 Organization of this Thesis

The structure of this thesis progresses as follows: Chapters Two, Three and Four are essentially descriptive in nature. The data assembled and presented in these chapters form the basic building blocks for the remaining chapters, an examination of the social and cultural significance of these vessels, and the inferences that can be drawn regarding transmittal and spread of skills and technology. The second section of the thesis (Chapters Five, Six and Seven) progresses from a contextualized analysis of prehistoric watercraft based on the descriptive data presented in previous chapters to a discussion of social and cultural significance. Finally an attempt is made to apply the conceptual framework to logboats and other types of watercraft from European regions outside the immediate study area.

Chapter by chapter contents is as follows. Chapter Two presents background information on earlier research and investigations of European and Czech logboats. Logboats (and watercraft in general) have been the subject of interest in some regions of Europe more than in others. Several main schemes of analysis, developed only since the 1970s, are available for researchers. Most analytical frameworks are typological or functionalist in nature and might be described as 'dehumanized', with little attention given to necessary elements of skill and knowledge. Evolutionary typologies and diffusionist theories are in many respects contradictory to the ways people actually learn and transmit skills. Theories of the origin and spread of dugout vessels are likewise hampered by lack of attention to context and lack of focus on the people who built and operated the boats. Chapter Two therefore provides a critique of previous analysis methodologies and theories of logboat origins.

Previous research on Czech logboats and watercraft in general is relatively sparse. A few researchers carried out investigations of logboat finds in the 1950s and 1960s, and at least two authors went beyond simple description by attempting to fit these vessels into some kind of (pre-) historical context (see Novotný 1951 and Hrubý 1965). Several new finds have prompted renewed interest in the first few years of the new millennium. Publications relating to these newly discovered vessels have focused on problems of conservation and curation, and little contextual analysis has been undertaken (Kučerová and Peška 2004; Šilhová and Špaček 2004). One major problem with Czech logboat studies is the lack of accurate dating, which hinders development of a well-articulated chronology. Only five vessels have been analyzed by ^{14}C or dendrochronology, and conservation of old finds with a variety of different materials makes further research of this type quite expensive (e.g. Wright *et al.* 2001). From a regional (Central European) perspective, logboat investigations from neighboring Poland, Austria and Bavaria have recently been published; and this thesis is intended to integrate with such research (for example Ossowski 1999; Stradal and Dworski 2002; Weski 2005). This chapter accordingly presents a general overview of European logboat studies, and previous investigations and literature on the topic of prehistoric Czech watercraft.

Chapter Two also outlines the methodology utilized for this thesis. This investigation differs considerably from preceding ones by moving from a strictly technological/functional approach to one that attempts a deep understanding of the vessels' social and political contexts as well. The integration of recent research exploring social aspects of maritime archaeology (cf. Nymoen 2008; Van de Noort in press; Westerdahl 2008) is essential to this methodological approach. Once information and data on Czech logboats has been assembled and the vessels situated in their physical and social contexts, patterns of construction and usage can be identified and analyzed.

In Chapter Three, a detailed look at the Czech physical and natural environment is provided, as well as an overview of human settlement in the region. The cultural and social behaviors that I hope to elucidate are inseparable from this natural environment, and cannot be understood without knowledge of it. The Czech Republic forms a fairly contiguous and self-contained geographical unit, being surrounded by mountains on nearly all sides (only the southeast border of Moravia is open to the neighboring countries, being mostly flat ground and plains).

Bohemia itself is a shallow basin, while Moravia is generally hilly or mountainous except, as mentioned above, on the flatlands of the south. Internal geomorphology and landforms are discussed in this chapter, as well as the most important geographic features for our purposes: rivers and major bodies of water. The region of study is located a considerable distance from any ocean or sea, and has few sizable bodies of water. There are, however, two important riverine watersheds: the northwest-flowing Vltava-Elbe river system in Bohemia, and the south-flowing Morava river system in Moravia. Mountainous and rugged territory means that in prehistoric as well as historic times, river valleys have always provided important corridors for movement and transportation in the Czech lands. The use of Czech waterways in the historical period, also examined in this chapter, provides further data on the recent importance of these transit zones. Chapter Three appraises the human significance and usage of the major Czech river systems by examining the physical geography - human interrelationships.

Chapter Four contains a database of vessels, providing physical measurements, morphological descriptions and other technical data for each boat. The first step in the data-gathering process for this thesis involved compiling a catalogue of all known and reported Czech logboats. In the course of my research, I was able to physically inspect and examine all but one of the existing vessels. In many cases it was necessary to document features that had not previously been reported, and to produce scale drawings for inclusion in the catalogue. Most of the existing vessels are held in regional museums or repositories near the discovery locations. Visiting these areas allowed me to get a "feel" for the landscape environment, at least in its modern incarnation (and of course major features of the Czech landscape, such as mountains and rivers, are not significantly different today than in late prehistoric times). While not a quantitative evaluation, this experience of visual analysis of landscape and climate provides food for thought (cf. Nymoen 2008).

The catalogue describes find contexts, circumstances of discovery, measurements and dimensions, treatment and conservation, and ultimate fates of the vessels. Technical methodologies exist for determining performance and load-bearing characteristics of logboats and other vessels, and naval architecture can provide one with quotients and indices for calculating everything from laminar and turbulent flow to the tensile strengths of building materials. As demonstrated by McGrail (1978), Mowat (1996), and Fry (2000), among others, logboat purpose, functionality, and intended usage can potentially be determined from typological and morphological analysis of empirical evidence. These methodologies are all quite useful, but must in the end be used as tools for understanding past human behavior and societies rather than as ends in themselves.

Chapter Five presents an analysis of the Czech logboats and their contexts, including utilization, details of form and construction, distribution, and dating. Elements of uniformity and diversity are immediately apparent. Patterns of morphology, construction, and features are identified and considered. Boatbuilding styles and traditions vary between the region's two main watersheds, although specific elements have crossed the 'land bridges' between the rivers' headwaters. The geographic context is thus an important part of the analysis, demonstrating the spread and adoption of styles and technique.

Chapter Five further uses the data and contextual information assembled in previous chapters to elaborate the social and cultural aspects of boat building and usage in this region and period. A central theme is the understanding and general articulation of the significance of the region's watercraft when examined within cultural and social contexts. Functionality is but one part of the overall picture here; just as important (but more difficult to elucidate) are cognitive aspects such as symbolic significance, and the perception of watercraft as prestigious objects, representing the community's skill, craftsmanship, and ability (cf. Westerdahl 2008). It is only relatively recently that studies of early vessels have passed to a contexualized level where aspects such as symbolic meaning and socio-cultural significance can be explored (cf. Gibbins and Adams 2001).

The discussion in Chapter Five further considers vessels' multiple roles and meanings, addressing topics such as communication, trade and cargo transport, social identity, and identification of key transportation routes. I seek to understand the boats' builders and users (and their cultures and societies), via the artifacts and contexts encapsulated in the archaeological record. Once more to quote Keith Muckelroy (1978:4): "Above all, it should be noted that the primary object of study is man…and not the ships, cargoes, fittings, or instruments with which the researcher is immediately confronted. Archaeology is not the study of objects simply for themselves, but rather for the insight they give into the people who made or used them… maritime archaeology is concerned with all aspects of maritime culture; not just technical matters, but also social, economic, political, religious, and a host of other aspects." Chapter Five concludes with the formulation of a model that seeks to explain the elements of diversity and uniformity apparent on Czech logboats.

Chapter Six seeks to apply ideas and results generated in previous sections of the thesis to regions and environments other than Bohemia and Moravia. If construction traditions can be identified, especially by patterns of features or morphology, then skill set transfer and adoption may also be identified. The influence of geography and the role of waterborne transport, central to this thesis, should be applicable and recognizable in almost any environment. The model is tested through examination of case studies from other periods and territories of Europe, seeking to ascertain whether similar results can be elucidated from different environments. The final aim of the case studies is not only to determine whether boatbuilding traditions can be traced both geographically and chronologically, but to identify elements of the practice of human exchange of skills and knowledge.

The final chapter (Seven) concludes the thesis, with a discussion of the findings as they relate to the research questions posed above. Data and information from previous sections of the thesis are arrayed, presenting conclusions regarding prehistoric watercraft usage and significance in Central Europe's inland river systems, and their role as indicators of information and skills transmittal. The thesis results have wider relevance and implications for boat building and culture change in general. The significance of the model developed in Chapter 5 is discussed, particularly implications for the major switch in ship design and construction occurring in Northern Europe between around 1300 and 1500 AD. The results of the thesis suggest new questions, and potential directions for further research are identified and examined.

CHAPTER TWO – PREVIOUS RESEARCH and METHODOLOGY

This chapter will review previous scientific work and investigations relating to the study of logboats in Europe, and to prehistoric and early historic watercraft in Bohemia and Moravia. A summary of logboat research from adjacent regions, especially Slovakia, Austria, Poland and Germany, extends the scope and context to include background and information on dugout vessels from those neighboring countries. An overview of the current state of established scholarly approaches to general logboat studies is presented, as well as an explanation of major methodologies used for vessel analysis. Previous approaches to questions of logboat origins and spread have tended to focus on culture-historical placement, diffusion or functionalist explanations. With few exceptions, the roles of people who actually built and used the boats have been significantly neglected in past and indeed present studies of prehistoric watercraft, especially dugout logboats. This chapter examines and critiques the most well-known and influential logboat studies from this basis. A further portion of this chapter will also provide a description of my own methodological approach, which makes use of and builds on past studies but is also intended to refocus attention on vessel builders and operators.

Almost all the currently existing material written about Czech logboats is descriptive in nature, often from discovery announcements or conservation reports. Several authors, however, have expanded their research beyond simple description and attempted more analytical or explanatory investigations. No comprehensive summary or catalogue of vessels from Bohemia or Moravia has previously been published. Recent discoveries have prompted renewed interest in Czech logboats, and improved conservation and curation techniques are being applied. The study and description of Czech logboats, within their historical and geographic contexts, has potential to elucidate the skill sets and technological traditions of the people who built and used the vessels. This in turn can help us to understand their actions and behavior, and their roles in culture and society.

2.1 Logboat Studies: Analysis and Theories of Origin

Boats, as opposed to floats or rafts, derive flotation and buoyancy from the displacement of water by a continuous watertight outer surface (McGrail 1987:5). A conceptual distinction between boats built as a *waterproof shell* or as a *waterproof frame* has long been recognized (Hasslöf 1958, cited in Westerdahl 1992; also Greenhill and Morrison 1995; McGrail 1987). The former are usually referred to as *shell-first construction*, the latter *skeleton-first* or *frame-first* construction. Logboats (also called 'monoxylous' dugouts from the Greek *μονόξυλον* or *mono*- single and *xylon*- tree), are a basic variant of the waterproof shell. In a general classification of watercraft, dugout logboats may be described as *shell-built by reduction*, i.e. the original raw material (a tree-trunk) is hollowed out and reduced in volume, leaving a waterproof shell. Reduction, as opposed to junction or moulding, is still used in ship construction for shaping components such as stems, aprons, and deadwoods (McKee 1983:44). To construct a logboat, the trunk may be either whole or split longitudinally. The log interior is reduced and hollowed out, possibly leaving various internal features, and the exterior may be shaped to improve hydrodynamic efficiency (Figure 2.1).

McGrail identified several variants of the basic logboat, comprising *expanded*, *extended*, and *paired* versions (McGrail 1987:56). Expanded logboats are moulded (often using heat) to expand and fix the hull shape. Extended logboats use extra planks or strakes to build up the hull sides and improve seaworthiness. Paired logboats are doubled and joined hulls, which improves stability and expands cargo space. Multiple logboat hulls may be joined to create a logboat raft. Other researchers refer to the basic logboat as a "hard" canoe, i.e. hollowed directly from the log, and those vessels expanded and molded by heat as "soft" (Rausing 1984:10). In northern Europe, basic logboats are sometimes called "trogförming" (trough-form), and expanded vessels "schotenförming" (pod-form) (Clark 1952:284).

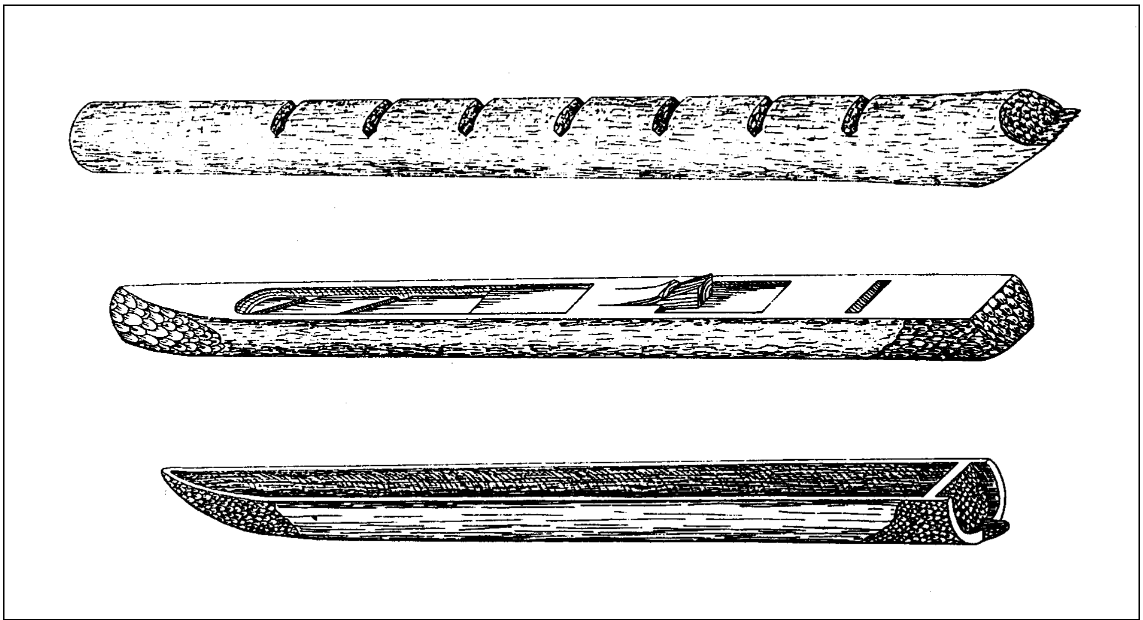


Figure 2.1 In this visualization, an entire log is being used to construct a dugout logboat. Notches along the top are gradually enlarged using wedges, and finally the interior is hollowed by adze. The final exterior shaping is also accomplished by axe and adze (illustration from C. Christensen 1990:136).

To improve seaworthiness and increase freeboard, planks or strakes can be fastened along the vessel's sides. As more strakes are added on either side, the original dugout torso became a log keel or centre plank (Figures 2.2, 2.3). These construction techniques can be seen on the eleventh century Utrecht boat (Van de Moortel 2000:9), the fourteenth century Kentmere boat (McGrail 1987:75), and even relatively modern vessels such as Bangladeshi riverboats or Pomeranian plank boats (Greenhill and Morrison 1995:111-114).

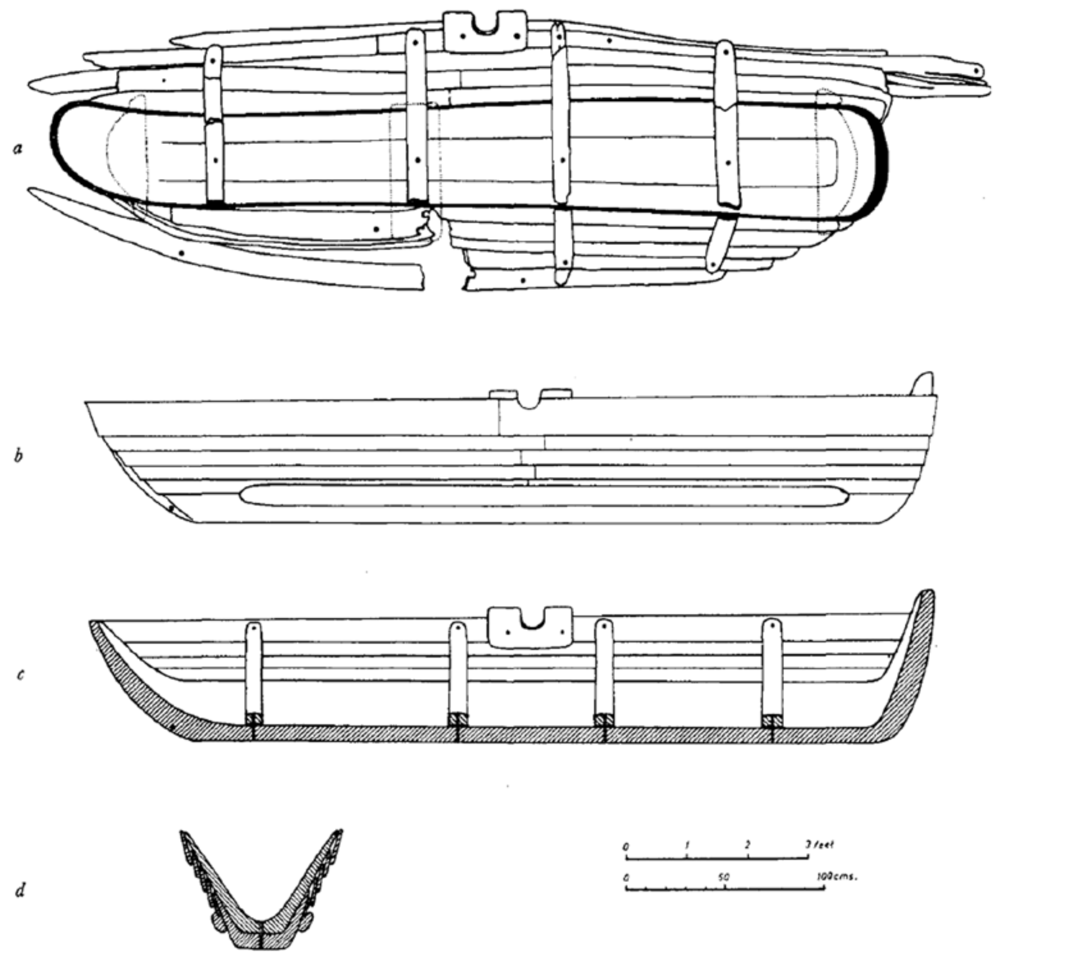


FIG. 30
BOAT FROM KENTMERE, WESTMORLAND
a. Plan made during excavation; *b*. Reconstructed side view; *c*, *d*. Sections through reconstructed boat

Figure 2.2 Vessel from Kentmere (UK), found in 1955 and dated to 1320±130 (530 – 990 Cal AD). The logboat torso has been extended by a series of strakes along the sides, attached with transverse frame members (illustration from Wilson 1966:83).

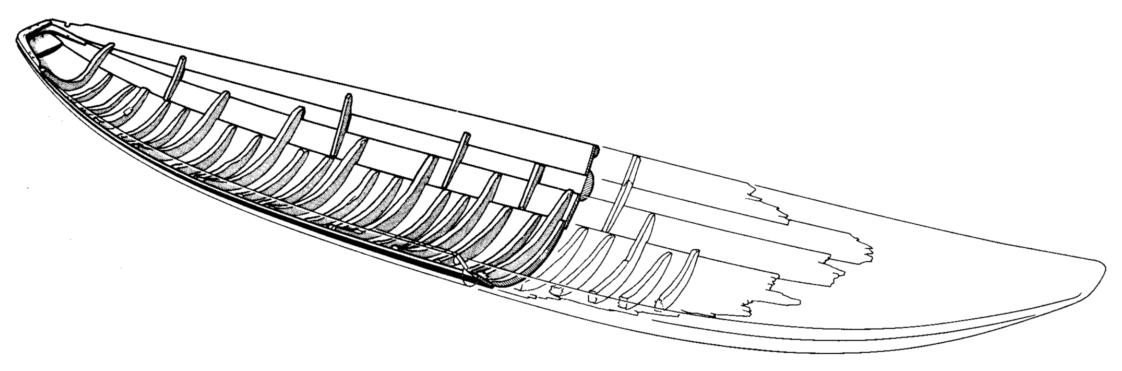


Figure 2.3 The Utrecht vessel, dating to the late 12th century AD, in which a logboat hull has been extended by adding numerous strakes joined by internal frames (illustration from Arnold 1992:68).

Similar techniques were used to increase the interior space. Alford described Carolina “split-dugout canoes”, made by splitting the tree trunk and inserting a plank down the vessel centerline to expand area and cargo capacity (Alford 1992:201). This style of logboat construction was extensively documented by early observations of New World canoes from Central America to the eastern seaboard of North America. On the Mosquito Coast rivers of Panama and Nicaragua, a long narrow flat-bottomed logboat called a *pitpan* was cut lengthwise into equal halves. Flat bottom boards were inserted, and the two halves rejoined to create a cargo vessel capable of carrying two and a half tons. The basic construction style was used into the early 20th century for the Chesapeake log canoe or Poquoson canoe, which was a hull made from two or more logs. Large Poquoson canoes could be made of five or even seven logs (Roberts and Shackleton 1983:31, 76-77).

European logboats have been found in coastal, riverine, lakeside and wetland deposits across the continent. The vessels have historically received more scholarly attention in some regions than in others, and at various times. Victorian antiquaries in Scotland, for example, extolled logboats largely on their supposed value as chronological indicators (Mowat 1996:1). Logboats received prominent attention in Ferdinand Keller's studies of Swiss lake villages (1865; 1878; see Figure 2.4) and Robert Munro's work on Scottish crannogs (1882). Along with Sir Cyril Fox's typology of English "dugout canoes" (1926), these early works sought to classify vessels by shape and form, and attempted further analysis on that basis. Interest waned as more examples were uncovered and researchers realized that logboat typology rarely indicates chronology. This class of artifact has a multitude of other inherent difficulties for the researcher: they are large, heavy, frequently in a poor state of preservation, difficult to conserve, and often come from a difficult to investigate context (i.e., underwater). These problems have led to an enduring perception of dugouts as somewhat esoteric and obscure, or even "low status" (Nymoen 2008:7), "distasteful" (Fry 2000:1) and "unloved" (McGrail 1978:22).

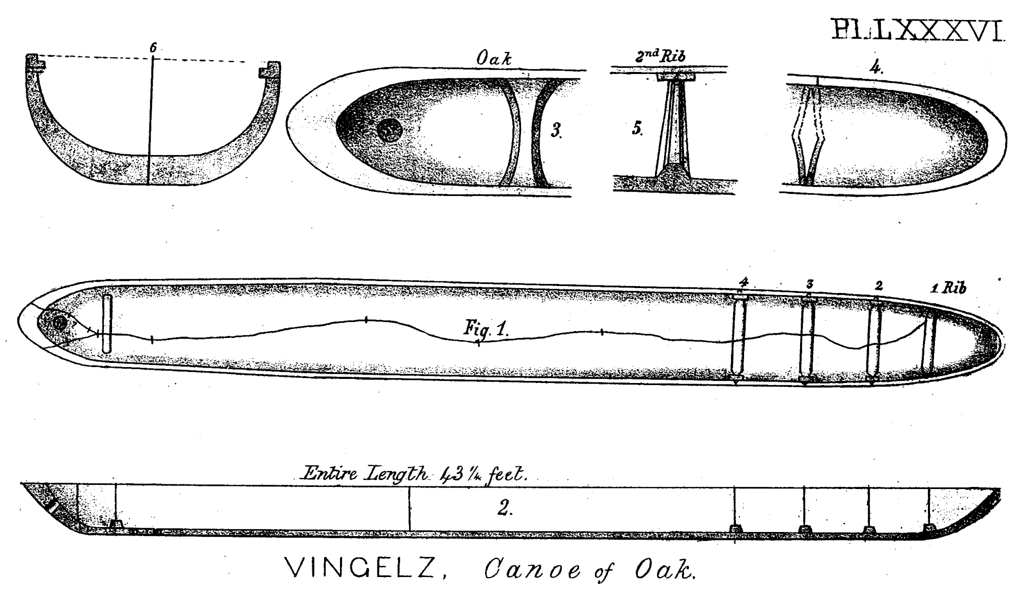


Figure 2.4 Dugout logboats illustrated in Ferdinand Keller's 1878 work *Lake Dwellings of Switzerland*.

With the development of methods of absolute dating, along with new techniques of maritime archaeology, logboat studies are placed on firmer ground. A variety of analytical schemes and programs have been developed, notably those of McGrail (1987), Arnold (1996), and Fry (2000). Typology and classification, while not necessarily relevant to chronology, are useful in analyzing properties and characteristics such as vessel function, payload, and performance. Logboat construction methods and techniques are increasingly well understood, and reveal much about the builders' tool-use and technological sophistication (for example Marsden 1989; C. Christensen 1990, and Arnold 2000). Finally, the value of logboats has become especially clear to those researchers interested in tracing the development of the ancient roots of watercraft, and especially the transition to planked vessels (for example McGrail 1987; Arnold 1989; Greenhill and Morrison 1995; and Ellmers 1996a).

Ethnographic accounts of logboats still in use or recently in use are a valuable tool for researching prehistoric vessels. Particular mention should be made of James Hornell's early work in Africa and Asia (Hornell 1940, 1946), and Basil Greenhill's documentation of vernacular watercraft in Southeast Asia and South America (Greenhill and Morrison 1995). The New World has been an especially fruitful region for ethnographic logboat research (see for example Roberts and Shackleton's extensive investigation of New World dugouts from Panama to the sub-Arctic (Roberts and Shackleton 1983), McCusick's (1960) work on logboats of the West Indies, Hammond's (1981) discussion of Mayan canoes, and numerous works on dugouts of the Pacific Northwest and Alaska (Durham 1960; and Holm 1994 with references)).

Among the most influential modern works on the archaeology of European dugouts is Seán McGrail's landmark study of the logboats of England and Wales (1978). In this piece McGrail catalogued all the then-known logboats from England and Wales, but most importantly, offered a detailed and extensive scheme for vessel analysis. In McGrail's opinion, real progress in understanding logboat form and function could only be made by explicit quantification during the analysis phase. To this end, he devised a series of indices, drawing on techniques of naval architecture and engineering, for calculating detailed nuances of vessel form, function, performance, and safety. McGrail's analysis (1978:95) defines performance in terms of speed, payload, and maneuverability, while safety consists of structural strength and durability, watertightness, and stability. The resulting calculated indices then allow the investigator to make statements about an individual vessel's form, function, propulsion and speed potential.

McGrail's highly detailed analysis schemes are unfortunately not well suited to poorly- or partially preserved specimens, and the full range of information was available for only 24 vessels of 172 in his own study. Recognizing the limitations of such a small sample, McGrail commented that a more final judgment of vessel capabilities must wait until more logboats are available for comparison (1978:329).

In the past 30 years, many more European logboats have been discovered and investigated, and a variety of other analysis schemes developed. Bonino (1981, 1983) made extensive use of historical and graphical material in his regional studies of Italian logboats (Figure 2.5), while Philipsen's (1983) thesis on Danish dugouts included a cluster analysis of constructional elements. Expanding from his investigations of French and Swiss vessels, Béat Arnold developed an extensive and detailed scheme of typology and has compiled a computer database that contains scanned records of articles and references for over 2400 European logboats (1993; 1996; 2002).

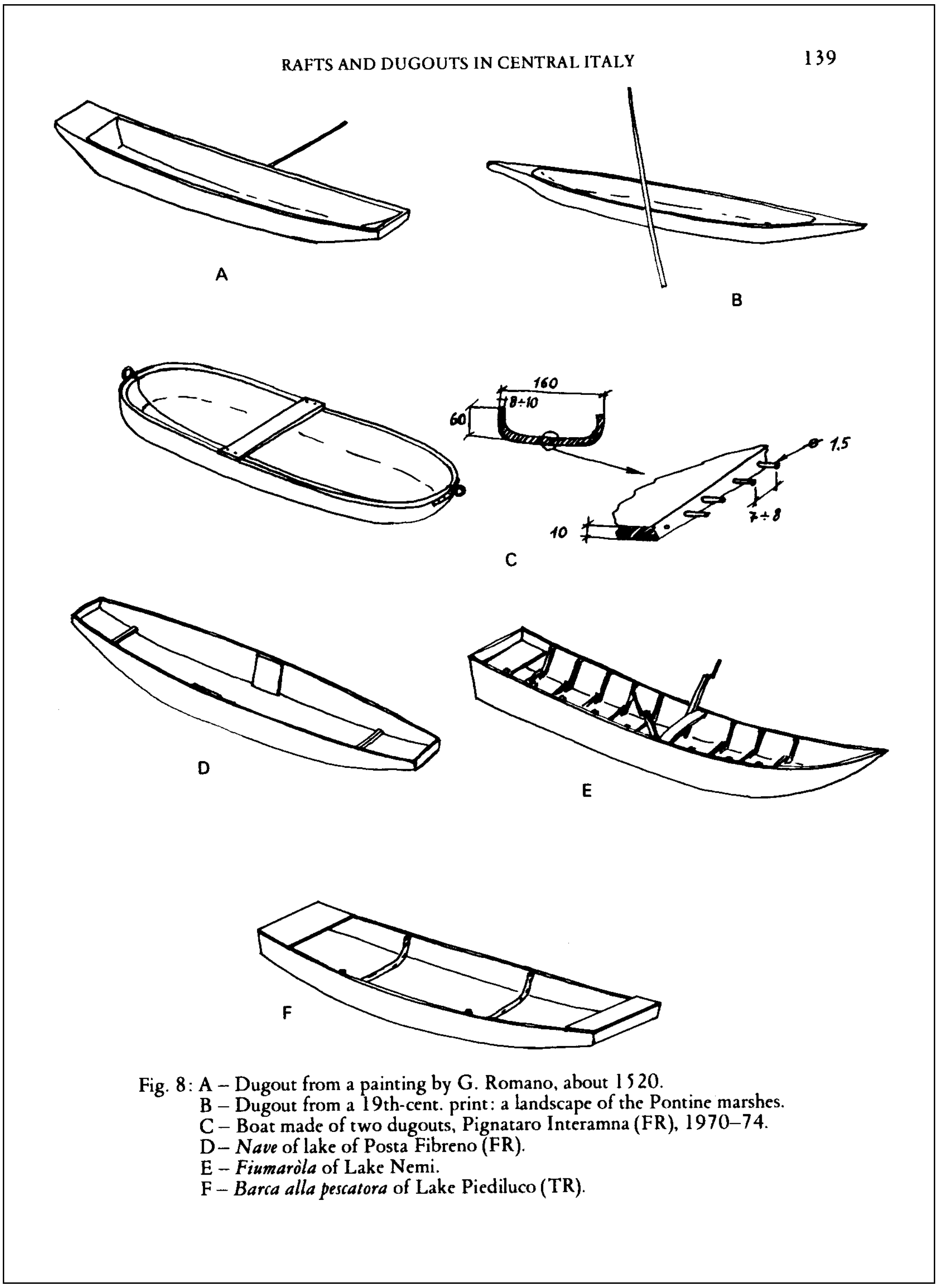


Fig. 8: A – Dugout from a painting by G. Romano, about 1520.
B – Dugout from a 19th-cent. print: a landscape of the Pontine marshes.
C – Boat made of two dugouts, Pignataro Interamna (FR), 1970–74.
D – *Nave* of lake of Posta Fibreno (FR).
E – *Fiumaròla* of Lake Nemi.
F – *Barca alla pescatora* of Lake Piediluco (TR).

Figure 2.5 Depictions of logboats and other small watercraft from Central Italy (Bonino 1981:139).

Arnold's typology is based on a series of codes used to describe vessel features, starting with general lines and gradually working to the smallest morphological details. This approach is designed to avoid problems encountered by earlier typologies (for example that of Fox (1926), who attempted classification of vessels as a whole, and McGrail (1978), who subdivided logboats into 3 parts (bow, central hull, and stern)). The flexibility of these approaches was limited, and they were found to be insufficient at describing the full range of logboat morphology. Arnold's system is supposed to be able to handle any possible combination of elements, even those features yet unknown. Arnold (1996:17) notes that his system is deliberately more graphic than quantitatively descriptive, in an effort to allow the widest possible application of the typology analysis (Figure 2.6).

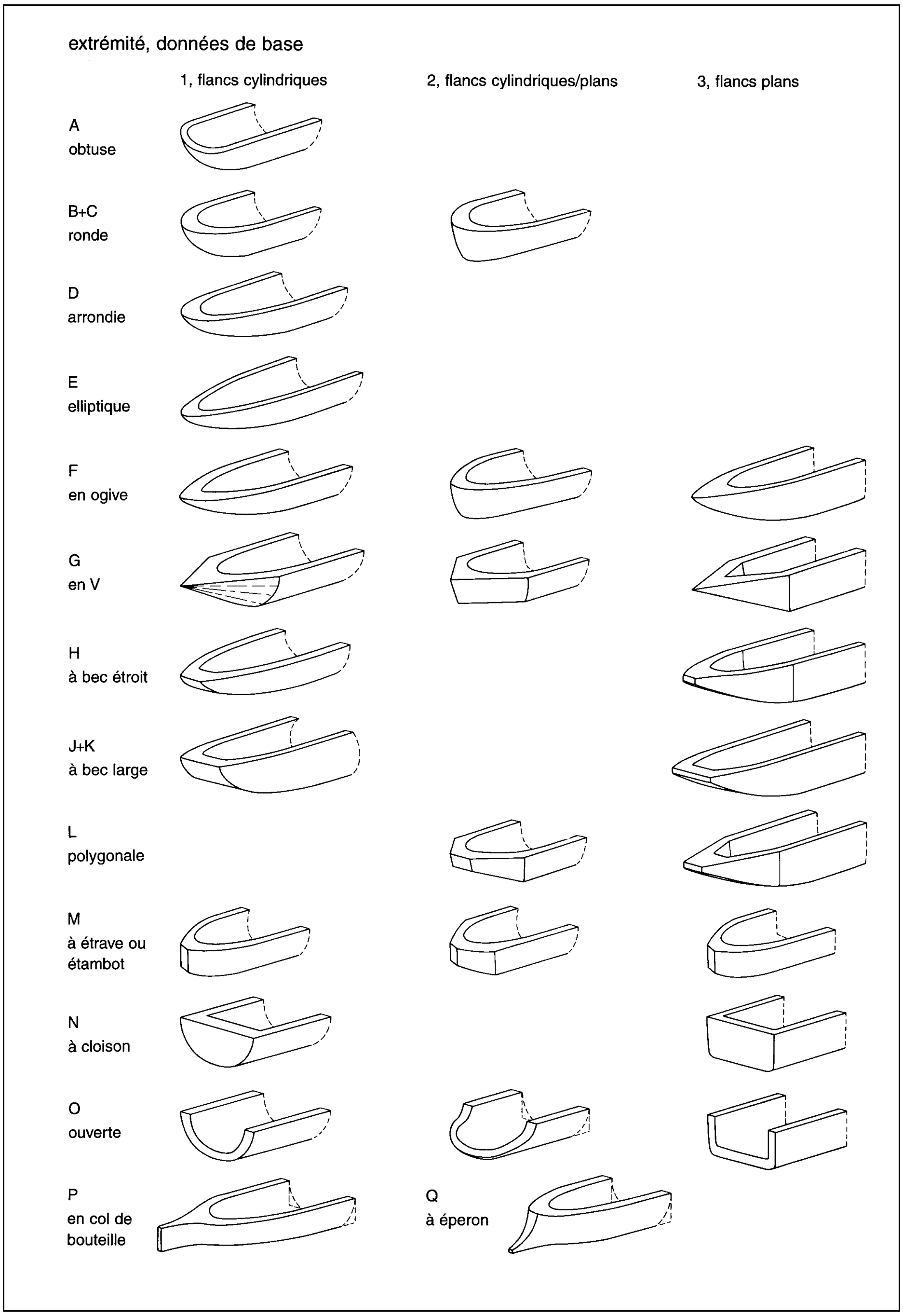


Figure 2.6 A portion of Béat Arnold's logboat typology scheme, classifying external bow shape and features (Arnold 1996:18).

Another useful analytical framework is that developed by Malcolm Fry for his examination of Northern Irish logboats (2000). Fry, while acknowledging McGrail's pioneering work, deliberately omitted the "complex hydrodynamic and architectural issues which other writers have handled exhaustively already" (2000:13). Fry developed his system of "minimum freeboard theory" by collecting data from the payload performance of modern experimental logboats, and creating a formula based on hull displacement and unladen draft (Figure 2.7).

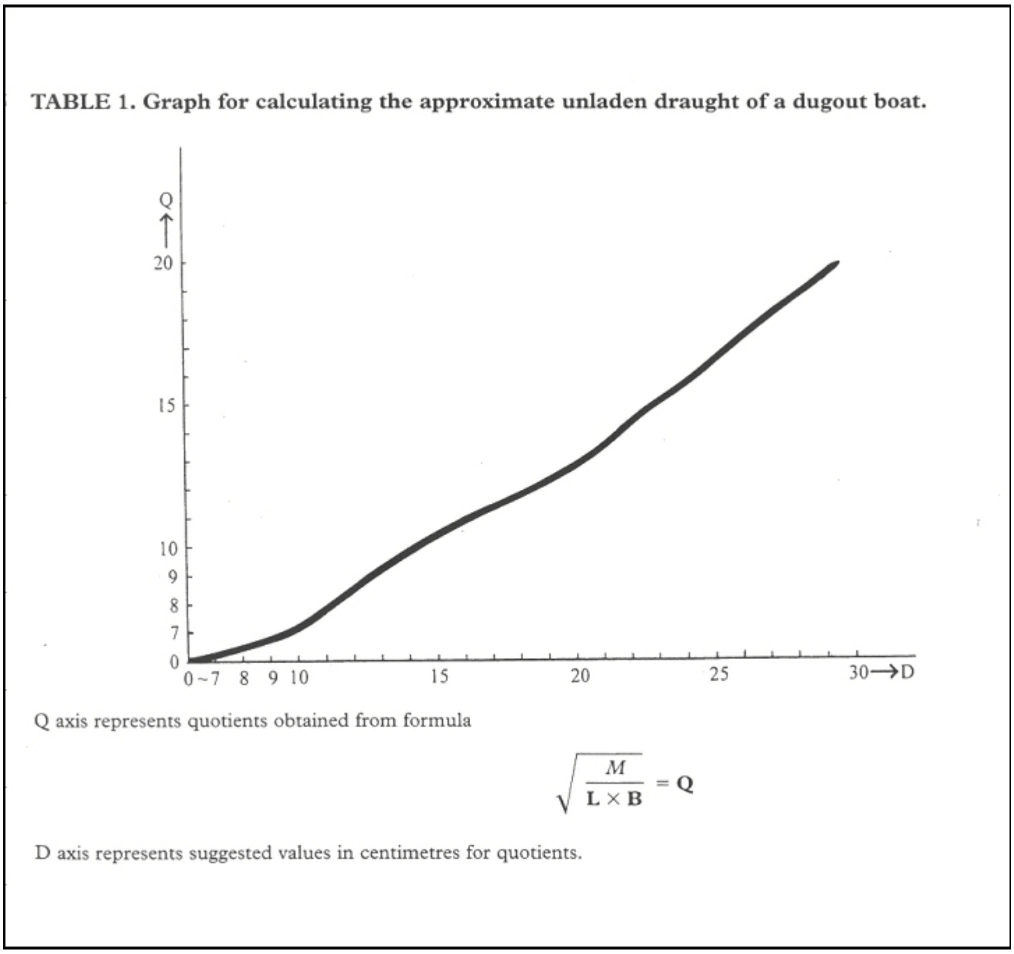


Figure 2.7 Graph developed by Malcolm Fry (2000) for calculating the approximate unladen draught of a dugout logboat, based on data collected using modern experimental vessels (M=hull mass, L=length, B=breadth).

Fry's scheme is especially well suited for vessel analysis based on scale drawings alone, and provides an approximate estimate of loading capacities. The accuracy of Fry's scheme when applied to large numbers of disparate vessels is perhaps questionable, but the results of analysis are useful at least for baseline estimates.

Experimental construction of logboats has helped investigators to understand construction methods. Detailed reports have been published, for example that by Arnold, who used a fire-hollowing and expansion process to replicate the Neolithic dugouts from Paris-Bercy (2006). Similarly hand-hewn logboats created in the Czech Republic by Radomír Tichý and students (Tichý 1999) were eventually sailed on the Mediterranean. Experimental studies such as these can provide useful baseline information on the labor and techniques involved in constructing a logboat.

In his well-known study of boats and the development of boat types from around the world, Basil Greenhill suggests that:

> More types of boat and vessel in the world probably owe their remote origins to a hollowed-out log than to a raft, skin boat or bark boat, for the hollowed log is susceptible to almost limitless development while the very nature of the structure and materials used in rafts, skin boats and bark boats restricts their development in varying degrees. The lines of descent from the logboat are extremely complex, starting and stopping again at different times in different parts of the world, interrelating in some areas, developing in other places without any apparent influence from other areas (Greenhill and Morrison 1995:101).

Although eloquent, Greenhill's investigation assumes an evolutionary perspective, and lacks consideration of the origins of logboats themselves and the ways in which technology is transmitted and adopted. Speculation on the origins of European logboats have often focused on typology (often as an indicator of chronology), and later on more functional explanations. Investigations of the processes by which logboat features and innovations are transferred and adopted have been lacking in the extreme.

As noted by McGrail (1987:57), most early investigations generally presumed logboat discoveries to be prehistoric in origin. Great antiquity was postulated for many logboats "on the flimsiest of stratigraphic or associative evidence" (for example the Friarton boat, cf. Mowat 1996:35; McGrail 1987:58). That some

British logboats could be post-Roman was suggested by Wilson (1966; also cited in McGrail 1987), and this of course was subsequently confirmed by radiocarbon dating.

The earliest explanations of logboat development (and indeed most forms of material culture) followed an evolutionary model, heavily influenced by the theories of Charles Darwin. The case for this argument rests on an analogy between cultural evolution and biological evolution, and requires an assumption of monogenesis (that is, that all the samples in question have a single common ancestor (cf. Pitt-Rivers 1875; also Renfrew 1979)). Among the first arguments of this type relevant to watercraft was that developed by Cyril Fox. Fox (1926) presented a genealogical typology model of logboat design and construction, with early primitive boats being followed by gradually more sophisticated vessels. Five groups, based mostly on bow and stern shapes, are deemed to be descendent forms which developed from a single prototype design of great antiquity (Figure 2.8). According to Fox, vessels with rounded cross-sections, following the shape of the parent trunk, must be the oldest models as these are inherently the least stable. Improvement was effected by squaring the sides and creating a chine, or by increasing the height of the sides and lowering the centre of gravity when laden. Pointed ends could increase vessel speed, and Fox saw composite or inserted transom ends primarily as a labor-saving device. Given the rather complicated extra work involved in composite transom ends (i.e. grooving, caulking, or lashing), this last assertion is rather surprising. Indeed McGrail (1987:35) has pointed out that transom ends are the only way to compensate for heart rot, which makes large oaks and other trees unsuitable for logboats unless the rotten end is somehow closed.

Fox's typological classification (1926:132) is comprised of the following groups:

Group I: Rectangular, punt- or trough-shaped vessels;

Group II: Rounded bow, square stern, widest point at the stern;

Group III: Both ends rounded or pointed;

Group IV: Spoon-shaped dinghies;

Group V: Pointed bow, square stern, widest amidships.

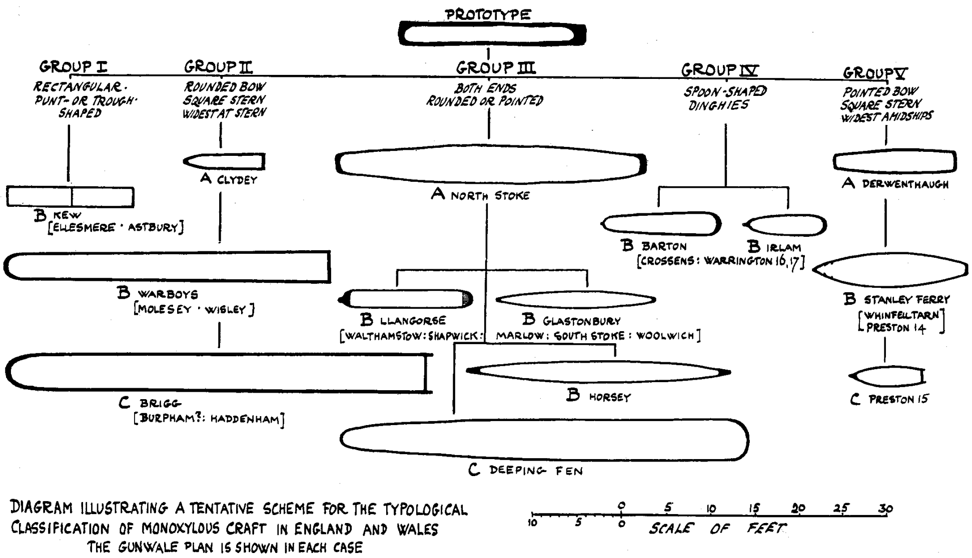


Fig. 3.

Figure 2.8 Cladistic diagram of logboat typology developed by Cyril Fox on the basis of his investigation of vessels from England and Wales (Fox 1926:132).

Further sub-groupings are also presented, based primarily on hull shape in cross-section. Vessel function and purpose were then assigned, based on the group and form. Fox continued his analysis by plotting 34 British vessels known at the time on a map, to see whether his groupings had any territorial correspondence. This analysis showed the first three groupings were primarily located in the south of England and Wales, the other two in the north, and a gap in logboat finds in general through the English Midlands. Fox admitted the “peculiar difficulties” of creating a chronology based on this typology, but suggested that Groups I and III had developed prior to the Roman period in Britain, and that the other groups were post-Roman in nature (Fox 1926:145).

James Hornell, as well, conceived of boat development (and especially of dugout logboats) in a linear fashion from earlier primitive to later sophisticated models (Hornell 1940; 1946). Hornell's earlier conception of the dugout as the ultimate ancestor of both clinker and carvel-built plank vessels was later modified to include bark canoes as a precedent of the logboat. Mainly on the basis of Australian, African and southeast Asian ethnographic examples, Hornell (1946) concluded that the earliest logboats were replicas of bark boats, likely originating in India or the Malay Peninsula.

Clark (1952), while fully cognizant of the essential utility of watercraft for trade and transport throughout prehistory, asserted that there is no evidence for boat use during the Paleolithic. Mesolithic settlement distribution and fish-bone middens, however, point to the use of boats fairly early in the post-glacial period. In Clark's view, the earliest boats in Europe would have been keeled skin-covered boats of the basic umiak type. Logboats "become feasible with the appearance, during Mesolithic times, of stone or flint-bladed axes capable of hollowing out and shaping tree trunks" (Clark 1952:284). Clark recognized the longevity of this vessel type, and (citing Mitzka 1933), commented that "when dug-outs were given up, it was not because they were ineffective, but simply that under modern conditions they were too expensive to replace by their own kind" (Clark 1952:286). This suggestion is supported by Arnold (1985a:285), who described the logboats still in use on the lakes of Central Switzerland through the 19th century. By the early 20th century the Alpine forests had become depleted of the large trees needed to construct dugouts, and the logboats were replaced with plank-built vessels due to the lack of raw material. Clark's work is directed mainly at describing the economic factors at work in Prehistoric Europe, and omits discussion of users and their role in the spread of logboat technology and boat building traditions.

Seán McGrail's extremely influential 1978 thesis ("The Logboats of England and Wales") tends to avoid questions of origin and spread of the vessel type, focusing instead on performance, construction techniques and classification. As does Clark, McGrail (1987:86) supposes that logs suitable for dugouts would not have been available until the Mesolithic, ca. 8000 BC. McGrail thus shares a regional approach with culture-historical thinkers (assigning logboats to a respective culture or period on the basis of absolute dating), although his analysis of the vessels is purely functional. Logboat development is seen in terms of diffusion of ideas and material culture, or simply as a result of migrations. McGrail is explicit in not attempting "to seek out origins or evolutionary trends", rather he intends to "marshal in due order the major part of the knowledge within our ken" of the water transport of early Europe (McGrail 1987:3). The extensive performance indices and systems of classification developed by McGrail reflect this perspective. Importantly, despite his extensive functional and technical investigations and undoubted contributions to the field of maritime archaeology as a whole, McGrail has never really participated in major theoretical debates.

McGrail's functionalist approach was adopted by Mowat (1996), who provides dates or approximate chronology for many Scottish logboats, but omits any discussion of the people who built them. In fact, Mowat's conclusion (1996:135) is completely dismissive of boat builders and operators, asserting that "the logboat is a simple form of construction, which requires only a low degree technical understanding and a simple toolkit for its construction. It has probably been readily re-invented on numerous occasions when circumstances demanded, and may well be so again." Mowat (1996:123) also discounts the possibility of recognizing boat building traditions or local groups based on morphology as an "unsophisticated analytical tool". In Mowat's view, the constraints placed on the builder by the available raw materials (i.e., the parent trunk), and the potential for decay, together present a virtually insurmountable obstacle to analysis.

A more optimistic functionalist perspective, in which form and morphology display evolutionary progress and development, is presented by Detlev Ellmers (1996a). Ellmers, similar to Clark (1952) asserts that the first boats used in Europe were skin-covered vessels, as trees large enough to use as dugouts were not available until environmental conditions ameliorated in the 8th millennium BC. Ellmers allows at least a modicum of human agency in the origin and spread of watercraft, suggesting reindeer hunters constructed the earliest boats to use during the hunt. Fishing was a further use for watercraft, and finally transport of goods and materials (and presumably, people) (Ellmers 1996a:13-15).

Ellmers contends that the first dugouts were a response to the changing environment, as Ice Age fauna retreated from temperate Europe, and people learned to procure food resources from dense forests and marshy valley plains. Dugouts, however, constituted a leap of technology, as this vessel type required a fundamentally different conceptual approach than the previously utilized skin boats. The reductive techniques of dugout boat building were an innovation involving considerable re-thinking. This new method of construction turned out to be "one of the crucial transition points in the history of boat building and water transport" (Ellmers 1996a:15). Ellmers takes the position that the shell-first method of construction based on the original dugout design was the evolutionary basis of all European boat and shipbuilding for the succeeding millennia.

In Ellmers' essentially environmentally-determined functionalist perspective, the form of the original dugout logboat (essentially based on the Pesse vessel, dated at 8270±275, or 7969-6568 cal BC) closely followed that of the parent trunk, with the result that it "rolled badly in the water and required much skill to paddle" (Ellmers 1996a:15). Shaping the vessel's ends was also a problem, as cutting across wood fibres lead to differential drying and cracking. This problem was eventually solved with the working of angled or beveled cuts along the grain, and the invention of inserted transom ends (as on the Mesolithic Tybrind Vig logboats, and the Iron Age Hasholme vessel). Interestingly, this particular construction technique is rarely utilized on post-Roman logboats, and indeed is completely absent from many regions of Europe.

In Ellmer's model, however, a linear development of logboat design (and that of other watercraft) is the key factor. As new construction techniques developed, logboats could be utilized in new ways. The improved vessels were used not only for hunting and fishing, but increasingly for long-range communication along Northern Europe's dense river networks. The spread and dissemination of the ever-changing techniques of logboat construction is therefore a function of environmental conditions and subsistence needs. Ellmers does not address potential for recognizing localized traditions based on specific morphologies or constructional techniques.

An even more fully-articulated version of the functional approach is presented in numerous works by Béat Arnold (1980; 1983; 1985a; 1993; 1996; 1998). Arnold's thorough and meticulous work examines morphology, and especially construction, of logboats from Switzerland and France (Figure 2.9). Arnold's detailed examination of the morphology and features of Swiss logboats has led to descriptions of boat building traditions spanning centuries and even millennia (Arnold 1980; 1985a; 1989; 1996).

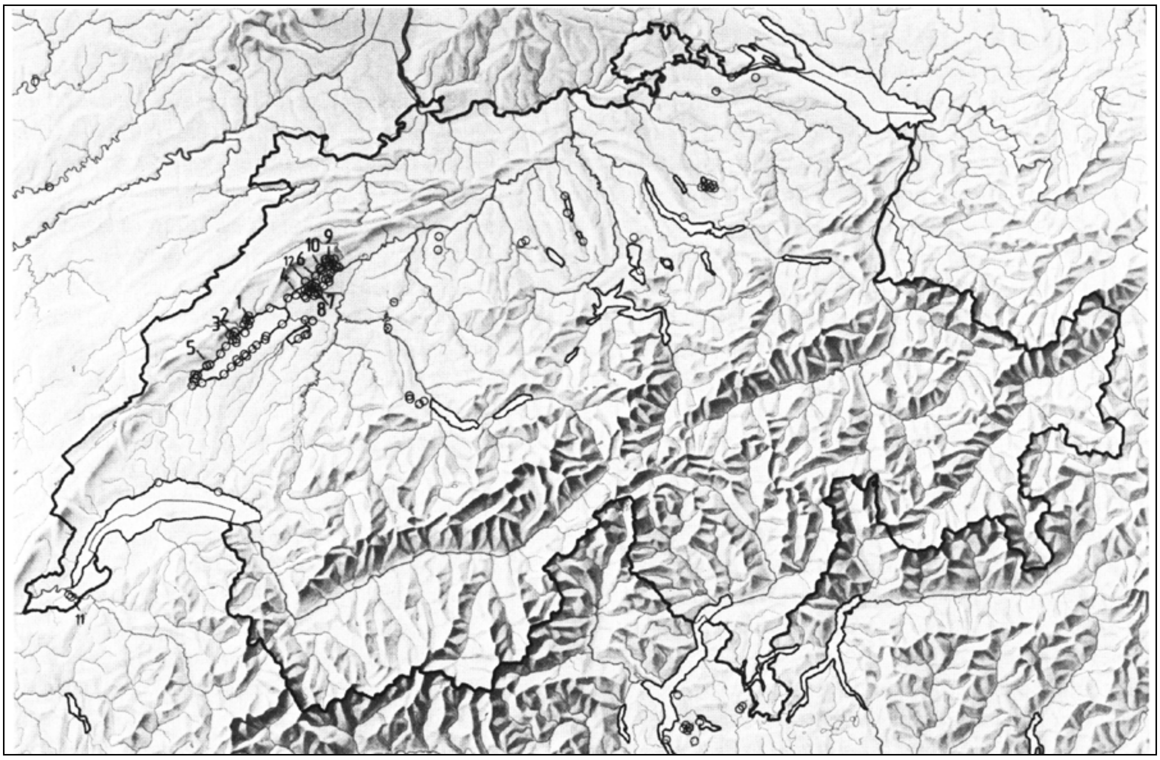


Figure 2.9 Logboat discovery locations in Switzerland, clustered along the large Alpine lakes and major river valleys, especially the Neuchâtel-Aar corridor of the upper Rhine watershed (map from Arnold 1985a:94).

The spread of various local or regional traditions is also apparent in Arnold's work (see Section 6.3 for a more detailed examination of Alpine logboats and boat building traditions).

Another relevant aspect of Arnold's work on logboats is his contribution to the study of Gallo-Roman vessels, especially their logboat origins and further developments of this vessel type on Swiss lakes and rivers (Arnold 1989; 1992). Logboat elements are visible to varying degrees on Gallo-Roman vessels over a period of centuries, even as the initial form diverged into different designs as the vessel-type was transferred across vast areas of Central and Western Europe. Arnold has also worked extensively documenting vernacular watercraft of all types from Swiss lakes and rivers. Many of these vessels show antecedent features indicating the adoption of foreign innovations, particularly in the post-Roman period.

Arnold's tremendous body of work, while extremely valuable from a technical perspective, gives little attention to the role of learning and skill, and the passing of such knowledge between individuals. Although in several instances the arrival of new vessel types is correlated to movements of people (for example, emigration of carpenters from Lake Constance to Lake Geneva, or boats built on Lake Neuchâtel by carpenters from Lake Thun) (Arnold 1985a:287), the long term transfer and adoption of various innovations is explained by more functionalist interpretations. This approach is informed by the (unstated) assumption that the available data are liable to provide more information regarding the economies of pre-modern peoples than about social organization.

The most comprehensive recent investigation of European logboat chronology is Jan Lanting's 1998 analysis of dated vessels from across the continent. In this work, Lanting has assembled more than 600 logboat radiocarbon and dendro-dates, grouped by country of origin. Although new data from the last decade since the article's publishing are not included, the sample is still undoubtedly the largest of its kind ever collated in a single investigation. The particular focus of this work is the determination of regions of origin for the logboat as a specific vessel type, and the paper does not deal with the development of the logboat through time or with details of performance (Lanting 1998:627).

The extensive database allows for the identification of regional trends and patterns, particularly in respect to the introduction of this vessel type in any given region of Europe. On the basis of the assembled dates, Lanting identifies several regional zones that show similar patterns of chronology (Figure 2.10). The oldest logboats in Europe are found in 'Continent Zone 1' (Lanting 1998:641). This zone, represented by 116 dated vessels, comprises Denmark, northwest Germany, the Netherlands, Belgium and northwestern France.

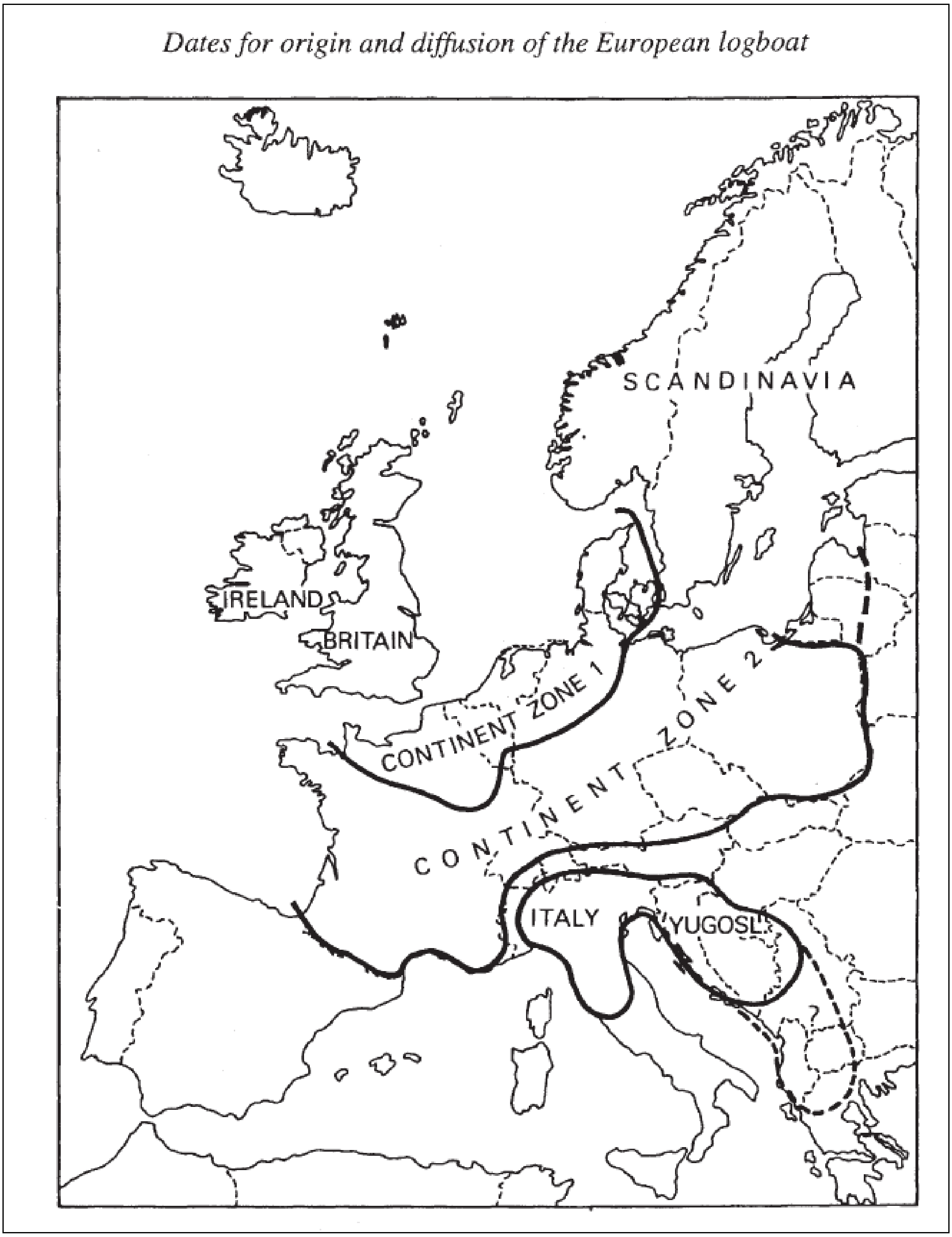


Figure 2.10 Geographic zones corresponding to Lanting's chronology for the origin and diffusion of the logboat in Europe (Lanting 1998:641).

The earliest logboats from Zone 1 date to before 7500 cal BC, and logboats were in use throughout the Mesolithic, Neolithic, Bronze Age, Iron Age and continued through the Roman period and Middle Ages. 'Continent Zone 2', represented by 244 dated boats, is comprised of the rest of France and Germany, Switzerland, Austria, the Czech Republic, and Poland (and likely Latvia and Lithuania). There are no Mesolithic logboats known from this zone, leading Lanting to assert that dugouts developed in this region only from the Neolithic. Within Zone 2, Lanting sees two regions with an earlier acceptance of logboats (a strip along the southern Baltic coast from Mecklenburg to Lithuania, and the Rhine-Saone-Rhone corridor from Germany through Switzerland and France). The remainder of this zone, including the Czech Republic, began using logboats only gradually, ca. 4000 BP or later (Lanting 1998:642).

British and Irish logboats are represented by 134 dates, the great majority of which are assigned to the medieval or early modern periods. Just a single date exceeds 5000 BP (Carrigdirty, Ireland, at 5820±40 (4780 – 4550 cal BC)), and no British logboat exceeds 4000 BP. Lanting thus postulates a late Mesolithic introduction of logboats in Ireland, possibly as a result of connections with NW France, and a much later introduction in Britain (Lanting 1998:631). Since Lanting's article was written, a possible logboat burial dating to ca. 3900 cal BC has been discovered near St. Albans in Hertfordshire (Niblett 2001). Drawings of the St. Albans find are not altogether convincing, however, and it is likely that the vessel is actually a log coffin.

One rather surprising result of Lanting's analysis is his conclusion that logboats were introduced into Scandinavia north of the Baltic at a very late date (the 1st millennium BC in southern Sweden, the 7th century AD in Norway, and only around 1000 AD in Finland!). Logboats were certainly present in Denmark during the Mesolithic (i.e. the Tybrind Vig boats), and the Ertebølle culture clearly extended into southern Sweden. It therefore seems likely that other factors may be responsible for the lack of Swedish logboats, perhaps even large scale glacio-tectonic history of the region. For example, post-glacial rebound has resulted in a significant uplift of northern and central Scandinavia, with some parts of coastal Mesolithic Norway, Sweden and Finland now tens of meters above modern sea levels. This means that early prehistoric remains are rarely found in waterlogged soils, which may explain the lack of preserved watercraft of any sort from older periods.

Lanting's final zone comprises an area south of the Alps, including northern Italy and the northern Balkans. A series of older vessels (Hotiza, Slovenia, dated to ca. 6100 BC, and Lago di Bracciano, Italy, at ca. 5500 BC) lead Lanting to conclude that this region may have been a second core area for the origin and subsequent spread of the logboat. Logboat remains appear to be absent from this region for a period of around 500 years (ca. 5500 – 5000 BP), to be reintroduced from the north via Switzerland and possibly France (Lanting 1998:644).

As useful as Lanting's analysis is from a purely chronological perspective, this sort of 'meta-narrative' approach fails to account for logboat design and building traditions, as well as the spread and transfer of specific features or constructional elements. The analysis demonstrates correlation but not causation. Context is entirely lacking, aside from great swaths of territory outlined on a continental scale. Socio-economic and political settings are ignored, and indeed local and regional geography. Key factors that facilitate or block movement of technology remain unarticulated. Another major flaw with Lanting's model is that vessel morphology is entirely disregarded. Logboats are examined as a single artefact type, with no consideration of variation in form, construction, or notable features. Boats grouped together in this model share few similarities (i.e. while Mesolithic Danish logboats often feature transom ends, they are absent on Dutch vessels from the same period, included in the same group). Lanting's model, based entirely on cultural diffusion, offers no explanation for the presence or absence of those features, and thus cannot describe factors that influence design. Human capacity for innovation is disregarded, and no mention is made of the people who built and operated watercraft, or the processes by which skills are transferred.

The current thesis takes a much different view, anticipating that morphological and especially constructional features of logboats are actually reflective of skill sets and technological traditions, and suggesting that the spread of independent technological trajectories may be traced geographically and chronologically. The role of humans as agents, effectively excluded from so many previous investigations, must be actively considered. The identification of factors which may be useful in explaining aspects of watercraft uniformity and diversity is thus a key goal.

2.2 Research from Neighboring Regions

To understand Czech logboats within a larger geographical context, it is necessary to examine vessels from neighboring regions, particularly Slovakia, Poland, Austria, and Germany. Logboats have not necessarily received equal attention from investigators in the various countries, and information on local vessels is available to varying degrees. Nonetheless, a general picture of logboat construction and use throughout Central and Eastern Europe is gradually emerging.

Logboats were in use on Slovak rivers until the mid 1950s, especially the Váh, the Kysuca and the Hron (all tributaries of the Danube). No archaeological recoveries are known, but several ethnographic examples are referenced in literature (Novotný 1951). A poplar vessel from Žilina, obtained in 1949, was at one time curated in the National Museum; a boat constructed from lime wood was collected at Krásno nad Kysucou, and one of red willow from Michalovce. The ethnographic examples from Slovakia were used exclusively for fishing, often with nets (Novotný 1951:269).

Ethnographic examples of logboats from Austria have been widely reported. G. Salemke's monograph on dugout monoxyls from Austria's Mondsee (1972) details construction methods and complements earlier descriptive material from the same region collected by Walter Kunze (1968) and Franz Angerer (1927). A handful of archaeological logboats are also known from Austrian lakes: for example a Roman period dugout from Carinthia (Stradal and Dworsky 2002), a medieval pine vessel from the Tyrol (Reitmeier and Nicolussi 2002), and a boat from the Obertrummer See dated to 580±50 BP (1295-1426 cal AD, KI-2724) (Lanting 1998:639). In addition there are two undated examples from the Salzburger Grünwaldsee (Werner 1973). These are interesting from a topographical perspective as well, all originating at relatively high altitude Alpine environments. An unfinished fir boat from the Untersberger Moor was also reported in 1913 (Hell 1913, cited in Harding 2000:180). Interestingly, no logboats are known from the Danube River in Austria.

German logboats are in general fairly well documented. As of 1998, Lanting estimated that there were between 700 and 800 logboats known in Germany, and at least 89 have been dated by absolute methods. Oscar Paret was among the first to list continental logboats, and his early study of the German Federsee vessels includes a short comparison with other European vessels known at the time (1930). More than 40 logboats are now known from the Federsee region, and at least eight of these are dated to the Bronze Age. The Federsee logboats are still undergoing analysis, and no comprehensive data have been published (Mainberger 2009).

A detailed description of Northern German monoxylous vessels resulted in an unpublished university thesis (Hirte 1987). The North German logboats, from both rivers and lakes, date from the late Mesolithic to early modern times. Bavarian logboats have also been the subject of several investigations in recent years, for example those published by Hubert Beer (1988, 1990, 1991), S. Bauer (1992), Tobias Pflederer (2002) and Timm Weski (2005). Beer described the discovery and recovery of a large (ca. 14 m) logboat from the Starnbergersee (Roseninsel), and Bauer reported the dendro-dates of the three Bavarian boats, including the Roseninsel vessel. Pflederer focused on accounts of recent recoveries from Bavarian lakes (Figure 2.11), while Weski presented information on paired and unfinished vessels (Figure 2.12). A rare Early Bronze Age logboat from the Degersee in Southern Germany was recently published by Mainberger (2009). This 5.3 m vessel, with an inserted transom stern, is the first prehistoric logboat known from the Lake Constance region. The Degersee boat appears to be closely related to the Bronze Age logboats from the nearby Federsee. Despite these useful contributions to the field of logboat studies, no comprehensive catalogue has yet been prepared for Germany.

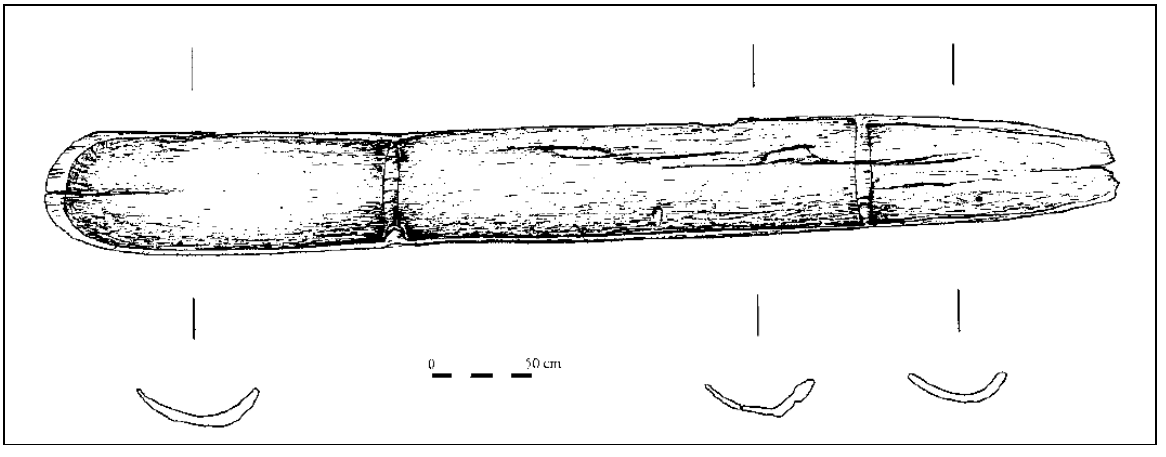


Figure 2.11 Logboat from the Bavarian Starnberger See, evidently constructed from a half-log, with two transverse ridges across the floor. This vessel was dated to the latter half of the first millennium BC (Pflederer 2002).

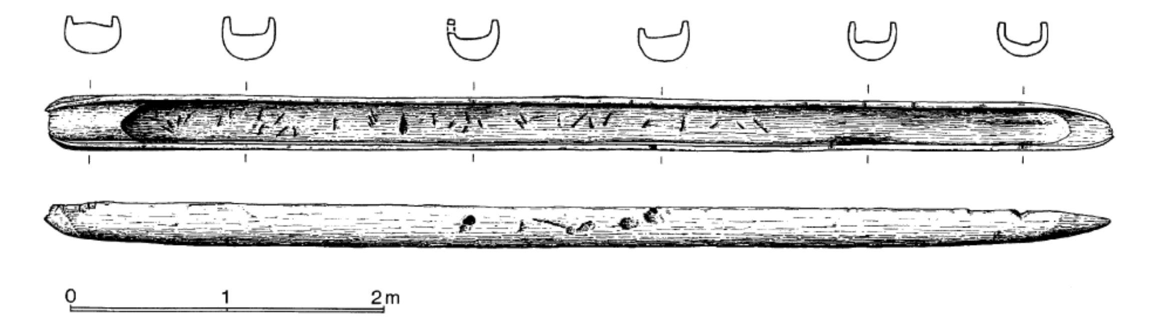


Figure 2.12 An unfinished logboat from Wessobrunn-Blaik (Bavaria). Weski (2005:274) considered that this vessel would be too unstable to float on its own without capsizing, and was therefore intended as one of a paired hull.

It is in Poland, rather, where Waldemar Ossowski and others (cf. Litwin 1995) have undertaken the most comprehensive logboat research in Central Europe. Ossowski's major articles in English (2000a; 2003) summarize much of his work; the definitive study is so far available only in Polish (Ossowski 1999). In the late 1990s Ossowski, working under the auspices of the Polish Maritime Museum in Gdańsk, compiled a catalogue of all known Polish logboats, including absolute dating for over 100 vessels (Pazdur *et al.* 2001). Over 300 archaeological Polish dugouts are currently catalogued, and the number continues to grow.

The earliest Polish logboats are dated to the 3rd millennium BP (Figure 2.13), and in eloquent testimony to the longevity of this particular vessel type, the most recent catalogued example is a boat made in 1996 (Ossowski 2000a:63). Polish logboats display a rich diversity of form, which Ossowski is inclined to attribute to function. During cataloging examinations of the Polish dugouts, evidence of logboat expansion was discovered on at least five vessels. Techniques and construction styles of expanded logboats are particularly interesting as regards their role in the genesis and developments of plank boats. The earliest expanded logboats in Poland are those from the boat-burials at three cemeteries of the Wielbark culture at the mouth of the Vistula River, dated to the 2nd century AD (Ossowski 2003:177-178). The area in question served as a distribution centre for the amber trade, and was likely inhabited by merchants and traders from many other parts of Europe. Ossowski speculates that the region's cosmopolitan nature likely promoted diffusion of knowledge and craft techniques such as the noted evidence of logboat expansion (Ossowski 2003:182).

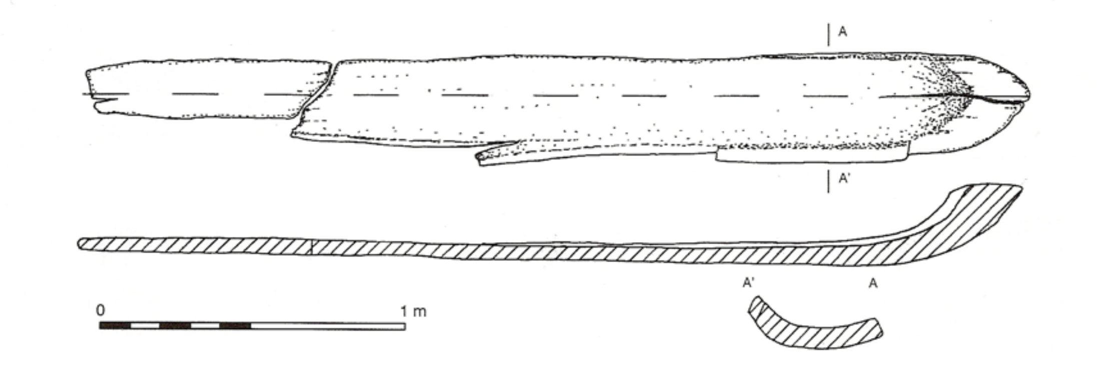


Figure 2.13 Logboat from Chwalimskie Bagno (Poland). The vessel is dated to 3660±40 (2190 – 1930 cal BC), and only the bow, floor, and a portion of the starboard side are preserved (illustration from Ossowski 2000a:61).

Expanded logboat remains from the Middle Ages are also known in Poland, for example the boats from Kazimierz Pomorski (dated after 952 AD), and Sierzchów (dated at 730±50, or 1208-1319 cal AD; see Figure 2.14) (Ossowski 2000a:65).

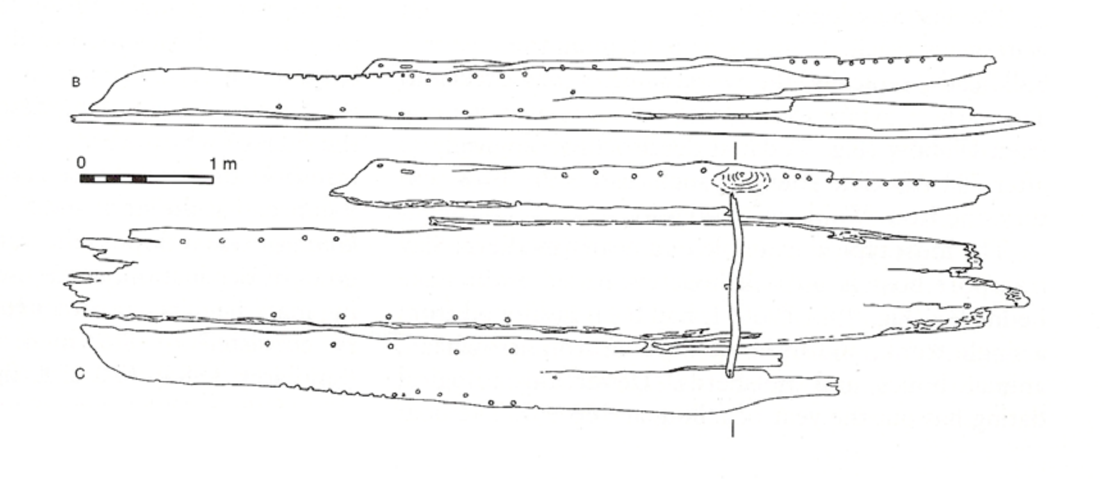


Figure 2.14 Logboat from Sierzchów (Poland) dated to 730±50 (1200 – 1390 cal AD) (Ossowski 2000a:63). The vessel has been expanded with a single strake on either side of the main dugout hull. A single frame was evident, made from a naturally curved oak crook. Numerous peg holes along the sides suggest that more strakes were attached above the surviving hull extent.

In terms of the first use of planked vessels in place of logboats in Poland, Ossowski suggests that it took place along the coast by the 9th century AD, and on inland waterways between the 13th and 15th centuries (Ossowski 1999:221). Difficulties in obtaining suitable raw materials (trees of the appropriate size near a watercourse) provided the main impetus for the transition. It is likely that similar or even later development took place in the Czech Lands, situated still farther from the coast (Rogers 2009). As previously noted, Arnold (1985a) described the replacement of Swiss logboats by plank-built vessels in the late 19th century, as forests became depleted of large trees.

Ethnographic logboats are also known from Poland, for example the vessels from the Dunajec River described by M. Boczar (1966). Dunajec dugouts, made from poplar, were fastened together in groups of four or five and used as cargo rafts into the late 20th century (Figure 2.15). Dugouts intended as fishing vessels were still being crafted in Poland on the Bug River and in the Kashubian Lakes district in the 1990s.

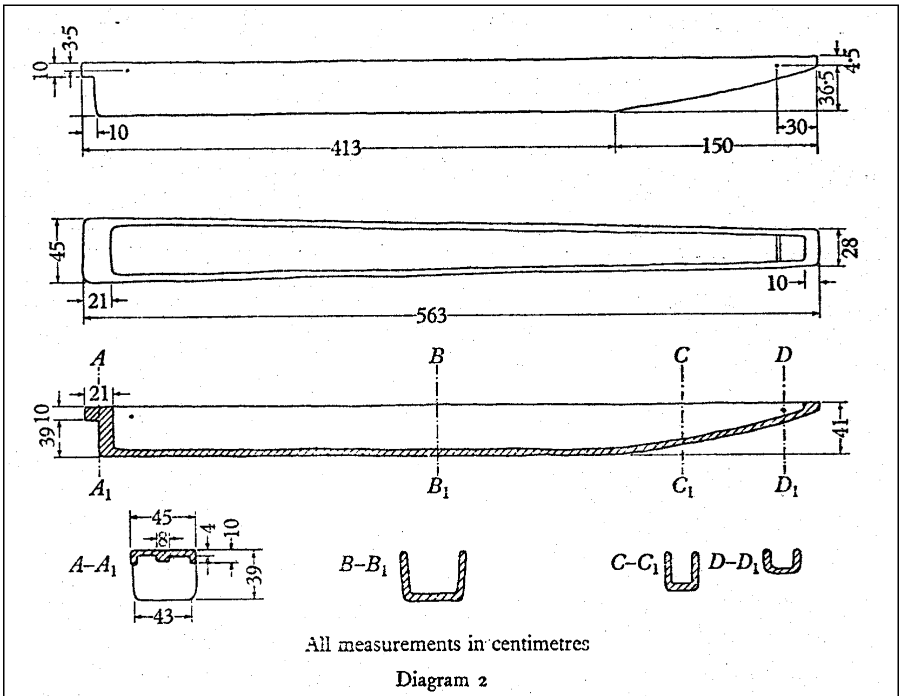


Figure 2.15 Typical Dunajec River logboat, fastened in groups to make a raft or flotilla (Boczar 1966:217).

2.3 Previous Logboat Research in Bohemia and Moravia

The field of archaeology in the Czech Lands has its origins in the 'národní obrození' (national revival) of the 19th century. Leading figures in the literary and cultural renaissance, such as historian František Palacký and linguist Josef Dobrovský, encouraged scholarly examination of the history and prehistory of their land. Such investigations were considered to be an essential component of the program of rediscovering 'Czechness' and casting aside Germanic (Austrian) domination. The archaeological collection of the Czech National Museum was founded in 1854, and the first issue of the academic archaeological journal *Památky archeologické* was published the same year.

Almost without exception, early Czech logboat finds came during dredging or digging along riverbanks. Starting in the 19th century, and gaining momentum in the early decades of the 20th century, local and national authorities in Bohemia and Moravia carried out a program of river course canalization. In an effort to prevent flood damage and improve irrigation, workers deepened the main channels and cut through meanders to straighten the rivers' courses (Figure 2.16). Many logboats were discovered during such work, while others were uncovered during construction along the rivers (e.g. the vessels from Poděbrady), or while digging for sand and gravel (Labětín). Only a very few escaped subsequent destruction. Several vessels lacking documented provenance were likely discovered under similar conditions, for example two of the three boats currently held in the Poděbrady museum. The museum's founder J. Hellich mentions these in a guidebook as early as 1931, although no discovery description or other identifying information is available (Hellich 1931:175). The unprovenanced monoxyl in Brandýs nad Labem was likely recovered in the same period.

Figure 2.16 Morava River near Staré Město, with oxbow lakes (old meanders) in the foreground (photo by the Czech Ministry of the Environment, 1995).

The earliest mention of a Czech logboat in an archaeological context comes from Dr. Jan Axamit, who in 1915 wrote on the reported discovery of two vessels near the Central Bohemian town of Přerov nad Labem. Axamit did not see these boats himself, but related that one had been found in a former arm of the Elbe River, and the other in a nearby peat bog (Axamit 1915:81). Neither of the Přerov vessels survived.

In 1921, Lubor Niederle (sometimes called the "founder of modern Czech archaeology") personally investigated a logboat find that was brought to his attention. Niederle's article 'Nalez člunu v Kolině' appeared in the journal *Obzor praehistorický*, and described the discovery of an 8m vessel during canal construction on the Elbe River in the town of Kolín (Niederle 1923). Niederle immediately recognized the need for conservation, and had the boat brought to the archaeological institute laboratory in Prague. This vessel still exists today, and is displayed in the Czech National Museum in Prague.

In Moravia, the earliest mention of a logboat discovery is K. Hanák's article in *Sborník velehradský*, describing the well-preserved vessel found at the village of Spytihněv on the Morava River (1930). Although undated and recovered from an ambiguous context, Hanák enthusiastically assigned the boat to the Slavonic period of the early 11th century. The Spytihněv vessel is today on public display at the Slovacké museum in the town of Staré Město.

Collecting and synthesizing information contained in simple site or discovery reports, two longer surveys examining early Czech watercraft were written in the post-war period. In 1951 Bohuslav Novotný, working mainly on the basis of Bohemian logboats, wrote a seminal piece entitled 'Nejstarši plavidla na Českých vodách' (The Oldest Vessels on Czech Waters). This far-reaching article draws on a wide range of historical and ethnographic research to describe a general development of European logboats. Novotný further sought to elucidate and explain archaeological logboat finds in Bohemia by means of ethnographic comparison with vessels still in use in Slovakia, Poland, on Austria's Alpine lakes, and as far afield as Papua New Guinea. The work concludes with a catalogue of all logboat finds known in Bohemia at that time (many of which have unfortunately not survived). Had this piece been available to a wider scientific audience, it would surely rank as an early classic in the field of vernacular small-craft studies. Unfortunately, published only in Czech in a rather obscure journal, Novotný's work remains unavailable to most researchers. Novotný articulated the main problem with Czech logboat studies well, which was, then as now, the lack of accurate dating, which complicates attempts to develope any sort of chronology. The article concludes with an attempt at a basic typology, separating Czech logboats into two categories: vessels with pointed bows, used for fishing and carrying people; and those with flat, square ends, used to carry cargo (Novotný 1951:283). While further discoveries and recent research have shown that this typology is likely an over-simplistic assessment, the importance of Novotný's early work endures.

In Moravia, Vilém Hrubý of the Czechoslovak Academy of Sciences, Institute of Archaeology in Brno had been researching and collecting information on Moravian logboats since the 1940s, although he did not publish his work until the mid-1960s. Hrubý's article 'Staroslovanské čluny na našem území' ('The Boats of the Ancient Slavs in Our Land') catalogues and describes vessels found in Moravia, almost all in the context of straightening the channel of the Morava River (1965). Hrubý's assertion that most if not all Moravian logboats date to the early Slavonic period (roughly from the 8th century onward) resulted in a nearly institutionalized belief in this assumption, at least insofar as regards dating assessments for surviving specimens. This contention also had roots in the 19th century cultural and historical revival and was espoused by Czech ethnographers as well, in an attempt to differentiate Slavonic antecedents from Teutonic invaders (see for example Sasinek 1886).

In the 1950s and 60s, further logboat finds were published as short reports in archaeological journals, particularly *Archeologické rozhledy*. Discoveries from Labětin (Hrala 1969), Poděbrady (Justová 1969), Skorkov (Nechvátal 1969) and Oseček (Novotný 1950) were published in this fashion. Others were reported in regional or museum newsletters (Hanák 1930, Bednařík 1957, Justová 1965). Many of these vessels were recovered and conserved, and exist today in museums or repositories.

In 1967, large-scale excavations at the Great Moravian citadel of Mikulčice uncovered two complete logboats and fragments of another. Excavations at this site have been on-going since 1954, under the auspices of the Czechoslovak Academy of Sciences, Institute of Archaeology, directed by Josef Poulík, Zdeněk Klanica, and most recently Lumír Poláček. The Mikulčice vessels were first described in the project's annual fieldwork report in 1968 (Klanica 1968), though they received scant mention in Poulík's authoritative summary (1975:134). A fourth vessel was discovered in 1984, but due to its extremely fragile condition, it was recorded and left *in-situ*. The many years of excavation resulted in a backlog of data and artifacts, and it was not until 2000 that Poláček published a complete description of the Mikulčice vessels (Poláček 2000).

Two quite recent logboat discoveries have also renewed interest in early Czech watercraft. The first, found in 1999 near the northern Moravian town of Mohelnice, is a sophisticated 10m vessel dated to after 281 BC (Kučerová and Peška 2004). The second is an unusual fir boat found in 2002 at Otradovice in Bohemia (Šilhová and Špaček 2004). Both vessels were dated by ^{14}C, and the Mohelnice boat was dated by dendrochronology as well. My own MA thesis was completed in 2004, presenting results of payload analysis for vessels found on the Morava River. In the fall of 2006, a program of dendrochronological analysis for other vessels was initiated, with results for one boat already (Rybníček 2006) and others expected in the future. In late 2007, samples from two logboats (Kolín and Otradovice) were radiocarbon dated as part of the current thesis (see section 5.1), expanding the number of dated Czech vessels to five.

2.4 Thesis Methodology

The methodological steps utilized for this thesis were chosen with the goal of identifying and maximizing the information potential of the vessels in question.

Both cognitive aspects as well as technological details are required for contextualization. Related topics that may involve boats (trade and exchange, for example) are also investigated. The thesis methodology is described below.

1. Gather information on Czech logboats; record and document.

The initial steps taken for this thesis consisted of gathering information regarding Czech logboats. Documentary evidence from journal articles was important, as were discovery records and primary source accounts from excavation reports. Library and archival research was undertaken to obtain existing documentary records. Very few Czech logboats have been physically documented prior to this investigation. The next step was therefore to document (measure, draw, and record) all surviving examples, with careful attention to details of construction and morphology. This fieldwork entailed visits to museums and repositories across the Czech Republic. Having assembled a catalogue of surviving logboats, I was able to classify and categorize the vessels. The objective is to discern patterns of construction, morphology, usage, and chronology – in short, anything that can shed light on the processes of construction and use. These are in turn relevant to the overall goal of understanding the spread and transmittal of boatbuilding knowledge and design traditions.

2. Situate the vessels in physical and social context, i.e. the 'riverine cognitive landscape'.

Situating the Bohemian and Moravian logboats within their physical context necessitates a thorough understanding of the Czech Republic's physical geography, hydrology, climate history and geology. Political boundaries, of course, do not necessarily correspond to natural ones such as coastlines or rivers. River catchment areas, separated by watersheds divides, have significance for the entire European continent. The place of the Czech watersheds and divides within the greater European context are therefore a topic for exploration in this thesis as well.

Situating the Bohemian and Moravian vessels within their social context requires an understanding of the regions' 'riverine cognitive landscape' (a modification of the 'maritime cultural landscape'). The concept of a maritime cultural landscape was originated and articulated by Christer Westerdahl (1992), who applied the idea to coastal and seafaring geographic regions. The concept grew from the realization that an understanding of human behavior (in this case prehistoric and early historic maritime communities) comes not only from technological and utilitarian aspects of building and using ships, but also from cognitive elements. The thoughts and actions of people in the past, like those of today, were never strictly logical. To gain an understanding of past behavior, symbolic and ritualistic aspects of behavior (here grouped under the *cognitive* rubric), must be also explored. This idea is firmly grounded in ethnography and sociocultural studies, and carries forward from seminal past works. One such investigation is Bronislaw Malinowski's classic monograph *Argonauts of the Western Pacific*, first published in 1922. Malinowski's study of the kula cycle of trade and exchange is very relevant to the current study, and his description of building a Trobriand dugout canoe is worth quoting at length:

> The canoe is made for a certain use and with a definite purpose; it is a means to an end, and we, who study native life, must not reverse this situation and make a fetish of the object itself. In the study of the economic purposes for which a canoe is made, of the various uses to which it is subjected, we find the first approach to a deeper ethnographic treatment. Following sociological data, referring to its ownership, accounts of who sails in it, and how it is done; information regarding the ceremonies and customs of its construction, a sort of typical life history of a native craft- all

> that brings us nearer still to the understanding of what his canoe truly means to the native.
>
> Even this, however, does not touch the most vital reality of a native canoe. For a craft, whether of bark or wood, iron or steel, lives in the life of its sailors, and it is more to the sailor than a mere bit of shaped matter. To the native, not less than to the white seaman, a craft is surrounded by an atmosphere of romance, built up of tradition and personal experience. It is an object of cult and admiration, a living thing possessing its own individuality (Malinowski 1961:105).

The symbolic context of vessel use and construction, often overlooked, is a not insignificant aspect of the maritime cultural landscape. Westerdahl's assertion that function and symbolism are parallel factors (2008:17) is similar to recent investigations of ritual in everyday life (i.e. Bradley 2005). Bradley's view of ritual as integral to domestic life rather than a separate and distinct sphere of activity is also relevant to this investigation, for it focuses not on ritual as a practice in itself, but rather on the *process* of ritualization (2005:33). The combination of functional (material) and symbolic (cognitive) aspects of life in a maritime community together form the maritime cultural landscape.

In Westerdahl's original conception, the maritime cultural landscape was defined as "the whole network of sailing routes, old as well as new, with ports and harbours along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial" (1992:6). The concept of 'riverine transport cultural landscapes' or 'riverine cognitive landscape' is essentially the 'maritime cultural landscape' applied to an inland setting. Although Westerdahl was careful to mention inland aspects (for example transit points and connections with inland waterways), his focus was necessarily on coastal communities. I suggest that fully extending this concept to interior rivers, lakes and watershed transit corridors will allow more complete contextualization of watercraft found in those settings.

3. Investigation of related topics.

Both the technical and cognitive aspects of watercraft are related to (although not synonymous with) their functionality. Any investigation must therefore include a discussion of the boats' intended and potential purpose and use. Transportation, communication, resource exploitation, and trade and exchange are all likely functions for these vessels. These topics are also explored in the context of logboat construction and usage.

4. Seek and identify patterns (construction, morphology, usage, chronology).

Previous logboat investigations (i.e. McGrail 1978; Mowat 1996; Fry 2000) are based on the theoretical assumption that inferences regarding logboat purpose, functionality, and intended usage can be made through analysis of empirical evidence. This thesis takes another step, requiring an understanding of the vessels' operating environments (both physical and human) to create a fuller and deeper understanding of vessel usage and significance.

Careful examination of the surviving vessels from a constructional perspective can identify specific building techniques and physical features. Patterns of identical or similar morphology and features may indicate local or regional construction traditions. Building traditions, as noted by Seán McGrail (1995:139-140) are an abstraction from reality and can be somewhat arbitrary, but are useful in recognizing patterns in the wide range of materials and techniques that have been used to build watercraft. Classification schemes allow ordering of data and recognition of relationships, differences and similarities. Polythetic groupings in particular reflect an intuitive understanding of the real world. Vessel functionality and utilization may also be identified through examination of constructional features combined with knowledge of the operating environment. If patterns of use can be established, these too may be used as indicators of tradition and culture.

5. Informed by the above, identify conclusions regarding the processes of information and skill set transmittal (which can be applied to models of how boats change, and possibly provide insight into how knowledge was passed and transferred across Europe).

Data and information gathered through the preceding steps are directly applicable to the research questions described in section 1.4. The results of analysis can be applied back to the initial queries regarding processes of technology and skill set transmittal. Relevant conclusions, informed by discussion of the investigation and results, are meaningful not only in regard to boats and watercraft, but to the spread of information and knowledge in general.

2.5 Following Chapters

No comprehensive study of Czech logboats has previously been attempted, despite the considerable information potential of these vessels. Data on Czech dugouts must be presented and made available, along with those of neighboring countries, to fill the gap. Fortunately, modern methods of analysis and treatment are now available for these vessels, and new finds would presumably benefit from similar handling. New research and theoretical frameworks, designed to maximize the vessels' information potential, are available. Details of construction and usage combined with geographic and human context will allow the Czech logboats to be situated within their appropriate cultural landscape. Contextual evidence, explicitly linking human skill sets with logboat research, is required to explain aspects of uniformity and diversity apparent in the archaeological record. Czech geography, environment and human history are accordingly examined in Chapter Three, and a detailed catalogue containing descriptions of all vessels is provided in Chapter Four.

CHAPTER THREE – CONTEXT: GEOGRAPHY AND TOPOGRAPHY, PHYSICAL AND HUMAN ENVIRONMENT

The development of transport geography is determined by landscape features and natural topography, as well as by social contexts such as culture and tradition. Craft, skill and technology also play important roles. This chapter describes the physical and human environments within which prehistoric Central European watercraft were built and utilized. The material remains of past human cultures are useful as a medium for learning about the lifeways and societies that created and left these remnants. Sites and finds must be contextualized to develop an understanding of their meaning and form (Harding 2000:3). Artifacts were created by people, used, and embedded in various contexts, both physical and cultural. The geographic element of this investigation is especially significant, as the spread of information and skill sets in physical space is a main focus of the thesis. As noted by Colin Renfrew (1983), archaeology and geography are increasingly linked fields of study, with converging approaches and methodologies. Locations of human activity are not determined solely by distribution of resources, but also by the distribution of other such loci of human activity (Renfrew 1983:320). The concept of ‘social space’ (human behavior and social relations within a spatial context) is useful for this investigation, concerned as it is with the processes of information transfer.

An important strength of archaeological evidence in general is its locational content, “that it relates to activities being carried out in the past at a precise spot with given environmental characteristics, in the context of which its former significance may be assessed” (Muckelroy 1978:217). This is a particular asset when examining the inland watercraft of Central Europe. One problematic issue for shipwreck archaeology at sea is that it is often difficult or impossible to know where a ship came from and where and by whom it was built. Inland watercraft are substantially more limited in their range of travel, and their human and environmental contexts can be easier to elucidate and describe. In the case of Bohemian and Moravian logboats, an understanding of the context, the riverine cognitive landscape, is the essential factor, which offers insight and comprehension of the people who constructed and used the vessels.

When discussing the Czech Republic's physical environment, I have put particular emphasis on geography, topography, and especially hydrographic features. In describing the human context, it is not my intent to provide an exhaustive account of Bohemian and Moravian prehistory and history. The area has been documented archaeologically since the mid-19th century, and a tremendous body of work is already known and available (e.g. Neustupný and Neustupný 1961; Fridrich 1994; Svoboda *et al.* 1996; Drda and Rybová 1998; Podborský 2004, and others). My objective in this section is rather to offer a summary of the main human cultures that have inhabited the region, and to discuss the points of their history and development that may serve to illuminate or clarify the significance of early watercraft in this setting.

3.1 Physical Context: Location, Geography and Climate

Watercraft, as a class of artifact, have an intimate connection with their environment. Their raw materials, shapes and construction are a clear reflection of the cultural, environmental and geographical context in which they are built and designed to operate. A boat's surroundings, consisting mainly of natural phenomena, cannot be greatly altered by the builders and users (McKee 1983:19). These vessels, and hence their utilization, significance, and importance to their builders, cannot be understood when separated from this context. The geographical position of the Czech Lands, the internal topography, and the physical requirements of transportation are essential for an understanding of the tradition and use of watercraft in the region. The Czech Republic as a geographical unit is of course a relatively modern construct, but one that greatly conforms to natural boundaries in the landscape. This section describes the geography and environment of the Czech lands, and their place within the larger region of Central Europe.

The modern Czech Republic borders Poland to the north, Germany to the west, Austria to the south, and Slovakia to the east (Figures 3.1, 3.2).

Figure 3.1 Location of the Czech Republic within Europe.

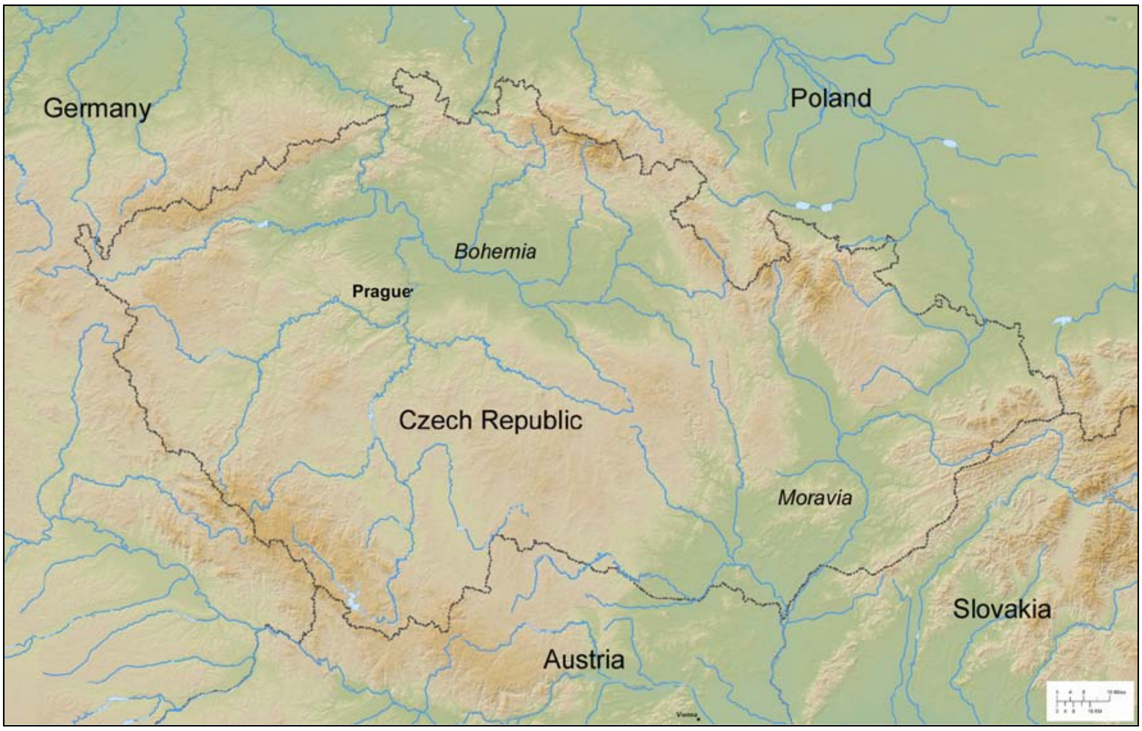


Figure 3.2 Topography and major features of the Czech Republic.

The country is approximately 500 km from east to west, and 200 km from north to south, with a total area of 78,866 km^2. Most of the country lies between 200 and 600 m above sea level. The Czech lands are traditionally divided into two large constituent regions, Bohemia in the west and Moravia in the east. A third small region is the area of Czech Silesia. The territory of Bohemia corresponds almost exactly to the watershed area of the Vltava-Elbe system, Moravia to that of the Morava River, and Silesia incorporates the small part of the Oder watershed on Czech territory (Figure 3.3). Bohemia itself is a shallow basin entirely encircled by mountains or hills, drained by a single major river system (the Vltava-Elbe).

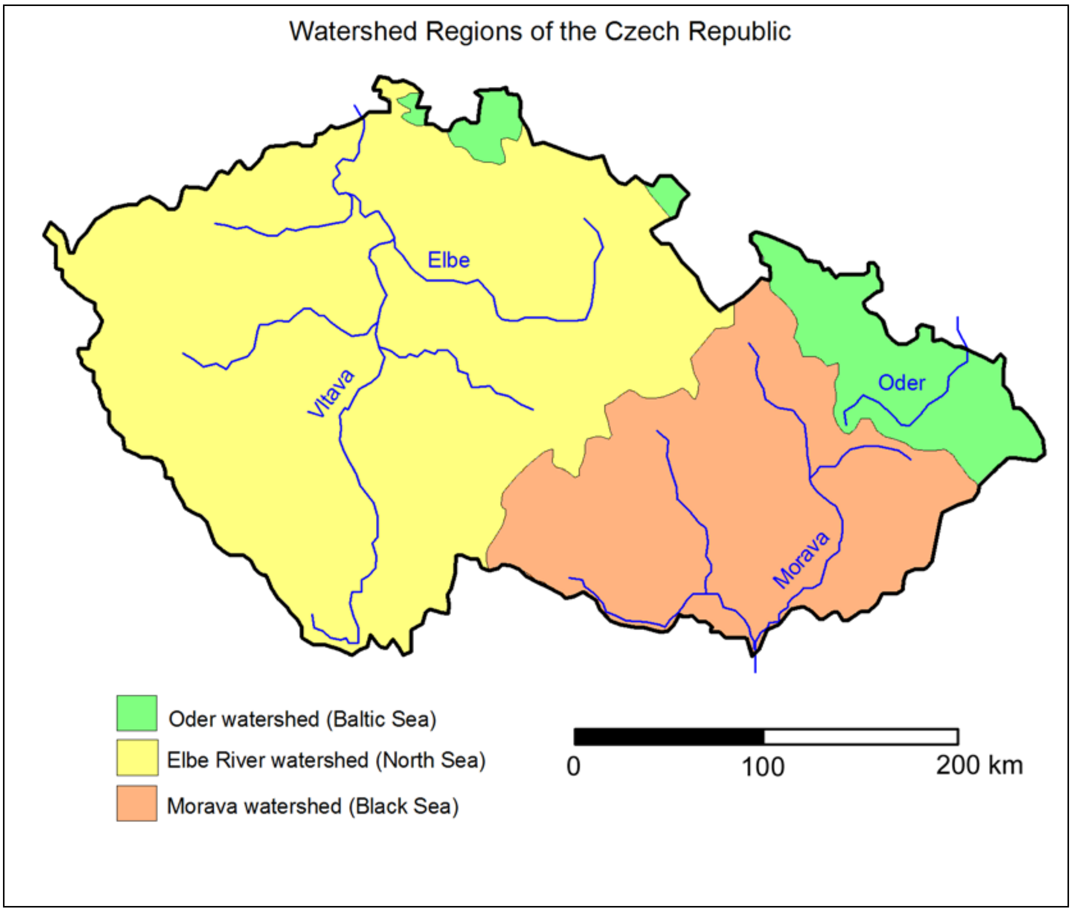


Figure 3.3 Watershed regions of the Czech Republic. The main catchment areas correspond approximately with the country's traditional constituent regions: the Vltava-Elbe in Bohemia; the Morava in Moravia; and the Oder in Silesia.

To the north lie the Krušné Hory and Krkonoše ranges (the Ore and Giant Mountains). The peaks of the Šumava range and deep woods of the Bohemian Forest lie to the south, while the extensive Českomoravská vrchovina (Czecho-Moravian highlands) forms the boundary between Bohemia and Moravia.

Bohemia and the central highlands are part of the larger Hercynian massif, uplifted along with the rising Alps. Convoluted gorges and ridges, especially in the highlands, resulted from complex tectonic folding during the Variscan orogeny (Havlena *et al*. 1967:8). The massif's interior has fractured and sunk; both the uplift and the faulting were accompanied by extensive volcanism. Classic cone-shaped peaks in northern Bohemia as well as famous hot springs and spas such as Karlovy Vary (Carlsbad) are reminders of past volcanic activity.

Moravia is bordered on the north by the Jeseníky range of the Bohemian massif and by the westernmost arc of the Carpathian range in the east. To the southeast, Moravia is open to Austria and Slovakia. The Morava River, flowing south through the middle of the province, is essentially the dividing line between the two separate geological units: the Bohemian horst to the west, and the Alpine-Carpathian massif to the east.

Climatic conditions in Northern Europe since the arrival of prehistoric humans were determined by alternating periods of warming and cooling. Eleven successive glaciations grouped into four glacial phases (Günz, Mindel, Riss, and Würm) occurred during the Pleistocene epoch. The northern borders of Bohemia and Moravia essentially correspond with the maximal extension of the Middle Pleistocene Fennoscandian ice sheet (Svoboda *et al*. 1996:2). The great glaciers twice reached the Ore, Giant, and Jeseníky mountain ranges, and penetrated the Moravian Gate. This is the only location in Central Europe where the northern ice sheet crossed the European continental divide into the watershed of the Black Sea (Šibrava 1967:23). The Morava valley in particular represents a node of the ice-free passageway between the Continental and Alpine glaciers, a corridor for movement of humans and animals.

Thick loess soils (silty and loamy periglacial sediments) formed at the glacial margins, and were deposited throughout the Morava valley and the Bohemian basin by wind and water (Kukla 1969:122; Svoboda *et al*. 1996:22). In general, warm interglacial periods were relatively temperate and favorable to human existence, while glacial periods were cold and arid. Extremes of either warm or cold climates were comparatively short and linked by a series of transitional phases. Following the Last Glacial Maximum (20,000 – 18,000 BP), the climate grew warmer. By around 10,000 BP, open steppes and tundra-like conditions gave way to dense forests, first birch and pine, then hazel and mixed oak (the Boreal and Atlantic periods) (Neustupný and Neustupný 1961:16). Variations in temperature and precipitation over the last 10,000 years have resulted in only relatively minor climatic changes.

The region's modern climate and ecological conditions are classified as temperate continental, with mild summers and cold rainy winters. The average year-round temperature is 8° C, and average annual precipitation is 693 mm. Days with snowfall range from 40 – 120, depending on elevation and exposure. Approximately one third of the country is covered by mixed deciduous forest, with coniferous species predominating in highland and mountainous regions. River channeling and embankment have dried many previous river basin swamps and floodplains (MŽP 2007). Reservoirs have been created by dams on many of the country's larger rivers.

3.2 River Systems

All water flowing through a given river originates from within a drainage basin or watershed (the total catchment area drained by the river and its upslope tributaries). Drainage basins are separated from one another by topographic divides (Waters 1992:116). If a divide separates rivers flowing to different seas or oceans, it is known as a continental divide. There are three major watersheds in the Czech Republic, all of which are separated by continental divides. The main river systems are the Vltava-Elbe in Bohemia, the Morava in Moravia, and the Oder in Moravia and Silesia (Figure 3.2). These catchments are individually described below.

The Vltava-Elbe river system drains nearly all of Bohemia, flowing from the mountains in the north, across the Bohemian basin, and out through Saxony to the North Sea. The Vltava, a tributary of the Elbe, is entirely contained within the Bohemian basin, while the Elbe flows to the North Sea.

The sources of the Elbe lie at 1384 m above sea level on the southern slopes of the Krkonoše range, near the Czech Republic’s highest point, Sněžka Peak (1602 m). Initially flowing south through the Krkonoše foothills, the Elbe emerges into the Bohemian basin at the modern town of Jaroměř, at the confluence with the Metuje River. The rather fast-flowing current slows and broadens at this point, creating meanders and oxbow lakes. The first large city on the Elbe is Hradec Králové, at the confluence with the Orlice River. Turning to the west shortly before the city of Pardubice, the Elbe then flows northwest through the fertile plains of central Bohemia, past the town of Kolín and just to the north of Prague before its confluence with the Vltava at Mělník. The final major tributary of the Elbe is the Ohře River, draining the southern slope of the Ore Mountains (Krušné Hory) which joins the Elbe at Terezin. Broad and wide (100 m wide at Mělník, 165 m at Litoměřice), the Elbe gradually turns north, cutting through the Ore Mountains and past the town of Litoměřice. Continuing on, the river flows through a steep-walled canyon (the ‘Porta Bohemica’) where towns such as Ustí nad Labem and Děčín are crowded along the river’s edge or up tributary stream valleys. Steep sandstone cliffs tower at some points up to 165 m above the river. The Czech Republic’s lowest point of elevation (115 m) is at Hřensko on the German border where the Elbe exits the territory, flowing on towards Saxony’s capital city of Dresden. The Elbe’s total length from the source to the North Sea is 1,094 km; the first 379 km flow through Bohemia (Povodí Labe 2007).

Bohemia's other main watercourse is the Vltava River. Although it is the Czech Republic's longest river, the Vltava is a tributary of the Elbe. The springs of the Vltava lie in the Šumava range of South Bohemia, just on the Czech side of the Bavarian Forest. The stream flows first to the southeast, into the modern Lipno reservoir, then north to the medieval town of Český Krumlov. By this time a significant river, the Vltava continues through the city of České Budějovice, where it forms part of the town's medieval moat. Continuing a northerly flow, the river passes through a series of elongated modern reservoirs: Hněvkovice, Orlík (where the tributary Otava joins the Vltava) and the final reservoir at Slapy. Just south of Prague, the Vltava is joined by its two most important tributaries: first the Sázava, flowing west from the Czech-Moravian Highlands, and then the Berounka, coming from Plzeň in West Bohemia. Passing beneath Prague's famous bridges, the Vltava finally joins the Elbe at Mělník, 25 km to the north of the capital city. The Vltava's total length, from the source in the Šumava range to the confluence with the Elbe, is 430 km, draining an area of 28,090 km^2. The Vltava-Elbe river system as a whole drains 48,486 km^2 of land in Bohemia (MŽP 2007).

The Czech Republic's second great watershed is that of the Morava River in Moravia. The Morava rises at an elevation of 1380 m in the Jeseníky mountain range, and flows southeast to emerge in the Moravian depression near the city of Olomouc. Cutting through the westernmost curve of the Carpathian Mountains, the Morava joins with the Bečva River near the town of Přerov. The remainder of the passage to the Danube is through flat or marshy territory. For the last 35 km, the river forms the boundary between the Czech Republic and Slovakia, finally joining the Dyje River at the country's most southeasterly point. The Morava is 362 km in length from its headwaters to the Danube, and drains an area of 26,579 km^2 (Kohoutek 1978:230).

One other major European watershed has its source in the Czech Republic, that of the Oder River, flowing to the Baltic Sea. The headwaters of the Oder are located on the north slope of the Low Jeseníky Mountains, between the cities of Olomouc and Ostrava. The stream is quickly joined by many tributaries, flows through Ostrava, and on into the northern Polish plains. Although the area of the Czech Republic drained by the Oder (6,453 km^2) and the length of the river on Czech territory (98 km) are relatively small, the significance of the watershed boundary is great.

The major Czech river systems described above form some of Europe's main continental watersheds: The Elbe flows northwest from Bohemia to the North Sea, the Morava flows southeast to the Danube and the Black Sea, and the Oder flows north to the Baltic Sea. The mountains or uplands that form boundaries between watersheds are of paramount importance when examining routes of human communications, trade, and population movements. Large river systems, used as arterial corridors, eventually terminate. The lowest or closest points between rivers or headwaters literally act as bridges or portages for movement between such corridors (cf. Westerdahl 2006). Three major crossings of this nature exist in the Czech lands: one between the Elbe and the Morava watersheds; one overland from the Vltava to the Danube; and the other between the Morava and the Oder watersheds (the Moravian Gate). Of the three, the Morava-Oder connection is the most significant, due to the proximity of river systems, ease of overland transport across the low pass, and the importance of the two regions connected via the Moravian Gate. To the immediate north are the coalfields of Silesia and southern Poland, while the fertile loess-loam soils of the Morava River valley to the south are among Europe's richest farmlands. At a somewhat greater distance, two of Europe's great seas and cultural spheres are connected across the Moravian Gate:

Scandinavia and the Baltic to the north, Pannonia, Italy, and the Mediterranean to the south. A major east-west corridor passes just to the south of the Czech Lands: the Danube, nearly meeting the headwaters of the Rhine, joining the Black Sea with the North Sea and Europe's 'Atlantic Façade' (Cunliffe 2001). Moravia, located precisely where the European continental divide crosses a continuous lowland tract, is thus the natural center of through traffic in Europe (Moscheles 1924:563). A detailed map of the main Czech rivers and their most important tributaries is presented in Figure 3.4.

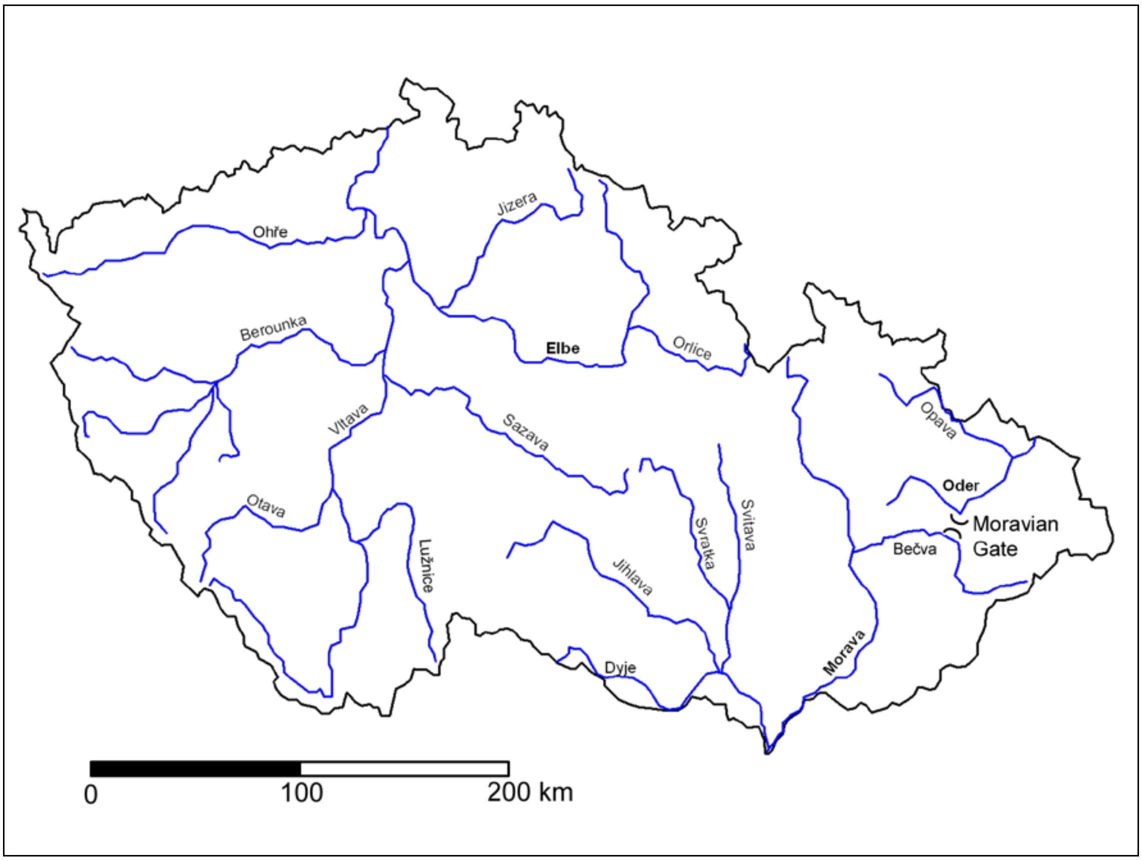


Figure 3.4 Hydrographic systems of the Czech Republic. The Moravian Gate is located at the low pass between the Oder and the Morava's tributary Bečva.

3.3 The Human Context

As a result of their geographic situation at the nexus of continental divides, the Czech lands have always been a center of transit. In prehistoric times the region was an intermediary between North and South, with innovations passing from the advanced Mediterranean and Balkan regions in the south to northern Europe. Human settlement and communications reflect this region's dominant geographic features. As mentioned previously, the most important routes for prehistoric settlers were the Elbe and Morava river corridors, the passage from the Danube to Vltava, and the overland passage across the highlands between Bohemia and Moravia.

Evidence of early Paleolithic humans is scarce in the Czech lands. Neanderthal remains have been found at several locations, notably the caves at Šipka, Kůlna, and Švedův stůl in the Moravian karst (Svoboda *et al*. 1996:47). *Homo sapiens sapiens* appeared in Bohemia and Moravia during the Würmian interglacial period (35,000 – 30,000 BP). Both cave habitations and open-air settlements are known, and lithic tool production became progressively more sophisticated. Collective hunting of big game became common during the Gravettian period (30,000 – 25,000 BP), and this horizon is particularly well represented in Moravia. Well-known "mammoth-hunter" burials and settlements at Předmostí, Dolní Věstonice, and Pavlov comprise the largest sample of human graves for this period in Europe (Svoboda *et al* 1996:169). Upper Paleolithic sites were strategically located along the region's rivers, as these were corridors for movement both of humans and the animals they hunted (Figure 3.5). The Předmostí site is characteristic: well positioned above the Bečva River at the southern entrance to the Moravian Gate, high enough to avoid seasonal floods, with a wide view both up and down the valley. An Acheulian horizon at Předmosti indicates the importance of this geomorphological location as early as the Middle Paleolithic (Svoboda *et al.* 1994). Pavlovian (Eastern Gravettian) settlements, larger than in preceding periods, tended to concentrate in the river valleys and along the main SW-NE

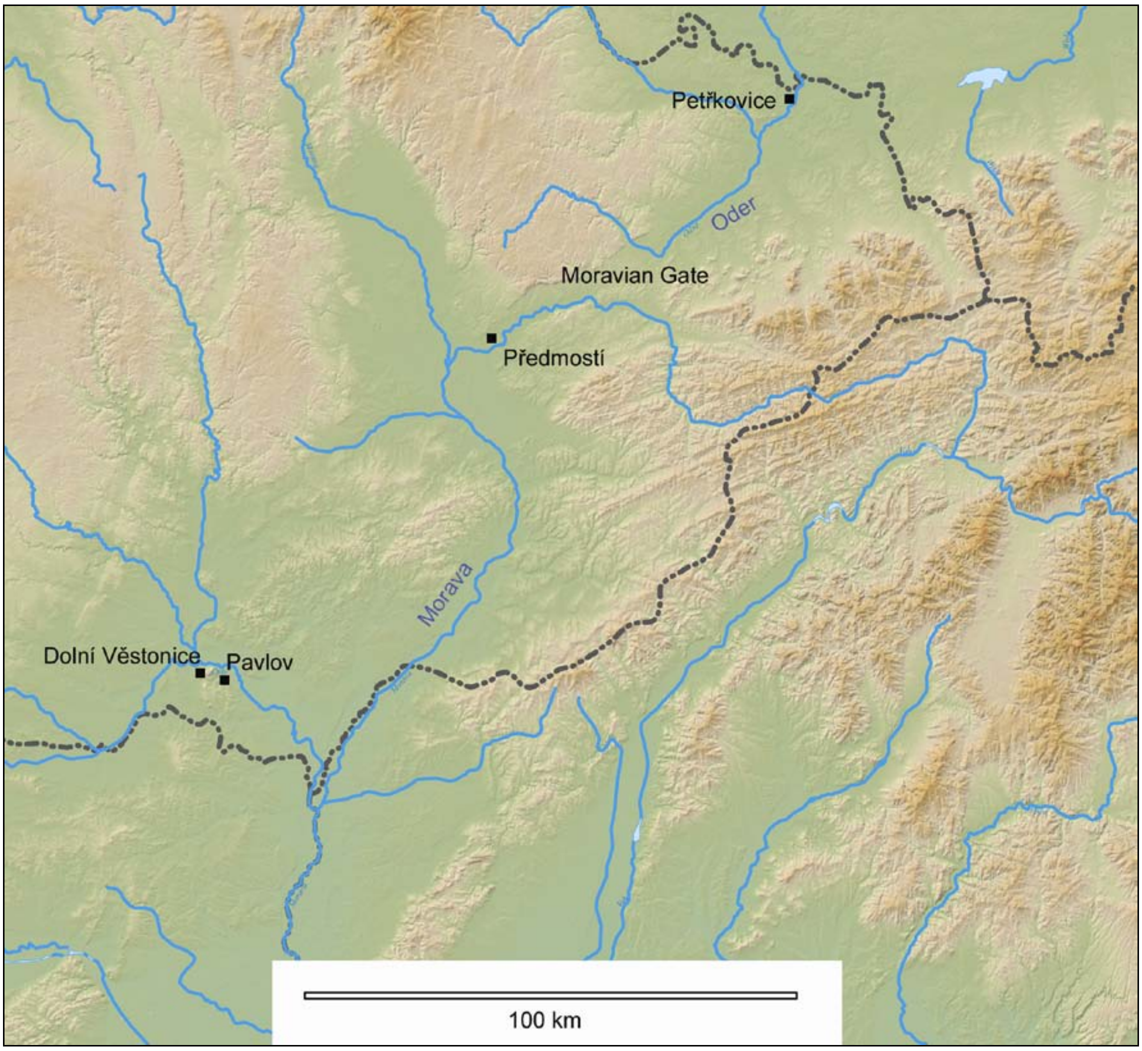


Figure 3.5 Important Paleolithic sites in Moravia, showing distribution along the main axis of communication through the Moravian Gate corridor.

communication axis through Moravia (Svoboda 1991:1). Pollen analysis indicates relatively temperate climate and intermittent forest at Předmostí (arboreal vegetation comprised 31% of the total sample), mostly coniferous species but also elm and beech. Forest cover was likely much greater in southern Moravia in the vicinity of Dolní Věstonice, usually over 50% (Svoboda *et al.* 1996:137).

Pavlovian cultures in Moravia were able to develop surprisingly advanced technologies, including the earliest known kilns and ceramic-making facilities (Vandiver *et al.* 1989). This technology was used to make figurines of people and animals, including the famous "Věstonice Venus" (Figure 3.6). Venus figurines have been found at two other sites in Moravia (Pavlov and Moravany) and also at

Petřkovice on the Silesian side of the Moravian Gate. Although many researchers associate the Venus statuettes with fertility rites or other ritual activity, Jochim (2002:81) noted that "their location within sites shows no patterning to suggest that the figurines were sacred objects of veneration." Vandiver *et al.* (1989) suggested that the production process itself, rather than the end product, served a socio-ritual purpose and that the figurines were never intended to be lasting objects.

Figure 3.6 Venus figurine from Dolní Věstonice, dated to ca. 26,000 BP. The figurine is made of local coarse-particled loess, fired at 500° to 800°C.

Pavlovian peoples were also extremely mobile, as recent studies of lithic materials at Moravian sites have shown. At the Pavlov I site, 96% of the lithic materials (various siliceous flints) were imported from sources around the Moravian Gate, or even Southern Poland, a minimum distance of 120 km (Svoboda 1994:72). The remaining materials, mostly radiolarites, came from sources at least 100 km away in Slovakia and Hungary. In Svoboda's interpretation (1994:75), regular movements of large groups for subsistence purposes (i.e., following animal herds) also allowed for procurement of distant raw materials.

Climatic cooling beginning around 25,000 BP (the peak of Pavlovian occupation) signaled the onset of the final ice age. The Moravian environment became much harsher, with permafrost formation and long winters as the ice sheet moved south over the northern European plain. Significant tree growth and forest cover was virtually eliminated from all but the most southerly zones of Europe, resulting in tundra and steppe conditions over much of the continent. The mountains and plains of northern and central Europe have been described as a "polar desert" or "arctic desert" between 25,000 and 14,000 BP (Jochim 2002:83). The original core population area around the Pavlov Hills gradually shifted to the north and east, possibly culminating in the Avdeevo and Kostenki occupations on the Russian Plain. Olga Soffer (1993:45) has suggested that the demographic shift (occurring over enormous span of time) was a response to movements in the main faunal resource base (mammoths and other large herd animals). The Moravian Gate corridor was thus the essential route both for procurement of food and tool materials, as well as enabling the movement of population in reaction to changing climatic conditions.

Human populations in Bohemia and Moravia were thus significantly reduced during the Last Glacial Maximum (around 18,000 BP). As the climate warmed again during the late Pleistocene and early Holocene, Mesolithic cultures populated the region. Schild (1996:152) suggests that early Mesolithic populations had no ties with the late Glacial populations of the region. Dolukhanov, on the other hand, sees a continuation of some forms of adaptation, particularly in riverine and lacustrine sites on the East European Plain (1996:168).

Mesolithic settlements in Bohemia and Moravia, in contrast to those of the Upper Paleolithic, were not located on loess deposits. With only sparse tree cover, the loess did not attract game animals favored by Mesolithic hunters. As the tundra became gradually wooded, a wide variety of small ungulates replaced the large migratory herds of reindeer and horse. A rich and diverse aquatic biotope developed in the region's rivers and lakes, with a variety of fish and waterfowl available for subsistence (Mithen 1994:86). Habitation sites were situated on sandy riverbanks and lakeshores, to facilitate fishing and exploit fauna that congregated near water (Tringham 1971:62-63). Numerous finds of flint fishhooks demonstrate the importance of fish in the Mesolithic diet (Neustupný and Neustupný 1961:36). Efficient water transport would have been essential for Mesolithic groups to exploit such aquatic resources.

Riverine communication routes must also have played a role in trade, as various raw materials for finely worked microlithic industries were imported from relatively long distances. Neustupný and Neustupný (1961:35) cite jaspers and cherts found at settlements along the Ohře River which originated on the Middle Rhine, and striped chert from southern Poland found in North Bohemian sites (see also Sherratt 1997:109-110). Zvelebil (2006) and Sulgostowska (2006) also emphasize the mobility of late Mesolithic populations, not only in the context of resource procurement, but also of intergroup social contact. Water transport was likely a key element in maintaining social structures, as family and local groups, associated into extensive networks, undertook regular visits and periodic aggregation to exchange goods, information, and marriage partners (Mithen 1994:119).

The first agricultural and farming cultures in Bohemia and Moravia appeared between 6,000 – 5,000 cal BC, arriving from the Balkan Peninsula via the Danube river valley and Pannonian Basin. The spread and adoption of agriculture, whether by colonization or native inhabitants, supposes a tremendous mobility. As suggested by Alasdair Whittle (1994:137), "distance and geography [in the Neolithic] may have been lesser barriers than we now suppose in our map-bound world."

The first Neolithic agricultural settlements occur simultaneously with the latest of the Mesolithic hunter-gatherers, precisely in those areas avoided by the older cultures: the rich loess deposits of the Morava valley and Bohemian Basin (Tringham 1971:68, Sherratt 1997:23). These soils were likely preferred for the combination of high fertility with exceptional ease of working (Clark 1952:95). Settlement sites tend to be clustered in areas of high loess deposits, especially along river valley edges (Figure 3.7). Neolithic settlements in Bohemia eventually spread from the broad central basin along the Elbe River into the canyons of the 'Porta Bohemica' (Zápotocký 1969:280-281). The first farmers cultivated many cereal crops: several varieties of wheat, barley, millet, with rye appearing in the late Neolithic. Several legumes were grown as well, including peas, lentils, and beans (Čižmářová *et al.* 1996:16). The material culture of these early agricultural communities is characterized by Linerbandkeramik (LBK) pottery. Childe considered Moravia to be the heart of the LBK culture area (his Danubian Ia), encompassing the region's main loess deposits (1929:36). LBK culture spread quickly across the continent, as evidenced by the homogeneity of pottery ornamentation throughout Central Europe and as far away as the southern Netherlands (Milisauskas 1978:55). In this context, Moravia in particular was both a core area for the culture and a corridor for transmission northward into Poland and westward into Bohemia.

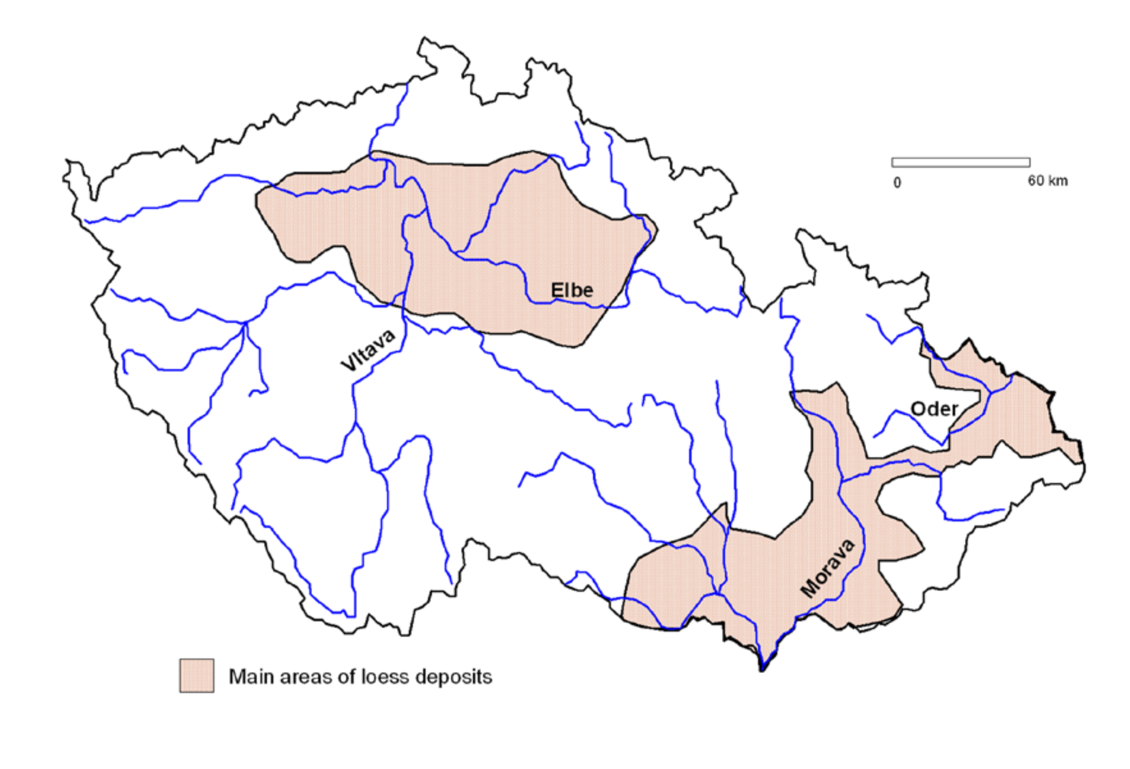


Figure 3.7 Main areas of loess deposits in Bohemia and Moravia, with notable concentrations in the Bohemian Basin and along the Moravian Gate corridor.

A regular succession of new pottery types, both imports and those developed locally, eventually replaced the initially uniform LBK assemblages. Stroke Ornamented Ware was followed by Lengyel, which in turn developed into Funnel-necked Beakers (TRB culture). Corded Ware ceramics followed, with many local and regional variations (Figure 3.8), succeeded in turn by Bell Beakers. Bell Beaker pottery shows extraordinary uniformity over a wide area, and according to Childe marks a complete break with all previous Danubian traditions (Childe 1929:188). Much has been written on the Bell Beaker assemblage, with few clear conclusions (e.g. Sherratt 1994:250-252). Childe (1957:223) viewed the 'Beaker Folk' as "bands of armed merchants who engaged in trading copper, gold, amber and similar scarce substances…roaming from the Moroccan coast and Sicily to the North Sea coasts, and from Portugal and Brittany to the Tisza and the Vistula.

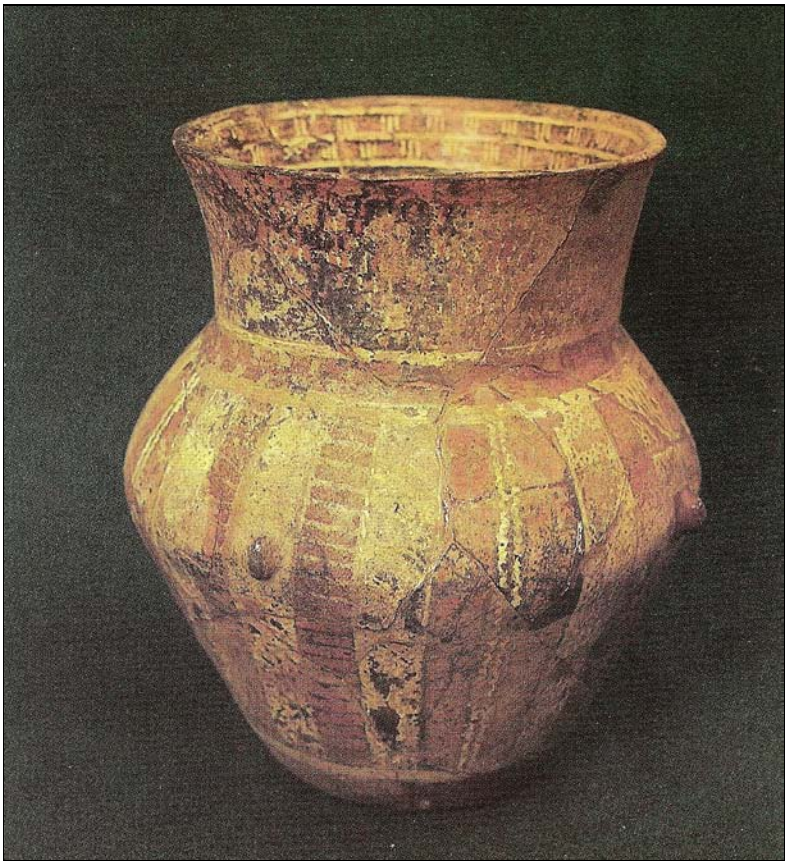


Figure 3.8 Moravian Painted Ware, a local version of the broader late Neolithic Lengyel complex ceramic style (photograph by the Moravian Museum, Brno).

At times they obtained economic and political authority over established communities of different cultures, and even led them on further wanderings…" More recent research suggests that the Bell Beaker phenomenon was not a migration of a distinct population, but rather a 'status kit' marking elites regardless of ethnicity, and maintained by a pattern of contact linking trade, ritual, and ideology across Central and Western Europe (Renfrew 1987:86-92, Sherratt 1994:251-254). Sherratt (1997:26) envisioned the spread of Bell Beakers as "a pattern of interaction", carried by "a new mobility…setting up its own network of riverine links within the Continent", especially the northwest-southeast Danube axis. Despite the networks of interaction, no single point of innovation can be identified (Renfrew 1987:91). Of major relevance for a large-scale contextual understanding are the repeated patterns of movement of people, goods and culture: either up the Danube and Morava Rivers into Poland and Bohemia, or conversely, up the Vistula, Oder and Elbe, down the Morava and Danube into Panonnia, the Balkans, and on to the Mediterranean.

Copper artifacts appear sporadically in the late Neolithic period, although normally only for luxury or high status prestige items. Stone, both local and imported, was the still the main raw material for tool production (Neustupný and Neustupný 1961:64). There is no conclusive evidence that copper was mined or processed in Bohemia and Moravia during this period. Rich metal deposits in the mountains of Bohemia were as yet unexploited. Copper goods were thus likely obtained via exchange networks or brought by incoming migrations (Čižmářová *et al*. 1996:25).

New methods of agriculture and stock husbandry caused profound social and economic changes during the Late Neolithic. Personal accumulation of wealth, evident in impressive individual graves, resulted in growing social stratification. Gold and amber from burials attest to the long-distance transport of these goods (Childe 1929:191). One interpretation of grave goods and cult-objects supposes a shift from matriarchy to patriarchal society during this period as well (Neustupný and Neustupný 1961:72).

By around 2000 BC, the principles of bronze smelting had spread across Central Europe. Among the earliest and most important Central European centers of bronze working is Únětice in Bohemia, the classic type-site. Although Corded-Ware groups were familiar with small-scale copper working, it was the beaker-using cultures in the later second millennium BC who were the first to use Bohemian tin for bronze working (Sherratt 1994:257). Metallurgy during this period became very well developed in Central Europe in general and Bohemia in particular. Numerous hoards of bronze items have been found in Bohemia, especially along the Elbe River (Zápotocký 1969:282-284). Childe (1957:134) correlated the development of the Central European Bronze industry with that of the amber trade, emphasizing the role of Mycenaean Greece and Crete.

The sources of the metals (both copper and tin) feeding the expansion of bronze manufacturing and use during the second millennium are not exactly clear, although spectrographic analysis of artifacts has identified cuprous material from the Harz Mountains, Slovakia, and the Alps (Neuninger and Pittioni 1963; Bath-Bílková 1973; both quoted in Sherrat 1997:131). Tin (which lowers copper's high melting point and at the same time increases its strength) is abundant in the Ore Mountains of Bohemia, although whether it could be extracted with Bronze Age technology is disputed. Placer deposits may have been available in Bohemian streams, although Harding (2000:201) points to the Elster valley in Germany as the tin source for the major Central European bronze industries (cf. Bath-Bílková 1973, but see also Bouzek *et al.* 1989).

Blanks in the form of rings were a widely traded commodity, moved along the rivers of Central Europe. Moravia was once again a key route in this exchange, trading copper and bronze for Baltic amber, and controlling the Moravian Gate route from Poland to the head of the Adriatic Sea. Transportation, whether overland or by boat, closely followed the river courses. The route of trade, known as the Amber Route or Amber Road, became the focus of cultural development in Central Europe at this time (De Navarro 1925; Vandkilde 2007:103). Hoard finds are a main source of knowledge of the Únětician culture, especially those deposited for ritual reasons in watercourses and marshes (Moucha 1994:62). Large copper hoards from this period have been discovered in southern Moravia along the Morava and Dyje rivers, and in Bohemia along the Elbe and Ohře. The largest, uncovered in Hodonín in 1893, comprised more than 600 items representing 120 kg of copper (Čižmářová *et al*. 1996:37).

According to some scholars (i.e. Kristiansen and Larsson 2005; Vandkilde 2007), the processes of interregional interaction played a major role in creating culture and society during the European Bronze Age. A continent-wide network of metal trade and exchange developed, linking regions regardless of ethnicity or cultural tradition. Alliances and connections created through ritual gift exchange created networks for trade and movement of people and goods. Production and exchange of prestige goods was a primary goal throughout the Bronze Age, bestowing and representing social and political power. One crucial factor, cited by Kristiansen and Larsson (2005:37-39) as the most fundamental basis of the entire system, was the open network of long-distance communication routes necessary for obtaining and distributing metal and other elite goods. In Bohemia, the essential route ran from Bavaria and the Upper Austrian Danube valley along the Vltava River to Central Bohemia (Moucha 1994:60). In Moravia, the Morava River was once again the main channel for inter-regional and long distance communication.

The general use of iron in Bohemia and Moravia is documented from the early Hallstatt period. Iron objects appeared for the first time around 800 cal BC, although iron processing did not take place locally until around 600 cal BC (Čižmářová *et al*. 1996:62). Iron ore is locally available in many areas of Europe, and although the smelting process is more complicated than that of bronze, the technology spread rapidly. The ready accessibility of iron had a likely effect on long-distance trade and exchange, although bronze metallurgy continued to thrive and was used especially for smaller objects.

Culturally, it is likely that the Hallstatt assemblage in Bohemia and Moravia developed from the late Bronze Age Knovíz, Věteřov, and Maďarovce groups. These groups were supposed by Neustupný and Neustupný (1961:128) to be ancestral to Central European 'Celtic' culture and ethnicity, although the two are not necessarily interchangeable. The term itself can be applied to ethnicity, language, art, material culture and perhaps other aspects of society, and does necessarily imply a continuous lineage of 'Celtic' identity and heritage (Renfrew 1987:214; Wells 2001).

In any case, iron contributed to new settlement patterns, as iron plowshares and coulters enabled agricultural exploitation of a wide variety of soil types. Although the bronze trade decreased, the growing urban centers in the Mediterranean world stimulated entrepreneurial production and activity throughout Europe. Prestige items of bronze and silver were imported from Etruscan Italy (Drda and Rybová 1994:84; Čižmář 2002b). Exotic objects from even farther distant origins have been found in Bohemian and Moravian graves, including objects from the Black Sea, the Near East, and possibly Egypt (Čižmářová *et al*. 1996:64-66; Svobodová 1985). Amber is represented both by ornaments and jewelry in burials, and unworked stores awaiting finishing or transshipment.

Hallstatt and La Tène period people utilized extensive trade routes throughout Europe, diffusing material culture of great similarity across the continent. Both raw materials and finished goods circulated widely, and low value coins became a common medium of exchange. Prestige goods from the Mediterranean, especially those associated with wine and drinking rituals, were sought after as essential objects for chiefly or princely households (Drda and Rybová 1994:84).

Barry Cunliffe (2001:311) has noted the "geographically favored region" of Europe extending around the north side of the Alps from Burgundy to Bohemia. Temperate climates and fertile soils are combined at this nexus of communications routes, where the headwaters of the Saône, Loire, Seine, Moselle, Rhine, and Danube all converge within a radius of barely 200 km. In Cunliffe's view, the favorable geography is partially to credit for the rapid social and economic change that occurred during Hallstatt and early La Tène. The development of a complex and sustained prestige goods economy, where paramount chieftains controlled and distributed exotic goods to maintain the social hierarchy, was made possible by constant and fairly large scale movement of commodities over long distances (Cunliffe 2001:314). The scale may have been expanded, but the routes had existed for millennia.

Without entering the debate on the ethnic or linguistic origins of the peoples inhabiting Bohemia and Moravia, I wish to further explore the La Tène style and 'typically Celtic' material culture and settlement patterns that are well documented in Bohemia and Moravia during this period (e.g. Břeň 1976; Drda and Rybová 1998; Čižmářová 2001; Podborský 2004), especially in relation to long-distance transport and communication.

La Tène style decorative elements, especially curvilinear floral, anthropomorphic and zoomorphic motifs, are found throughout Bohemia and Moravia. Particularly fine examples include the bronze pitcher decoration from Brno-Maloměřice cemetary, the bronze head from the *oppidum* at Staré Hradisko, and the stone head from the *Viereckschanze* of Mšecké Žehrovice (Figures 3.9 and 3.10). Some scholars have argued that these motifs were adapted from Greek and Etruscan decorative patterns, and were even potentially influenced by ornamental traditions from steppe lands east of the Carpathians (Wells 2001:54-55). It has been suggested that Central European contacts with the Greco-Etruscan world since early Hallstatt had developed into a "north-south axis of exchange…superseding all other axes" (Brun 1995:15-16). Status was displayed and emphasized by lavish Mediterranean imports, embodying mystical knowledge of distant people, places, and practices (Helms 1988).

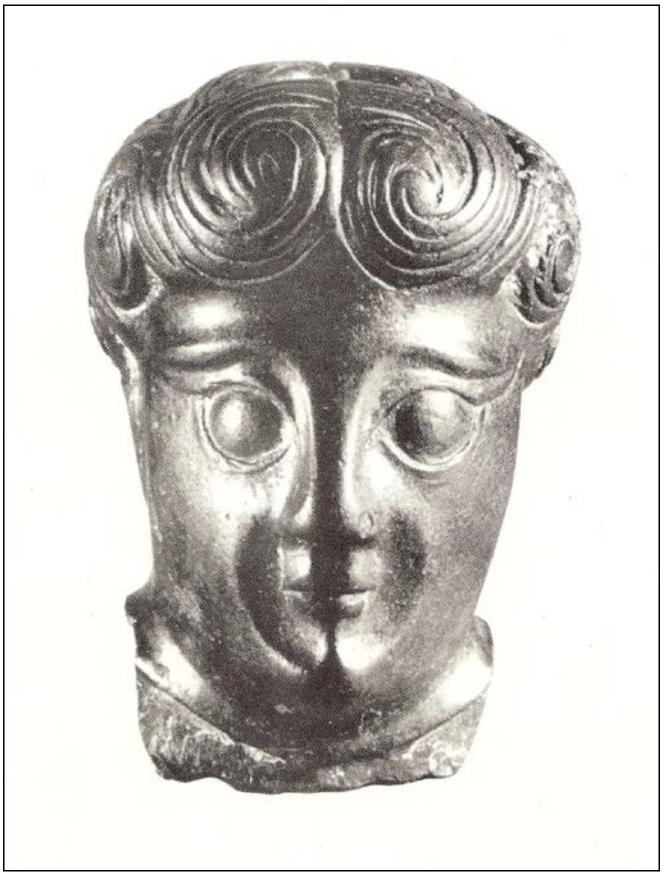


Figure 3.9 Bronze head from the Staré Hradisko oppidum (photograph from Čižmář 2002a, back cover).

Figure 3.10 Bronze pitcher decoration from the Brno-Maloměřice cemetery (photograph by the Moravian Museum, Brno).

The result, according to Peter Wells (2001:54), was a growing “interregional identity”, which spread across Europe by the 4th century BC.

Long-distance trade and travel, spreading and maintaining material culture, status, and social structures, was the glue that held the world together in the last millennium BC. The clearest evidence for the importance of communication routes comes from archaeological investigations of Hallstatt and La Tène period settlements, especially *oppida*. These centers of culture, craft, and economic activity are actually to some extent defined by their situation in the local and regional terrain. As described by Jiří Břeň (1976:82), “Not all fortified settlements in Czechoslovakia [dating from this period] are *oppida*. The decisive factor in identifying the settlement as an *oppidum* is its importance…which depends to a certain extent upon the locality”.

Oppida are often described as centers of political power, of industry and economy, and centres of craft production. Many authors also observe that rather than being positioned as hubs for districts of notable fertility and population density, *oppida* were located as centers of trade and production for trade (e.g. Wells 1984:124; Audouze and Büchsenschütz 1992:235). As observed by Cumberpatch (1995:74), the locations of Bohemian and Moravian *oppida* were closely related to control of primary communication routes. In Cumberpatch's view, "…indirect control of agricultural production via ideological sanction and/or the circulation of goods was of greater significance than the ownership of land in the modern sense" (1995:74). *Oppida* and other craft production centres in Bohemia and Moravia were strategically located to control the main communication routes over both land and water, and their geographic distribution and placement is a direct reflection of that aim.

In Bohemia, the best-known *oppidum* is at Stradonice, near the town of Beroun. The settlement is located on an imposing high bluff directly on the south bank of the Berounka River. The hilltop here was settled during early Hallstatt times, and became a fortified *oppidum* in the early 1st century BC (La Tène D1) (Sklenář 1993:206). Despite being mined by local inhabitants and looted by treasure hunters in the 19th century, the richness of this settlement is evident in the surviving museum collections: for example, over 1300 brooches are held in various collections (Břeň 1976:83). Stradonice thus ranks as one of the richest sources of brooches from this period anywhere in Europe.

Geographically, Stradonice controls the lower reaches of the Berounka, flowing from Western Bohemia to its confluence with the Vltava near the center of the Bohemian basin. The settlement's wealth was likely built on production and export of gold and iron ore from the nearby deposits around Beroun and Křivoklat. The Berounka River provided a convenient route into Central Bohemia, as well as north and south along the Vltava.

A number of strongholds were located along the Vltava River, controlling the entire length of this important watercourse. The southernmost *oppidum* in Bohemia is at Třísov, near the modern town of Český Krumlov. This settlement is only about 60 km overland from the *oppidum* at Gründberg on the Danube, and was thus likely a transshipment point as well as an important production center for typical graphite-coated ceramics (Břeň 1976:83). The overland route between Třísov and Gründberg crossed the continental divide between the North Sea and Black Sea catchment areas, a theme that is repeated throughout Bohemian prehistory (and indeed in historic and modern times).

The *oppidum* at Zavíst, located at the southern margin of the modern city of Prague, controls the Vltava – Berounka confluence. Located just 25 km from Stradonice, the settlement was built atop a massive hill cut by a steep stream canyon. A temple-like 'acropolis' occupied the settlement's highest point. Initially settled in the Neolithic, the most intense occupations came in the 5th and 1st centuries BC. At its maximum extent, the *oppidum* covered nearly 150 ha and was surrounded by 8 km of rampart walls (Břeň 1976:83).

Between Třísov and Zavíst are the *oppida* of Hrazany and Nevězice, both located along the Vltava. Both were clearly positioned to maintain control along the important water route, and there are indications that Hrazany functioned as a production center for iron ore. Excavations at Hrazany have revealed a human presence as ancient as the Mesolithic, and at Nevězice since the Bronze Age (Sklenář 1993:90).

České Lhotice, the final *oppidum* in Bohemia, controlled the overland route from Bohemia to Moravia. This route crossed from the Bohemian basin to the Morava River valley, over the continental boundary dividing the North and Black Sea watershed regions. České Lhotice was located on a deep tributary of the Elbe (the

Chrudimka), and was thus connected to Bohemia's main overland and waterborne trade routes.

Staré Hradisko and Hostýn, the main *oppida* in Moravia, are located on opposite sides of the Morava River, along the Moravian Gate corridor. It is possible that the destroyed site at Kotouč u Štramberka in the Oder River watershed was also an *oppidum*, controlling the northern end of the Moravian Gate (Čižmář 2002a:4). The site at Lhotka-Lovosice on the Elbe River in Northern Bohemia, while not a fortified *oppidum*, clearly played a large role in production and distribution of various goods (Cumberpatch 1995:81). Lhotka-Lovosice and similar *emporia*, all located along major water communication arteries, were major centres of economy and trade (Drda and Rybová 1994:87). A map of *oppida* and other Iron Age settlement locations is shown in Figure 3.11.

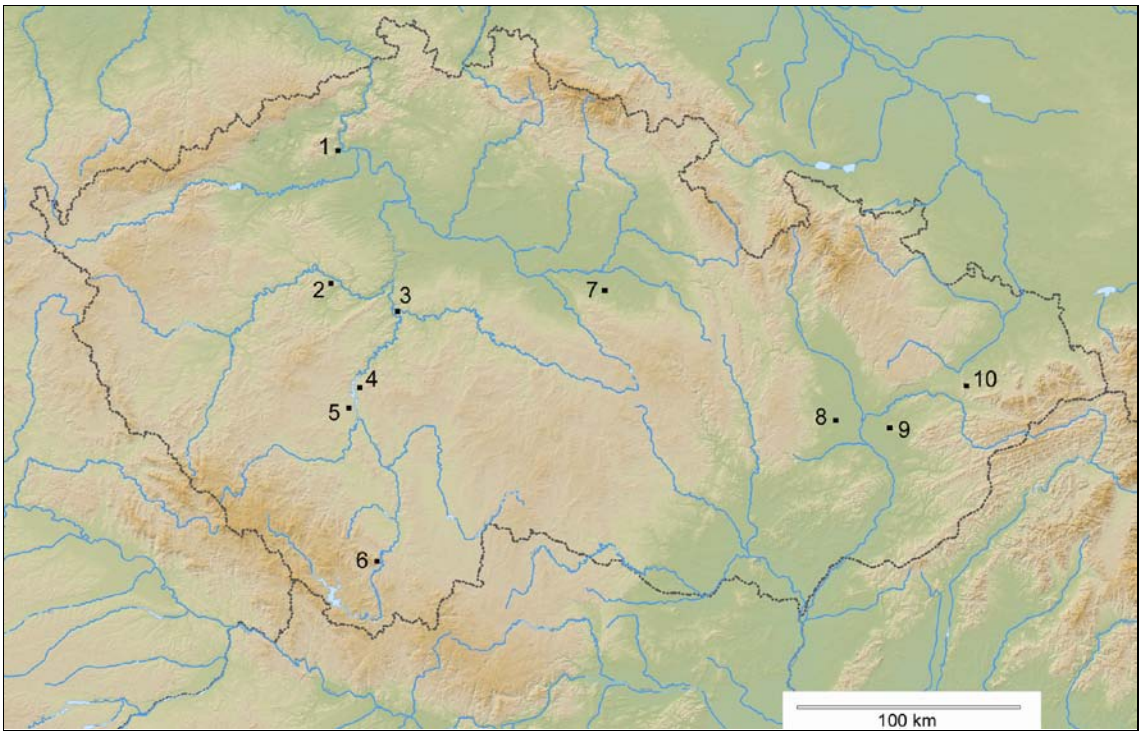


Figure 3.11 *Oppida* and other La Tène period settlements: 1) Lhotka-Lovosice (emporium), 2) Stradonice, 3) Zavíst, 4) Hrazany, 5) Nevězice, 6) Třísov, 7) České Lhotice, 8) Staré Hradisko, 9) Hostýn, 10) Kotouč u Štramberka (possible *oppidum*).

Ulrike Teigelake (2003:157) identified several criteria for distinguishing potential evidence of water transport in the absence of vessel remains. Chief among these are “Conspicuous wealth or fortification near navigable rivers or at a transition from land to water routes, settlements near rivers despite unfertile land, and concentrations of long-distance imports near rivers.” The significance of waterborne transportation and riverine communication routes to the Celts is shown by their choice of location for building *oppida* and other major settlements.

Around the middle of the first century BC the La Tène peoples of Central Europe sharply declined in number. German tribes, displaced by Roman invasion and occupation in Western Europe, moved into the region. Two large Suebian tribes (Marcomanni and Quadi), and several smaller groups under their hegemony, occupied Bohemia, Moravia and lower Austria during Roman times. Relations between Romans and barbarians north of the Danube *limes* were generally friendly, but prone to interludes of hostility. Commerce between the two spheres was clearly profitable for both sides, and one function of Roman forts along the Danube may have been to protect this trade (Pitts 1989:49). During the Marcomannic Wars (168-180 AD), the Roman Emperor Marcus Aurelius established a frontline fort at Mušov on the Dyje River, fortified with deep moats and earthen ramparts (Sklenář 1993:141). It is likely that there were Roman camps deeper in Moravia; Roman bricks are incorporated into 8th and 9th century constructions as far north as Staré Město, and possibly even Olomouc (Peška 2004, pers. comm.). By the mid-2nd century Rome apparently had the right to choose or approve new Suebian kings, and there is some suggestion that Marcus Aurelius was planning a new Imperial province of ‘Marcomannia’ for the region north of the Danube (Pitts 1989:49).

The Emperor Commodus concluded peace on the Middle Danube in 180 AD, and the war's end allowed consolidation of the Teutonic tribes north of the river. Repeated invasions by Goths, Huns, and other barbarians weakened the Roman Empire. During the first few centuries AD, German tribes including the Swabs, Heruls, and finally the Langobards inhabited Moravia (Galuška 1991:6).The decay and collapse of the Roman Empire left a turbulent situation in Central Europe, and a succession of various tribes and ethnicities moved through the area. In the 6th century AD, the first Slavs arrived in the region. Regardless of the original Slavic homeland (a topic of near-endless argument among archaeologists, linguists, and Slavicists), by the early 6th century Slavs had spread around the flanks of the Carpathian Mountains, across Pannonia into the Balkans, and west to Moravia and Bohemia. Modern Czech historians date the Slavs' arrival contemporaneously with the Langobards' departure to Italy in 568 AD (Galuška 1991:11). This date is corroborated by archaeological evidence, as the earliest Slavic pottery in the region dates to the middle or late 6th century (Jelínková 1989:252).

The arrival of Turkic-speaking Avar nomads in the Danubian region around 560 AD, however, further complicated the situation. The East Romans paid the Avars immense tributes in an effort to convince them both to subdue the barbarians living north of the *limes*, and to cease raiding Byzantium themselves. The Avars, their treasury fattened with large amounts of imperial gold, established a powerful hegemony centered in Pannonia and extending over a large area of central Europe. Slavs and other tribes living in this region were obliged to pay tribute and render services to the Avar khanate. A certain amount of social and cultural integration took place, as Slavs participated in Avar military campaigns and imitated customs of the Avar elite. Mixed Slav and Avar burials and settlements are evidence of the gradual development of an Avar-Slav cultural zone during this period. Their relations assumed many different forms, but the mutual influence was strong. In 626 AD, a mixed Slav-Avar army joined a Persian attack on Constantinople. Slavs served mainly in the infantry, but also used dugout logboats to ferry troops across the Bosporus. The Chronicle of Paschal described the attack:

> On that Sunday, the accused khagan went to Khalai [modern Bebek] and put into the sea the *monoxyla* which were to cross to the other side [of the Bosporus] and bring him the Persians in accordance with their promise. When this became known our naval vessels accompanied by light boats set out on the same day to Khalai, despite an unfavorable wind, in order to prevent the *monoxyla* from reaching the other shore…Neither on Sunday night nor at daybreak on Monday did their boats manage to deceive our watches and cross over to the Persians. All the Slavs who came in the *monoxyla* were thrown into the sea or were slaughtered by our people (The Chronicle of Paschal, from Schenker 1995:18).

The Avars withdrew, and the defeat was one among many that signaled a decline in their ability to maintain hegemony over the khanate (Barford 2001:70).

From time to time, inhabitants of border areas of the khanate or regions of harsh subjugation rose in rebellion against the Avars. In 623 AD, a renegade Frankish fur and slave trader named Samo joined local Slavs in a revolt, and eventually became their leader. The rebellion was successful, and the political entity created by Samo is often cited as the first West Slavic state. The main source for this event is the Merovingian *Chronicle of Fredegar*, compiled in Burgundy in the 660s AD. Samo ruled the Slavic confederation from 624-659 AD, and following his death it collapsed into tribal anarchy. Although the precise location of Samo's state has never been determined, archaeological and documentary evidence points to Lusatia, Bohemia, and Moravia (Schenker 1995:22).

Whatever tribal union had been achieved during Samo's reign seems to have disintegrated after his death. Despite the lack of unity, social stratification and development proceeded, and is reflected in the archaeological record. High value items such as bronze belt-ends and hooked spurs, characteristic of societal elites, appear in burials from this period. Foundries and metal working shops are evidence of increased specialization by craftsmen. Settlement patterns also changed, away from semi-dugout huts built on posts characteristic of early Slavic dwellings, to large fortified "ringwall" forts (Galuška 1991:26). Ringwalls – fortified settlements surrounded by palisade walls, often on river islands – were built across a broad territory, from the Dnieper to the Saale River. The two largest and most well known Moravian ringwall forts are the settlements at Mikulčice and Staré Město, both on the Morava River (Figure 3.12). These fortresses were well placed to control access through the Moravian Gate, as well as routes leading to deposits of various raw materials (iron ore for example).

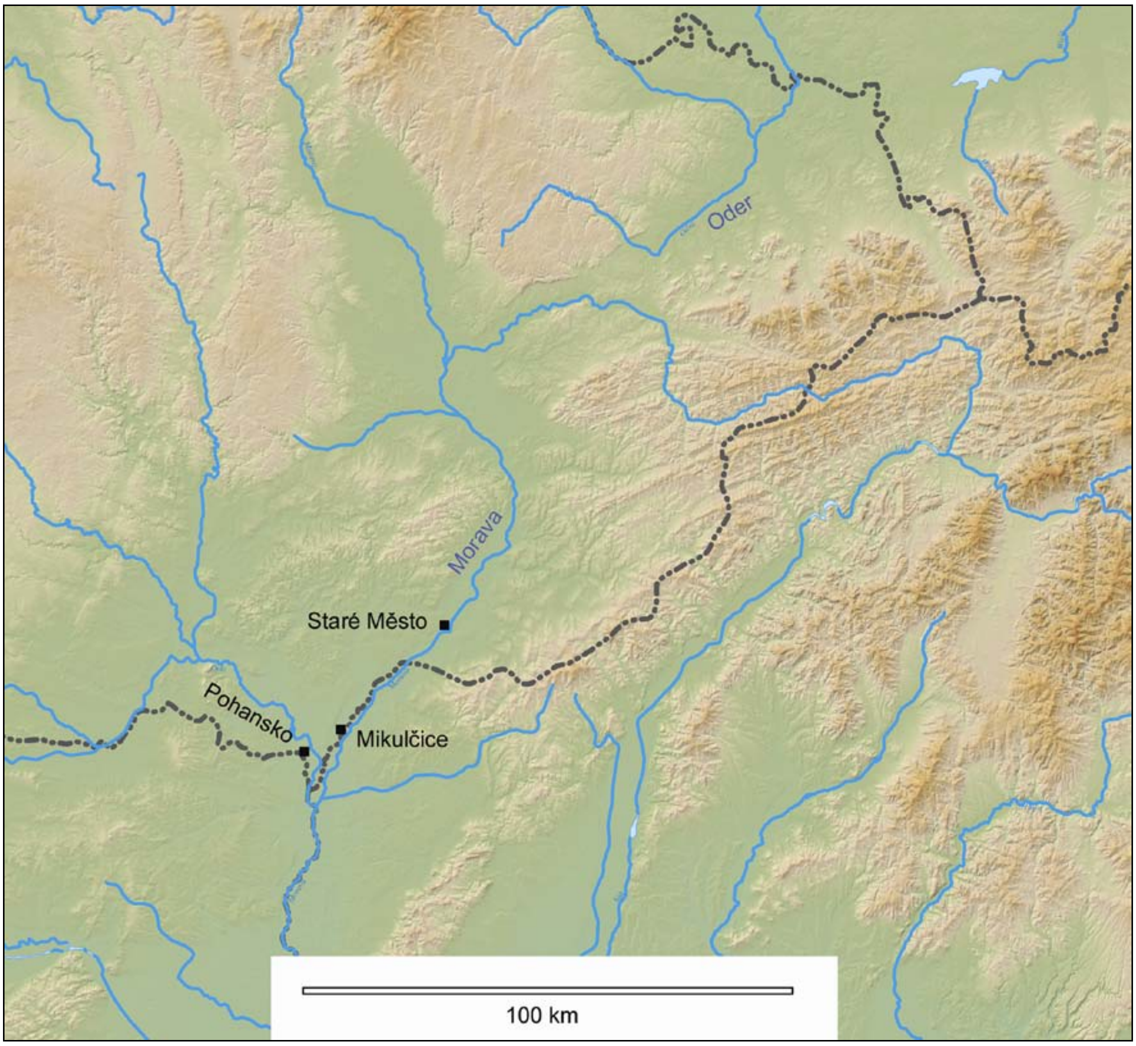


Figure 3.12 Slavonic ringwall forts in Moravia: Mikulčice, Staré Město, and Pohansko.

The Avars were finally destroyed in 796 AD by the military expeditions of Charlemagne and his son Pippin. The *khagan's* fortified camp between the Danube and Tisza rivers was demolished, and the chronicler Einhard reported that the Franks got more booty from this war than any other (Thorpe 1986:67). Some Avars accepted baptism and pledged fealty to Charlemagne, but most dispersed and fled (many to the protection of Krum, *khagan* of the Bulgars) (Riché 1993:109).

The Avars' departure created a substantial power vacuum in Central Europe, bounded on the west by the Frankish *Ostmark* (military frontier zone). Inhabitants of western Pannonia came under the influence of the Frankish kings (who had assumed the defunct title of "Roman Emperor"), and those to the south and east were dominated by the rising Bulgarian khaganate. Between the two powers, in the Morava and Nitra river valleys, two independent Slavic principalities developed. The Slavs stubbornly fought against repeated Frankish attempts to subjugate them. The Moravian dukes Mojmír I (d. 846), Rostislav (r. 846-870), and Svatopluk (r. 871-894) were able to centralize power in a series of strongholds along the Moravian Gate trade route, especially the ringwall fortresses at Mikulčice and Staré Město. In 830 AD Mojmír annexed the territory of Nitra (now in Slovakia), and pushed into parts of Poland, Bohemia, and Lusatia. The Moravians' rapid acquisition and consolidation of territory earned them the title of "Greater Moravia" from the Byzantine Emperor Constantine VII Porphyrogenétos (Schenker 1995:25).

Weakened by repeated conflict with the Franks and stretched by overly ambitious expansion, the Great Moravian state finally collapsed during the nomadic Magyar invasions in the tenth century. Settlements were abandoned, and political authority fragmented. The initiative in building a west Slavic state passed to Bohemia.

The Slavic inhabitants of Bohemia settled throughout the basin, especially on fertile land along the region's major rivers. Significant political and commercial centers were located at Prague and Levý Hradec on the Vltava, and Libice and Stará Boleslav on the Elbe (Figure 3.13). The initial political heir to the Moravian dukes was the Přemyslid clan, residing in Prague, and ruling over the lower Vltava and the Elbe as far as the Ohře. The Přemyslids were able to gradually unite Bohemia, although not without encountering significant resistance from the rival Slavník clan. The Slavníks, based at Libice on the Elbe, controlled much of South and East Bohemia (Polišenský 1991:20-21).

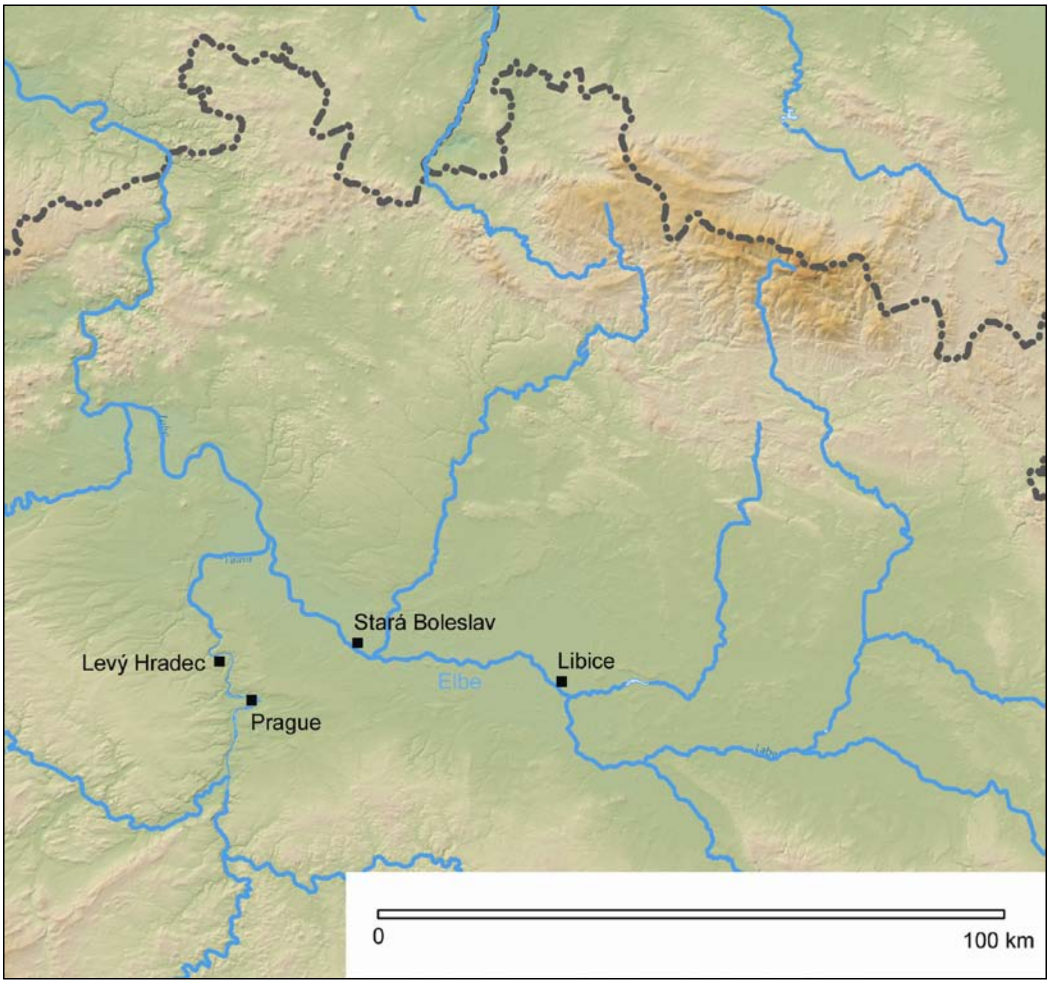


Figure 3.13 The most significant early Slavonic settlements in Bohemia included Levy Hradec and Prague on the Vltava River, and Libice and Stara Boleslav on the Elbe River.

After extirpating the rival Slavníks, the Přemyslid prince Břetislav was finally able to regain control over Moravia (ca. 1030 AD). The territorial boundaries of the lands ruled by Břetislav (and his son, King Vratislav) were remarkably similar to those of the modern Czech state. The Přemyslids' hereditary kingship was granted by the Emperor Frederic II in 1212, and the Bohemian king was also privileged as an Imperial Elector. Historical sources attest to the importance of waterborne communication routes both in Bohemia and Moravia from this period forward.

3.4 Historical Use of Czech Waterways

Czech rivers were intensively used in the historical period for transport of cargo and commodities. The earliest documentary evidence concerning the use of Czech waterways, both in Bohemia and Moravia, relates to the salt trade. One of the earliest examples is the tenth century Raffelstetten Codex (903-904 AD), a collection of laws regulating river traffic and tolls associated with the salt trade on the Danube, and indirectly its northern tributaries. The Codex described how *naves salinariae* (salt boats) sailed down the Danube and up to the Morava to reach the *mercatum Marahorum* (Moravian market) (Třeštík 1973:874).

In Bohemia the oldest preserved record is the Litoměřice Act of 1057, which describes three types of boats used for carrying salt on the Elbe (*navicula*, *navis mediocra*, and *navis magna*) (Zápotocký 1969:277). Other cargoes moved by rafts and boats on the Elbe included fish, hides, honey, grain, and wine. In the twelfth century, Bohemian exports included flour, beer, and building materials (Hons 1975:47-48).

During the Middle Ages, both in Bohemia and Moravia, two groups of people who made a living from the rivers (boatmen and millers) came into conflict. The millers' repeated construction of dams and weirs on the rivers, intended to raise water levels for millraces, created obstacles to navigation. In 1542, the Moravian assembly passed a decree, proclaiming that "measures shall be taken by anyone who constructs weirs on the river such that the Morava shall be freely navigable during times of adequate water flow…for boats or for transportation of timber or other goods…under penalty of a fine of 100 groschen" (Jakubec 2002:24). The situation apparently did not improve, and in 1579, the Estates General of the Margravate of Moravia appointed a special commission to investigate poor navigational conditions on the river. Millers were again strictly enjoined from hindering the flow of traffic on the river, and the Estates mandated "windows" during which the weirs were to be opened to allow navigation (Hons 1975:53).

Similarly in Bohemia, dams and mill weirs impeded navigation on both the Elbe and the Vltava. Authorities dealt with the rivers separately until 1777, when Empress Maria Theresa issued the 'Navigation Decree', which stipulated that all construction on Czech rivers must be approved the royal governor, and prohibited millers and fishermen from interfering with boats (Hubert 2006:9).

Salt continued to be an important river-borne commodity. As Bohemia and Moravia came under the rule of the Austrian Habsburg monarchy, restrictions were increasingly placed on salt imports from abroad. The Habsburgs instead maintained an imperial monopoly on salt distribution from Austrian sources, which was a great source of revenue for the royal treasury. Salt was transported to the Czech Kingdom from the Austrian Salzkammergut region via the Traun River to Linz or Mauthausen on the Danube. From there the salt was carried overland in wagons to České Budějovice where a storage and distribution center was established (Hubert 2008:24) (Figure 3.14).

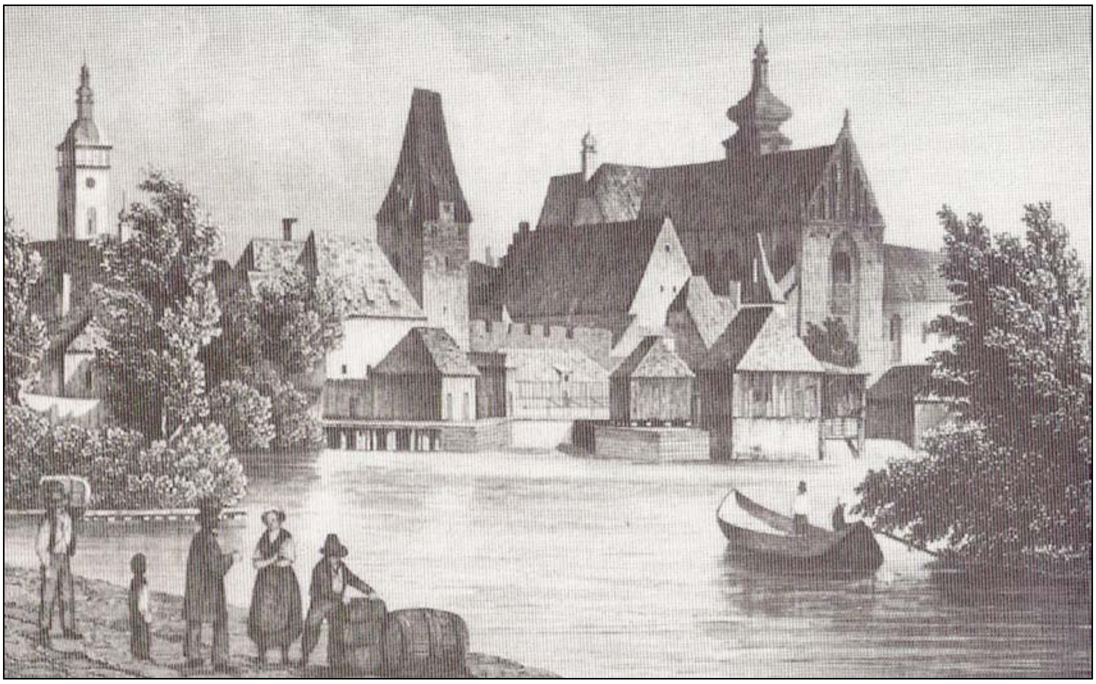


Figure 3.14 19th century view of České Budějovice salt house and monastery (Hubert 2008:62). Note the flat-bottomed vessel at right.

Salt was further transported from České Budějovice to Prague and Central Bohemia in boats and barges on the Vltava River. Navigation improvements on the Vltava were carried out in connection with the salt trade, and in 1547 Emperor Ferdinand I issued a royal decree mandating openings in weirs and millraces to allow river traffic. A shipyard was also established in České Budějovice, and boat-builders from Upper Austria were brought to build river barges. Work along the river progressed rapidly, and the first salt boats sailed from České Budějovice downstream to Prague in August of 1550 (Hubert 2008:25).

The salt trade and associated shipbuilding along the Vltava opened the door for a wide range of waterborne transport. Building materials and timber were other important commodities carried by river traffic. Boat building became an economically important industry in several cities along the Vltava, initially in České Budějovice and later in Týn nad Vltavou, Kamýk and numerous smaller towns (Figures 3.15 and 3.16). Water transport on the Vltava reached its apex in the mid-19th century (Figure 3.17 and 3.18).

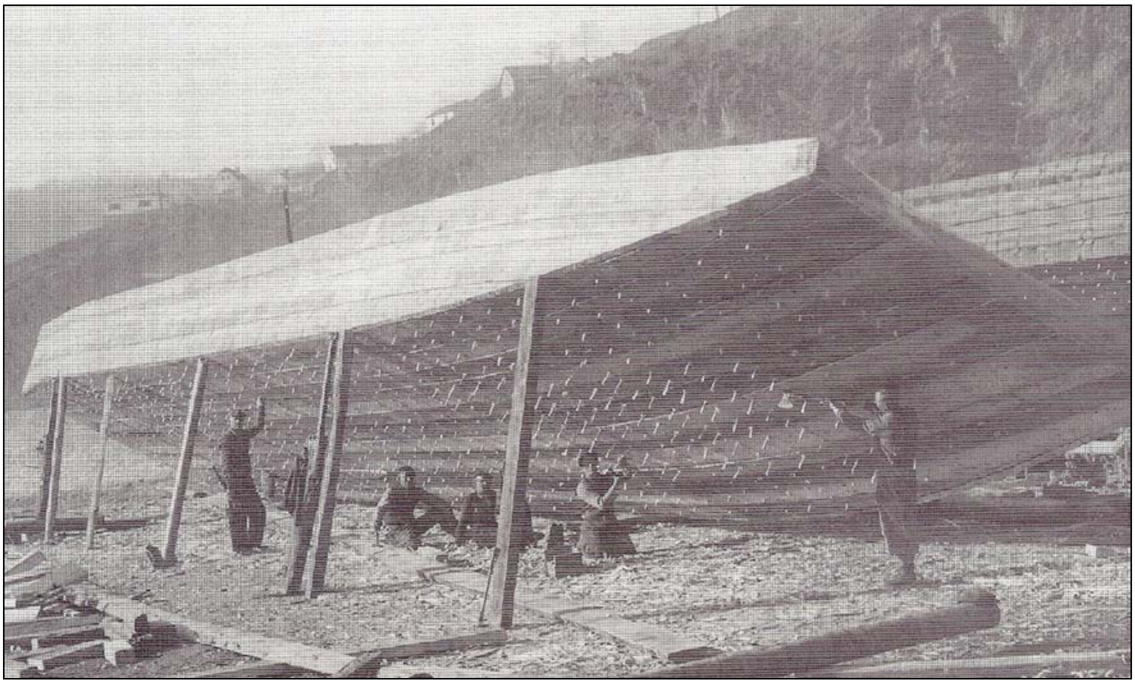


Figure 3.15 Building a large cargo vessel in the boatyard at Štěchovice on the middle Vltava, early 20th century. Large vessels were built with the hull angled or resting on one side, to allow pegging and joinery of the flat bottom (photograph from Hubert 2008:96).

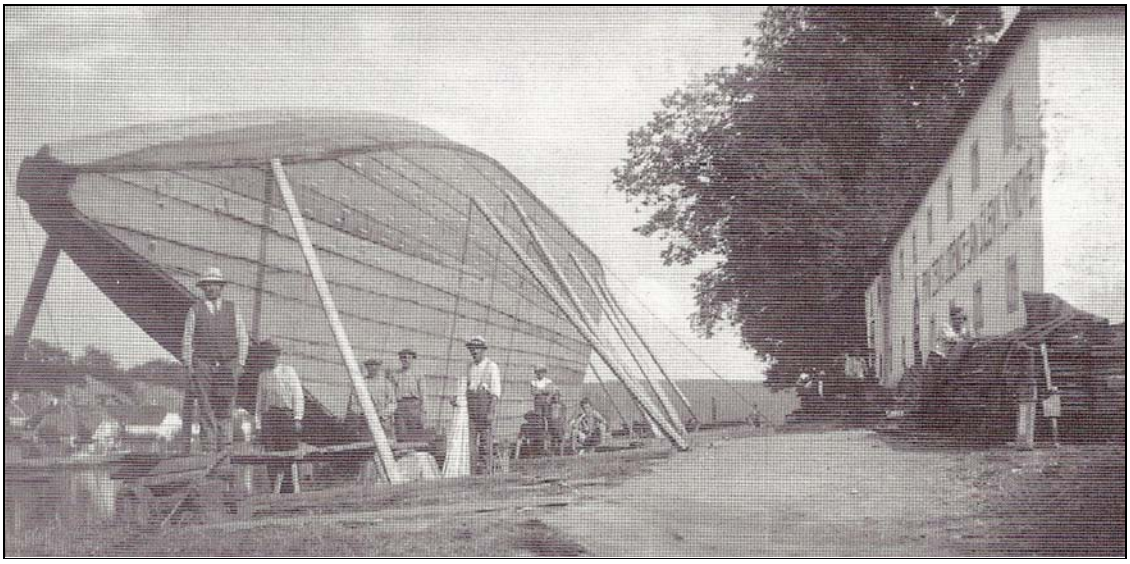


Figure 3.16 Boat construction in front of the salt house at Týn nad Vltavou, late 19th century (photograph from Hubert 2008:85). In contrast to the vessel in the previous figure, this boat has a pointed bow. Both vessel types would be towed by horse from the riverbank.

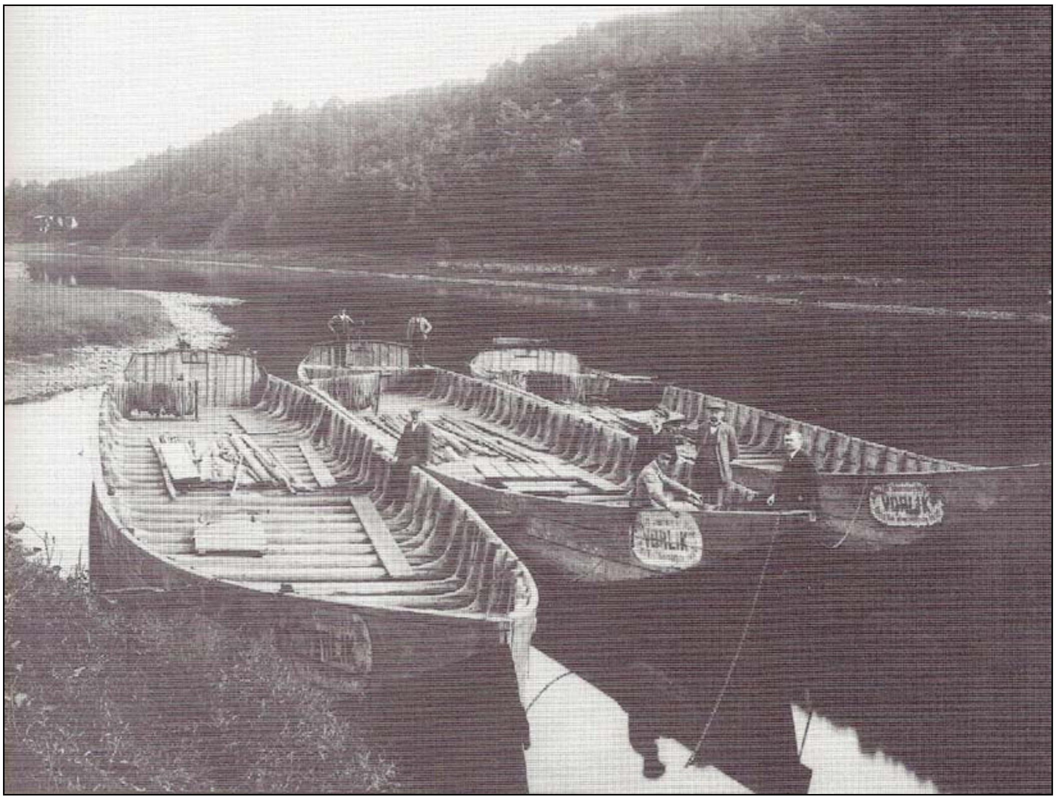


Figure 3.17 Cargo boats on the Vltava River, late 19th or early 20th century. This type of vessel was called a *šif* (from German *Schiffe*). These boats, with cargo capacities from 30 to 60 tons, were used mainly for transporting lumber and quarried stone (photograph from Hubert 2008, frontispiece).

Figure 3.18 Unloading lumber from cargo vessels on the Vltava River in Prague. Boats were extremely important for transporting building materials and for keeping the growing capital city supplied with foodstuffs from farms in the countryside (photograph from Hubert 2008:46).

The first Czech steamboat, the *Bohemia*, was built in 1841, and steamer service on the Elbe between the Obříství (north of Prague) and Dresden began the same year. The advent of railroads in the late 1800s greatly diminished the importance of river traffic and cargo (Hubert 2008:23, 29).

Not content with the natural extent of water routes, Czech (and later Austrian) rulers had numerous schemes to connect the headwaters or boundaries between Bohemian and Moravian watersheds via canals. Czech king (and later Holy Roman Emperor) Charles IV (r. 1347-1378) hoped to create a trans-European trade route from Venice to Lübeck via Prague. In connection with this project, royal engineers planned a canal linking the Danube and Vltava Rivers (approximately between Linz in Austria and České Budějovice in Bohemia). According to the 16th century bishop of Olomouc, Jan Dubravius, work actually began on the project but had to be abandoned due to financial and technical difficulties (Jakubec 2002:23).

Nearly three centuries later, in 1653, the Moravian Estates first raised the question of joining the Morava and Oder rivers via a navigable canal. A proclamation was issued in the name of his Imperial and Royal Majesty Ferdinand III, Emperor of Austria-Hungary, King of Bohemia, and Margrave of Moravia, stating that improvement of navigation was a matter of “common usefulness and good,” and would “improve trade with neighboring lands, and expand business and commerce” (Jakubec 2002:25). The Emperor hired one Filibert Luchese, an Italian architect, to study the problem. Luchese identified many obstacles to navigation, including 15 weirs, numerous shoals, and concentrations of logs, tree trunks, and snags. Luchese’s plan to straighten and deepen the Morava’s main channel was never realized, mainly due to the expense: despite using free labor of peasants under corvée obligation, his plan cost 93,000 gold ducats (Hons 1975:54). The late

17th century Ottoman attacks on Vienna and Moravia killed Luchese's plan for good.

The 18th century brought further attempts to join the region's major rivers by canals. One such attempt was undertaken by a certain Lothar Vogemonte (Lothario à Vogeso Monte). Vogemonte, on the basis of his canal-building experience in the Low Countries, managed to get himself appointed advisor to the Imperial Court in Vienna. In 1700 Vogemonte published his "*Dissertatio de Utilitate, Possibilitate, et Modo conjunctionis Danubii cum Odera, Vistula, & Albi Fluviis, per Canalem Navigabilim*" (Dissertation on the Usefulness, Potential, and Methods of joining the Danube with the Oder, Vistula, and Elbe, by a Navigable Canal) (Vogemonte 1700).

Vogemonte's scheme called for two canals: one connecting the Bečva with the Oder near Nový Jičín, and another between the Morava and Elbe Rivers. The canals would thus link Vienna with both the Baltic and North Seas, via the Morava, the Oder, and the Elbe Rivers. After careful study, the Bohemian Assembly approved the plan, and in 1711, Emperor Leopold I granted Vogemonte a ten year Imperial *privilegium* (exclusive concession) for purposes of constructing his canals. The *privilegium* went unused, however, and no canals were ever built.

Although the Bohemian and Moravian canal projects were never realized, it is revealing that the various links were proposed precisely across the watershed boundaries delimiting the region's major geographic transport zones: between the Morava and Oder (across the Moravian Gate); between the Morava and Elbe, and between the Vltava and Danube. The divides in question separate basins that have been major habitation and population centers since earliest prehistory. Only with the development of railroads in the late 19th century were the land barriers between major river systems finally bridged.

3.5 Summary of Contextual Elements

Productive soils and good communication routes along major rivers provided ideal habitation for prehistoric peoples in Bohemia and Moravia. The fertile loess deposits and river basins were densely populated since the Neolithic; continuous settlement in the highlands did not occur until the early Middle Ages (Neustupný and Neustupný 1961:13). Mountainous regions have been important sources of metal ores (iron, lead, copper, and tin) since the Bronze Age (Cumberpatch 1995:67). As a whole, the region has been both a center of innovation and culture, as well as a corridor for movement of people, trade goods, and information.

Geography in this context assumes an important role, not as an end in itself, but as a means to that end. As described by Fernand Braudel in his epic study of the Mediterranean region, geography "helps us to rediscover the slow unfolding of structural realities, to see things in the perspective of the very long term" (Braudel 1972:23). The geography and topography of Central Europe determined the flow of inland communication, as travel and transport (on a continent-wide basis) were funneled through the river valleys and across a few key passes or watershed boundaries. The Moravian Gate across the continental divide is particularly important in this regard. Trans-European trade routes made extensive use of the route passing through the Moravian Gate, especially from the Bronze Age onward. Water transport, far more efficient than overland haulage, was likely an important element in trans-continental trade and exchange. Use of the rivers was extensive, and may be viewed as a series of interlocked transport zones, together comprising an 'inland waterways' cognitive landscape.

This is the physical environment and human context within which the pre-modern peoples of Bohemia and Moravia built and utilized logboats and other forms of watercraft. The key routes of transportation and communication dictated by geography, in use since Paleolithic times, demonstrate the utility and necessity of watercraft in this environment. Construction of such vessels entailed a significant investment of time and materials, requiring specialist skill and knowledge. Analysis of the vessels themselves, combined with an understanding of the operating environment, reveals trends and patterns of human behavior. The following chapter catalogues and describes all known Czech logboats, and provides details of context such as local geography and discovery circumstances. This and other relevant information is needed to interpret these vessels and the behavior of their builders. The body of data thus assembled will be examined for evidence of skill, information and technology transfer, both over space (geography) and through time.

CHAPTER FOUR – CATALOGUE of VESSELS

This chapter provides a comprehensive catalogue of logboats found within the territory of the Czech Republic, both surviving examples and those known only from literature, antiquarian sources, or eyewitness reports. Particulars of each vessel are provided, including circumstances of discovery and current location and condition. In the process of my research I was able to personally inspect, measure and record all but one of the surviving boats, and thereby corroborate or update any previous descriptions. Vessel plans and measurements are provided, as are maps showing discovery location, geography, and local archaeological context.

4.1 Catalogue Overview

At least 40 logboats are known from the Czech Republic, and 20 boats are preserved in repositories or regional museums (13 in Bohemia and 7 in Moravia). Two additional vessels are known to remain buried *in-situ*. The following catalogue is intended to provide a comprehensive record of all vessels, including descriptions of discovery sites and circumstances, physical dimensions, morphology, dating (if known), analysis, and relevant comparative material. The catalogue is presented geographically, examining vessels from Bohemia and Moravia separately, starting with those discoveries located furthest upriver (the highest elevation) within the respective catchment area or watershed system. For ease of cross-referencing, vessels are numbered according to the order in which they appear in the thesis. Vessels that have not survived and are known only from literature or other sources are noted as such. I have followed the prevailing convention of naming vessels either after the discovery location, or the museum repository where they are now kept. Data on surviving examples, including measurements, discovery locations, and current repositories are summarized in the following table.

Vessel	Cat. No.	River	Current Location	General Description	Wood species	Length (cm)	Width (cm)	Height (cm)
1. Brandýs n. Labem	16	Elbe	Oblastní muzeum Praha – východ, Brandýs nad Labem	Floor fragment	Oak (*Quercus sp.*)	492	56	14
2. Čelákovice	14	Elbe	Čelákovice - městské muzeum	Stern missing	Oak	672	62	33
3. Jaroměř	1	Elbe	Jaroměř - Josefovská radnice	Complete	Oak	622	50	31
4. Kolín 1	5	Elbe	Prague - National Museum	Complete	Oak	796	62	50
5. Kolín 2	6	Elbe	Děčín – Oblastní muzeum	Nearly complete	Oak	917	81	38
6. Labětín	4	Elbe	Pardubice – Východočeské muzeum v Pardubicích	Stern missing	Oak	801	70	62
7. Mikulčice 1	32	Morava	Mikulčice NKP	Bow only	Oak	283	75	26
8. Mikulčice 2	33	Morava	Mikulčice NKP	Complete	Oak	883	66	36
9. Mikulčice 3	34	Morava	Mikulčice NKP	Complete	Oak	988	71	45
10. Mikulčice 4	35	Morava	left *in-situ*	Torso	Oak	672	75	26
11. Mohelnice	24	Morava	Vlastivědné muzeum, Olomouc	Complete	Oak	1046	105	60
12. Oseček	7	Elbe	Terezín depository (NM)	Two parts	Oak	~1400	84	25
13. Otradovice	12	Elbe	Čelákovice - městské muzeum	Stern missing	Silver Fir (*Abies alba*)	665	80	40
14. Poděbrady 1	8	Elbe	Polabské muzeum, Poděbrady (zámek)	Floor fragment	Oak	496	80	25
15. Poděbrady 2	9	Elbe	Polabské muzeum, Poděbrady (zámek)	Nearly complete	Oak	362	68	40
16. Poděbrady 3	10	Elbe	Polabské muzeum, Poděbrady (zámek)	Floor fragment	Oak	364	50	10
17. Prerov n. Labem	11	Elbe	Reg. Muz. Kolín (Český Brod)	Fragments	Oak	~1030	130	90
18. Příkazy	25	Morava	Chudobín depository (Olomouc)	Complete	Oak	418	65	30
19. Skorkov	13	Jizera	left *in-situ*	?	Oak	?	80	?
20. Spytihněv	26	Morava	Slovacké Muzeum, Staré Město	Complete	Oak	383	60	30
21. Toušeň	15	Elbe	Oblastní muzeum Praha – východ, Brandýs nad Labem	Nearly complete	Oak	635	70	26
22. Uherské Hradistě	28	Morava	Slovacké Muzeum, Staré Město	Complete	Oak	522	76	34

Table 4.1. Surviving Bohemian and Moravian Logboats.

4.2 Bohemian Logboats

Of more than 20 reported dugouts from Bohemia, at least 13 still exist. The majority of Bohemian vessels come from the region's dominant waterway, the Elbe (Labe) River. Two logboats are known from the Elbe's tributary the Jizera River, both found within several kilometers of the confluence. One lost example (Hradec Králové) possibly came from the Orlice River, and several (also not surviving) are recorded from the Komořany Lakes region. Interestingly, no logboats are known from the Czech Republic's longest river, the Vltava. Samples from two Bohemian vessels (Kolín 1 and Otradovice) have been radiocarbon dated. A map of discovery locations for all Bohemian logboats is shown in Figure 4.1.

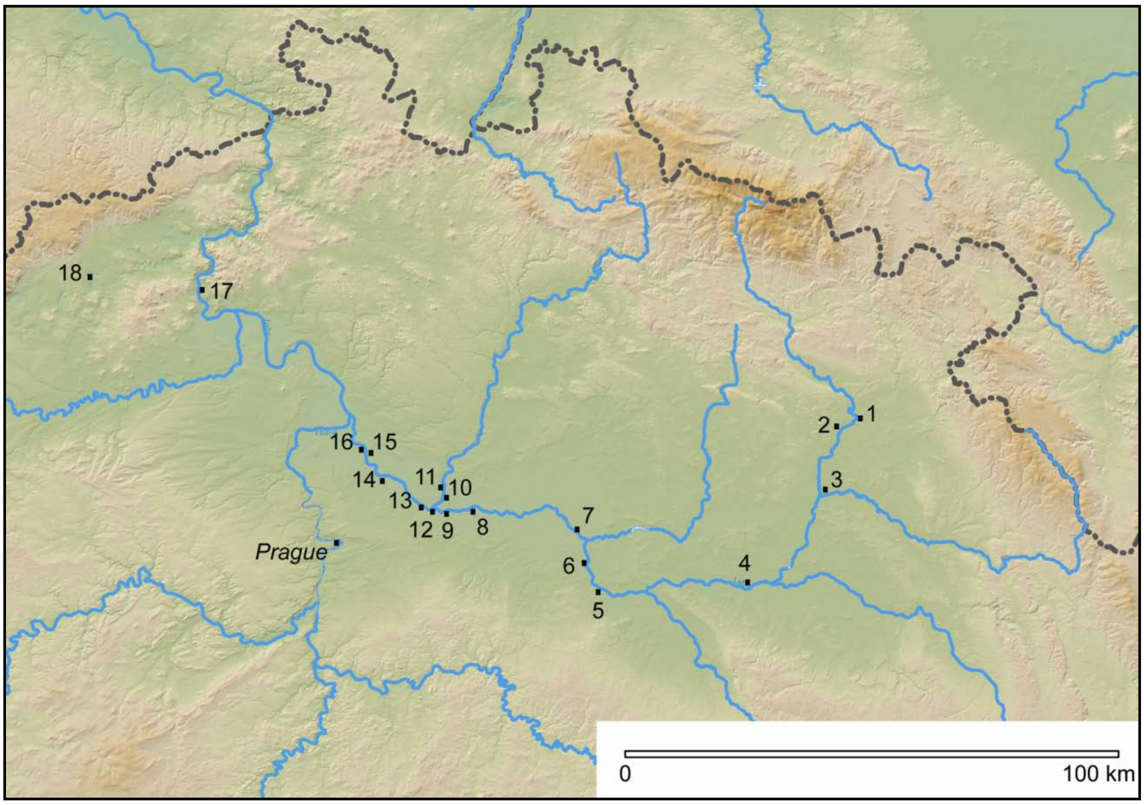


Figure 4.1 Map of all logboat discovery locations in Bohemia: 1- Jaroměř (Černožice); 2- Smiřice; 3- Hradec Králové; 4- Labětín; 5- Kolín 1 and 2; 6- Oseček; 7- Poděbrady 1, 2 and 3; 8- Přerov; 9- Čelákovice; 10- Otradovice; 11- Skorkov; 12- Toušeň; 13- Brandýs nad Labem 1 and 2, also Stará Boleslav; 14- Jiřice; 15- Tišice; 16- Neratovice; 17- Libochovany; 18- Jiřetín (Komořany Lakes).

Vessel:	Jaroměř
Catalogue number:	1
Material:	Oak
Condition:	Complete
Date:	Not dated
Location:	Jaroměř-Josefov museum

The vessel found farthest upriver on the Elbe is a 6.22 m oak dugout held in the Jaroměř-Josefov museum (Figure 4.2). This vessel was discovered by workmen digging a new river channel during bridge construction at the small town of Černožice, 4 km from Jaroměř (Novotný 1951:288). Another logboat was also discovered at the neighboring village of Smiřice, but it has not survived and no other information is available. The discovery location of Černožice is situated on the northeastern margin of the Bohemian basin, where the Elbe River emerges from the foothills of the Krkonoše range. Several important tributaries join the Elbe in close proximity, chief among them the Metuje and Úpa Rivers. As with the rest of the Bohemian basin, this is an area of fertile soils resulting from loess deposits and river sediments, attractive for human settlement since the late Mesolithic. The confluence of rivers would also offer convenient access routes to forested uplands as well as the Polish Plain beyond.

The Jaroměř logboat is unique among Czech examples in that it has a nearly square profile in cross-section. In general shape the vessel is relatively long and low with no internal protrusions such as ridges or bulkheads. Square platform ends are perforated by rectangular holes, two at the stern and one at the bow (Figures 4.3, 4.4 and 4.5). Width at the bow is 46 cm, stern width is 56 cm, and maximum height is 31 cm. Vessel walls are 3-5 cm thick, and there are no bulkheads or transverse ridges. In construction, the parent log was split longitudinally in half, then shaped and hollowed to the desired shape.

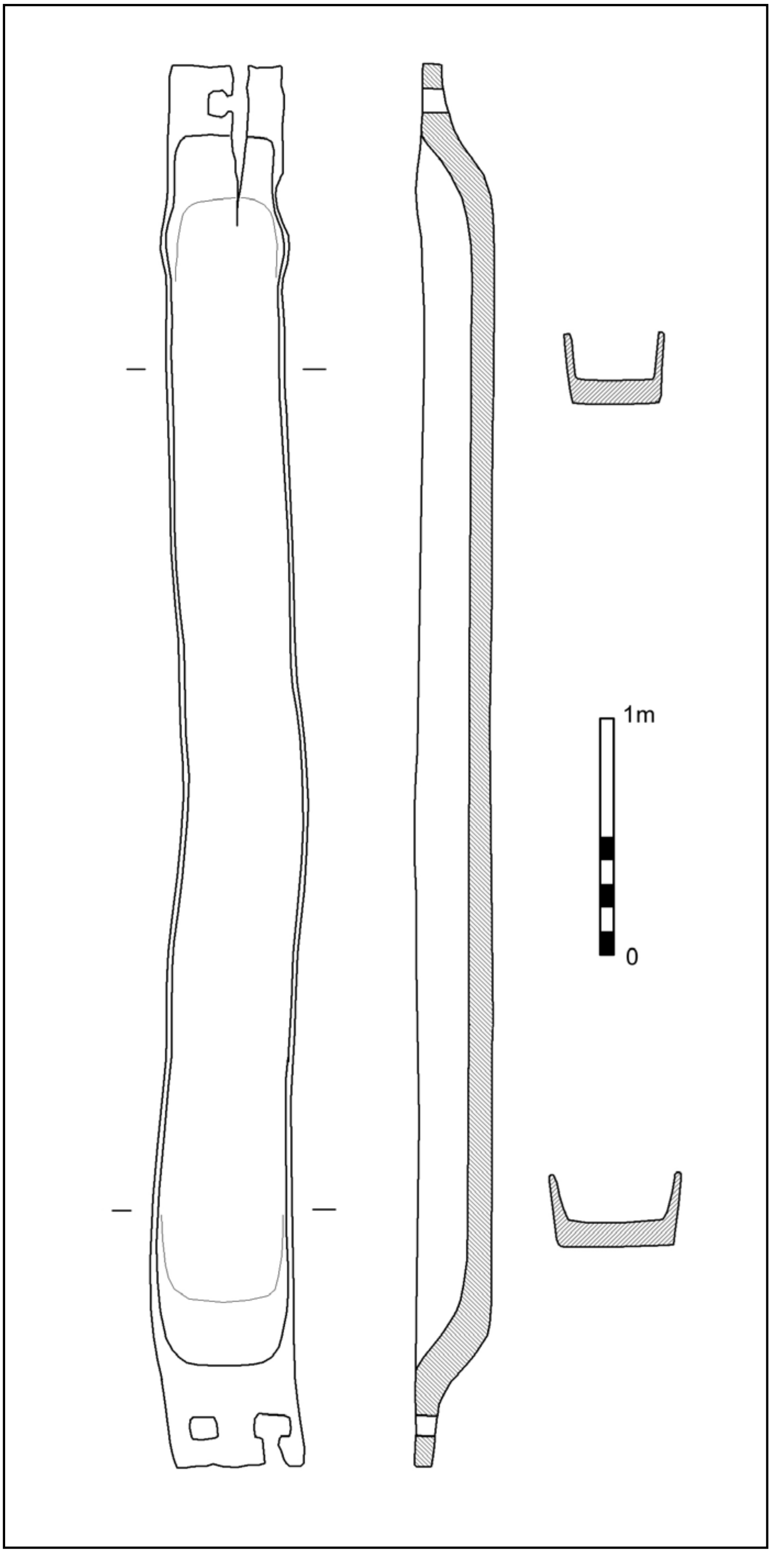


Figure 4.2 Jaroměř vessel plans (documentation by Jason Rogers).

Figure 4.3 Jaroměř vessel, view from bow end[2].

[2] All photographs are by Jason Rogers, unless otherwise attributed.

Figure 4.4 Jaroměř vessel, view from stern end.

Figure 4.5 Jaroměř vessel, detail of holes at stern end.

A number of nearly identical vessels have been found in adjacent areas of Poland, along the upper reaches of the Oder River (Ossowski 2006). Three such vessels (boats from Lewin Brzeski, Koźle, and Roszowicki Las) survive in Poland (Figure 4.6), although many more are known from historical sources (i.e. Hellmich 1912). These logboats, known as *Lewin*-type vessels, are characterized by square or trapezoidal cross-section, rectangular hull-ends, and low height of the sides in relation to vessel length. In addition, nearly all the *Lewin*-type boats have a single hole in the bow and two at the stern. These vessels were typically 7 – 12 m in length, and the largest of them could carry up to 1.5 tons of cargo. This unique and recognizable style of construction is not known from adjacent areas of Poland.

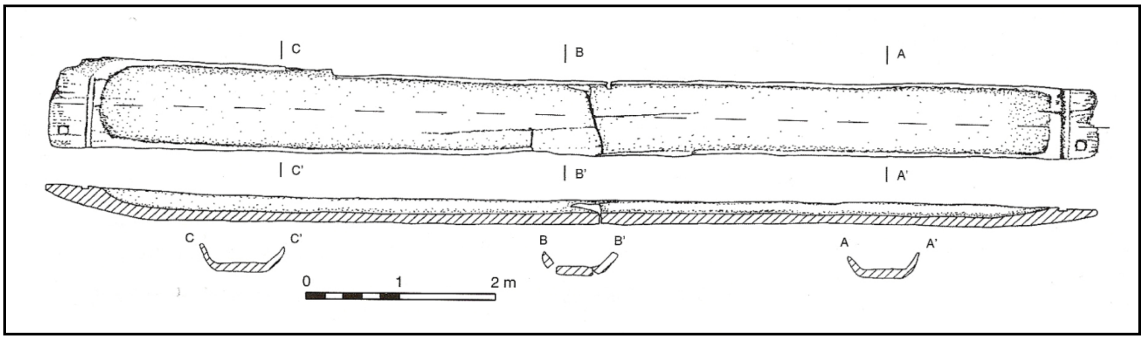


Figure 4.6 Logboat from Lewin Brzeski (Poland), dated to 1620±50 (drawing from Ossowski 2000a:61).

The low height is a result of the parent log being split lengthwise in half, in order to obtain two identical timbers from a single trunk. The advantage of splitting the parent log in this fashion lies in the resulting identical twin hulls, which are then joined to form a raft (see Figure 4.7). The paired hulls were joined by transverse poles, which did not go through the holes in the platform ends but were fastened to the top walls or in special grooves at the hull ends. The sloping transition from the open bow and stern may have facilitated rolling barrels into and out of the vessel. Several logboats of this type have been excavated with the twin hulls still joined, for example the vessel from Roszowicki Las (Poland), whose joining lath broke during recovery. The rectangular holes at the bow and stern were likely used for additional strengthening elements, used to join individual hulls into a raft and reinforce the entire structure (Ossowski 2006). That the construction should be so standardized, including location and shape of holes at the bow and stern, and that features should be repeated on so many vessels shows the strength of this particular boat-building tradition and the influence of skilled builders. Important tributaries of the Oder and Elbe rivers in this region (the Metuje and Stěnava respectively) come as close as 5 km from each other, making it likely that the *Lewin*-type design 'jumped' the watershed divide and was brought to the Bohemian basin from the upper Oder.

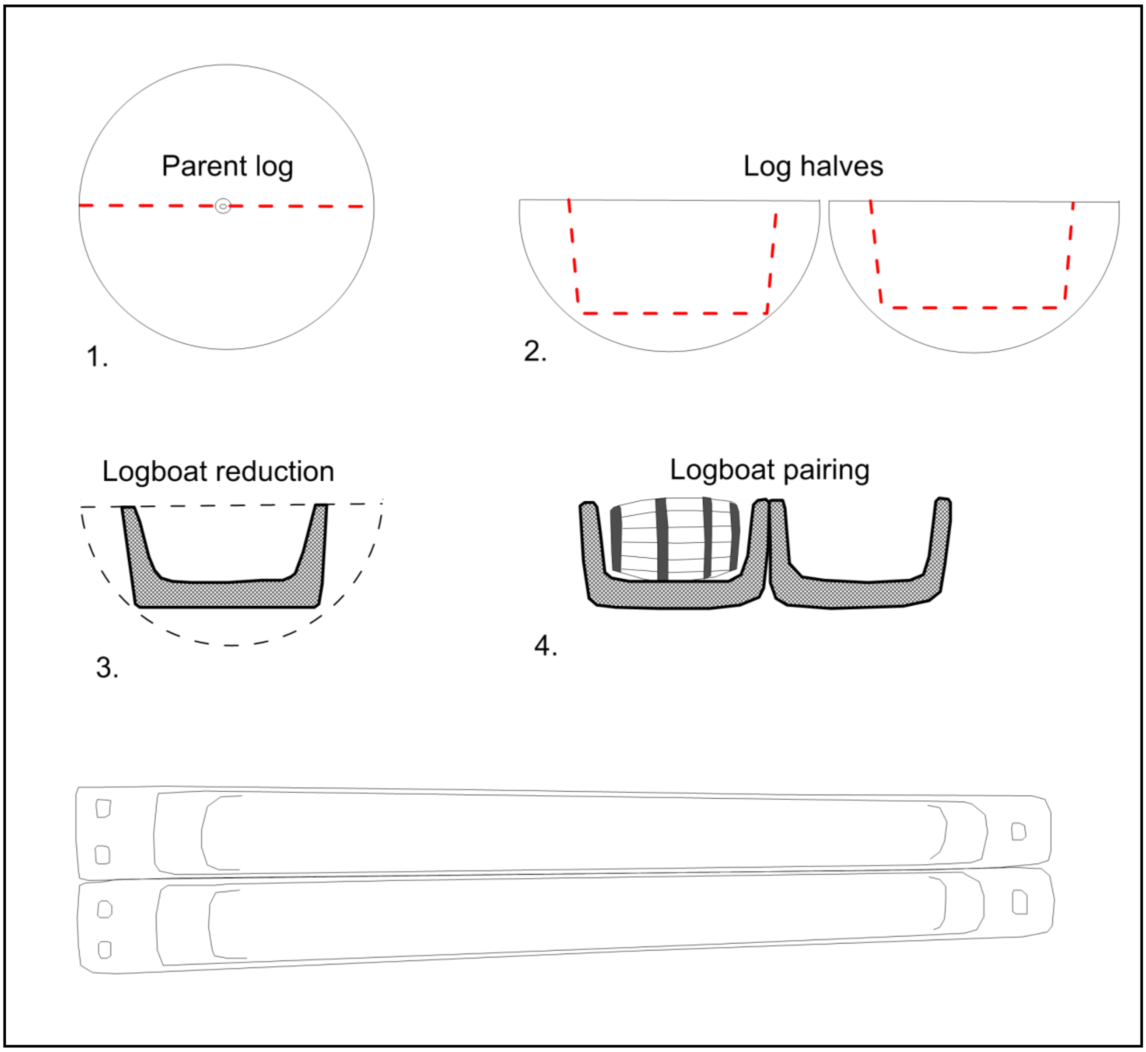


Figure 4.7 Postulated construction sequence for the Jaroměř vessel, showing paired hulls created from a single tree trunk (drawing by Jason Rogers).

Regarding the intended usage of the *Lewin*-type vessels, Ossowski speculates:

> The discussed boats were discovered in the area in which traces of the presence of Celts were found and which was inhabited by Przeworsk culture peoples in the first centuries AD. Important transport routes ran through that area and intense economic development was traced manifesting itself, inter alia, in the form of highly developed metallurgy. The population of that culture conducted animated trading activities with Celtic and Italic centres, and at a later time, with Roman provinces and the neighbouring peoples, where amber trading was of great importance. Logboats of such type could serve for floating goods or as barges carrying even large cargos (Ossowski 2006).

The intensive nature of the amber trade at this time is apparent from the discovery of three large amber hoards near Wrocław, with a combined weight of nearly 300 kg (Čižmářová 2004:66).

The vessel’s discovery location at Černožice is 4 km downriver from Jaroměř. Two significant hills rise above the flat Elbe river plain here, one on either side of the river, each topped with a prehistoric fortress. Both sites were fortified during the Lusatian (Urnfield culture) period, and occupied into the early Hallstatt (Sklenař 1993:77, 194). The stronghold of Habřina on the right bank lies approximately 4 km from the river, and that of Skalice just a kilometer from the Elbe, on the river’s left bank. Prior to modern channel dredging and maintenance, the river would have meandered between the two prominences, changing course after high spring flooding. The geographical prominence of Habřina and Skalice means that they were natural locations for controlling trade and communication between Bohemia and Poland on this route.

Vessel:	Smiřice
Catalogue number:	2
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

A 4.8 m logboat fragment was found in 1947 while dredging the riverbed at Smiřice, 2 km downriver from Černožice. The piece was 56 cm wide, and had two transverse ridges (Novotný 1951:288). The fragment’s current whereabouts are unknown; it was likely destroyed soon after discovery. The transverse ridges indicate that this vessel was built using a different construction technology than the Jaroměř logboat mentioned above.

Vessel:	Hradec Králové
Catalogue number:	3
Material:	Oak
Condition:	Does not survive
Date:	Not dated

In 1907, an oaken vessel was found in a small lake, likely a former river arm, at the confluence of the Elbe and the Orlice rivers (Novotný 1951:289). The discovery site has long since been claimed by construction, and now lies within the city of Hradec Králové. No further information about the vessel or its ultimate disposition is available.

Vessel:	Labětín
Catalogue number:	4
Material:	Oak
Condition:	Stern missing
Date:	Not dated
Location:	East Bohemian Museum, Pardubice

The Labětín vessel was discovered on the Elbe River in 1957 by workmen excavating sand, and was brought to the attention of the local schoolmaster and unofficial village historian. The boat was initially transported to the small museum in the nearby town of Přelouč, and then to the Eastern Bohemian Museum in the city of Pardubice. The vessel's stern is missing and was likely broken off when the boat was pulled from the riverbed. The remaining torso measured over 10 m in length at the time of recovery (Šenk 1994), although the loss of several fragments from the aft end meant that the length in 1969 was only 8.35 m (Hrala 1969:813). Further fragmentation of the stern has occurred, and today the boat measures exactly 8 m in length, approximately 70 cm wide, with a maximum height of 62 cm (Figure 4.8). Several holes 4-5 cm in diameter perforate the sides (Figure 4.9), and wall thickness varies from 5-9 cm. The vessel form closely follows that of the original whole trunk, and was constructed by stripping the bark from the parent tree and hollowing the interior. The bow was cut to a rough wedge shape, with no overhang or platform, leaving a massive portion of solid wood at the vessel's forward end (Figures 4.10 and 4.11). There is no chine, and the hull profile is semi-circular in cross-section. Attempts to date the Labětín boat by dendrochronology have so far been unsuccessful (Radek Sedláček 2006, pers. comm.).

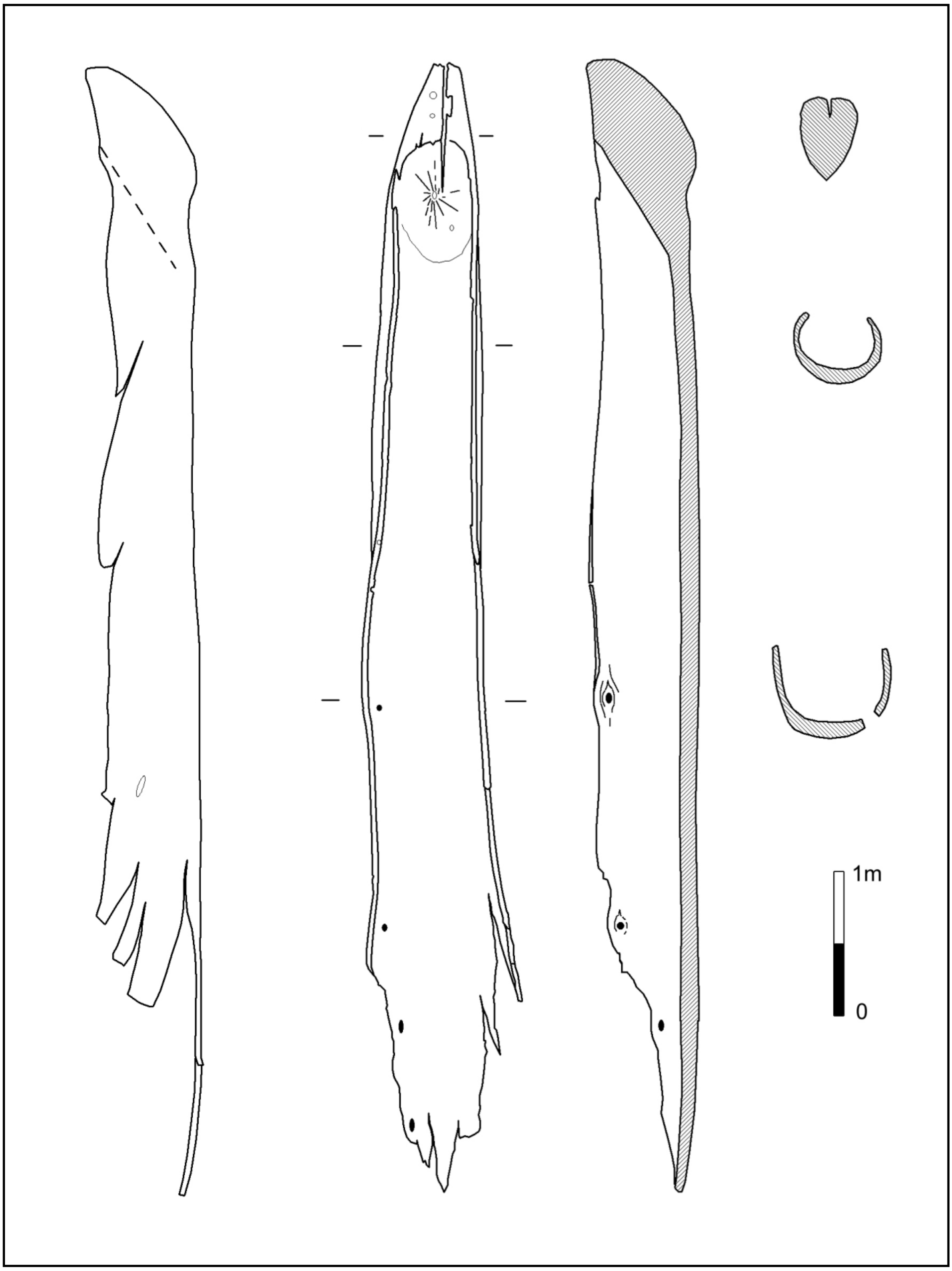


Figure 4.8 Labětín vessel plans (documentation by Jason Rogers).

Figure 4.9 Hole in upper port side of the Labětín vessel.

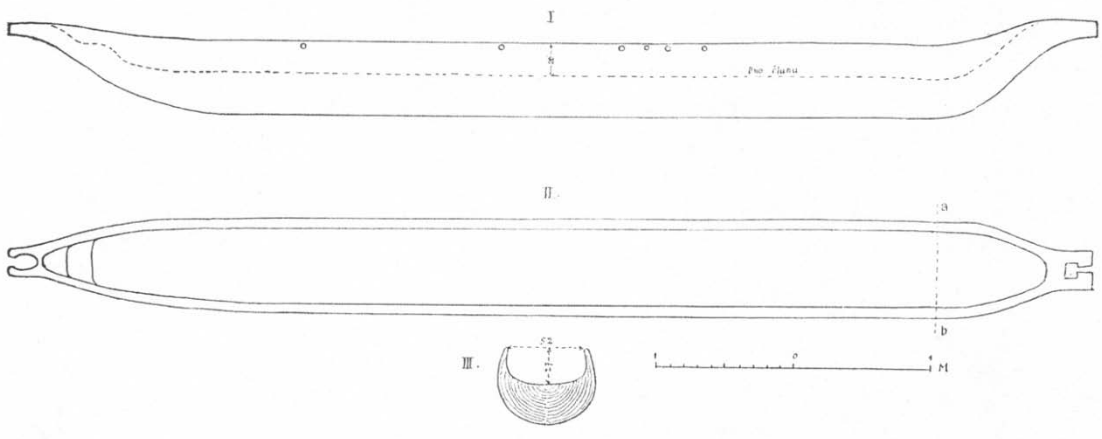
Figure 4.10 Bow of the Labětín vessel.

Figure 4.11 Bow of the Labětín vessel.

Vessel:	Kolín 1
Catalogue number:	5
Material:	Oak
Condition:	Complete
Date:	980±40 BP (Cal AD 990-1160)
Location:	National Museum, Prague

A logboat discovered in the city of Kolín in 1921 was recovered and is now displayed in the National Museum in Prague. The oak vessel lay approximately 3 m below the riverbed during canal construction on the Elbe River, and was brought to the attention of archaeologist Lubor Niederle from the National Museum upon its discovery. A number of iron implements from various periods were also uncovered during the excavation. As a result of Niederle's personal attention the boat was raised and brought to Prague for conservation.

Niederle initially measured the vessel at 9.45 m in length, 66 cm in width, and 55 cm high (Figure 4.12).



Obr. 10.
Dřevěný člun nalezený v Labi u Kolína.
Pirogue monoxyle trouvée dans l'Elbe près de Kolín en Bohême.

Figure 4.12 Kolín 1 vessel as recorded in 1921 (Niederle 1923).

Some degradation has apparently occurred, although the original measurements may have been inaccurate. When recorded in December2007, the vessel measured 7.96 m in length, 62 cm in width, with a height of 50 cm (Figure 4.13). Similar to the Labětín boat, the Kolín 1 vessel was constructed from a whole tree trunk by removing the bark and hollowing the interior (Figure 4.14). There are no bulkheads or transverse ridges, and a number of round holes (2-3 cm in diameter) perforate the vessel's upper sides (Figure 4.15). The holes were initially interpreted as outrigger attachment locations (Niederle 1923:34). The bow and stern taper to narrow overhanging ends, both of which are incised by narrow slots. The stern slot is cut in the shape of a 'T', possibly a niche for a steering oar (Figure 4.16). Hrubý (1965:127) described a nearly identical feature on a Moravian vessel (Staré Město), which was later destroyed. Niederle suggested that the bow slot was intended either for a figurehead or to hold a torch during nighttime fishing. In 2007, radiocarbon analysis (Beta-235738) of a wood sample from the Kolín 1 logboat resulted in a date of 980±40 (Cal AD 990 to 1160).

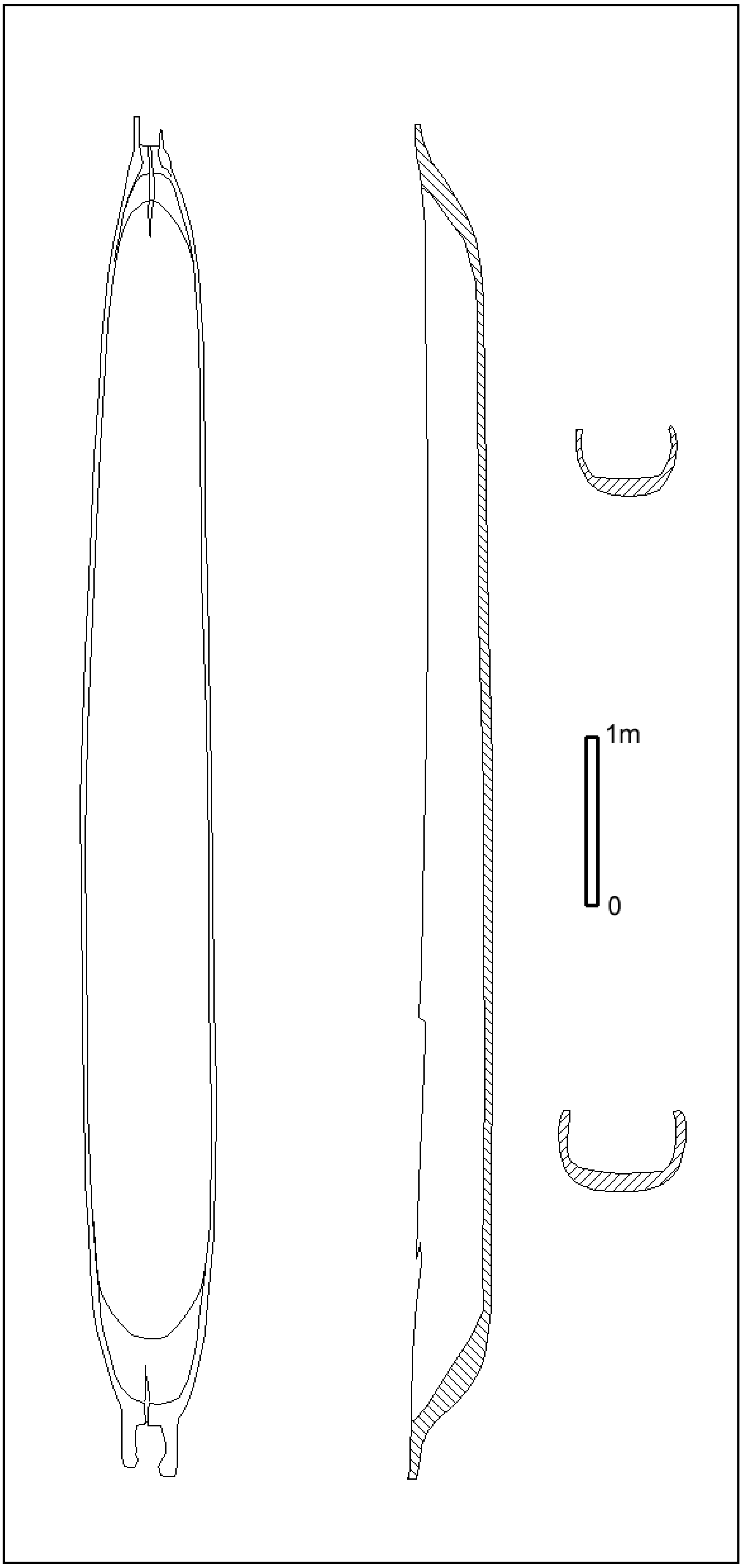


Figure 4.13 Kolín 1 vessel plans (recorded in December 2007, documentation by Jason Rogers).

Figure 4.14 Kolín 1 logboat, view from the bow towards the stern.

Figure 4.15 Holes along upper edge of starboard side, Kolín 1 logboat.

Figure 4.16 Stern cutout, possibly for a steering oar, Kolín 1 logboat.

Vessel:	Kolín 2
Catalogue number:	6
Material:	Oak
Condition:	Nearly complete
Date:	Not dated
Location:	District Museum, Děčín

The second logboat recovered from Kolín was pulled from the Elbe River during canalization works in the 1920s (Figures 4.17 and 4.18). The vessel has been on display since 1990 at the Oblastní museum in Děčín as part of the "Sailing on the Elbe" exhibit. The boat currently measures just over 9 m in length, although some damage to the stern means that the original length was somewhat greater. The maximum width is 81 cm, and maximum height is 38 cm. Two transverse ridges are carved across the floor, one at a distance of 110 cm from the stern, the other 201 cm from the bow (Figures 4.19, 4.20, 4.21). Although relatively flat bottomed, there is no appreciable chine and the transition to side walls is rounded. Floor thickness varies from 10 to 15 cm; side walls are thinner; from 4 to 5 cm. The vessel ends are squared in plan view, although tapering upward in profile. Although damaged, it appears that the stern end likely had an overhang.

Figure 4.17 Kolín 2 logboat at the time of discovery in the 1920s (photograph courtesy of the Kolín regional museum).

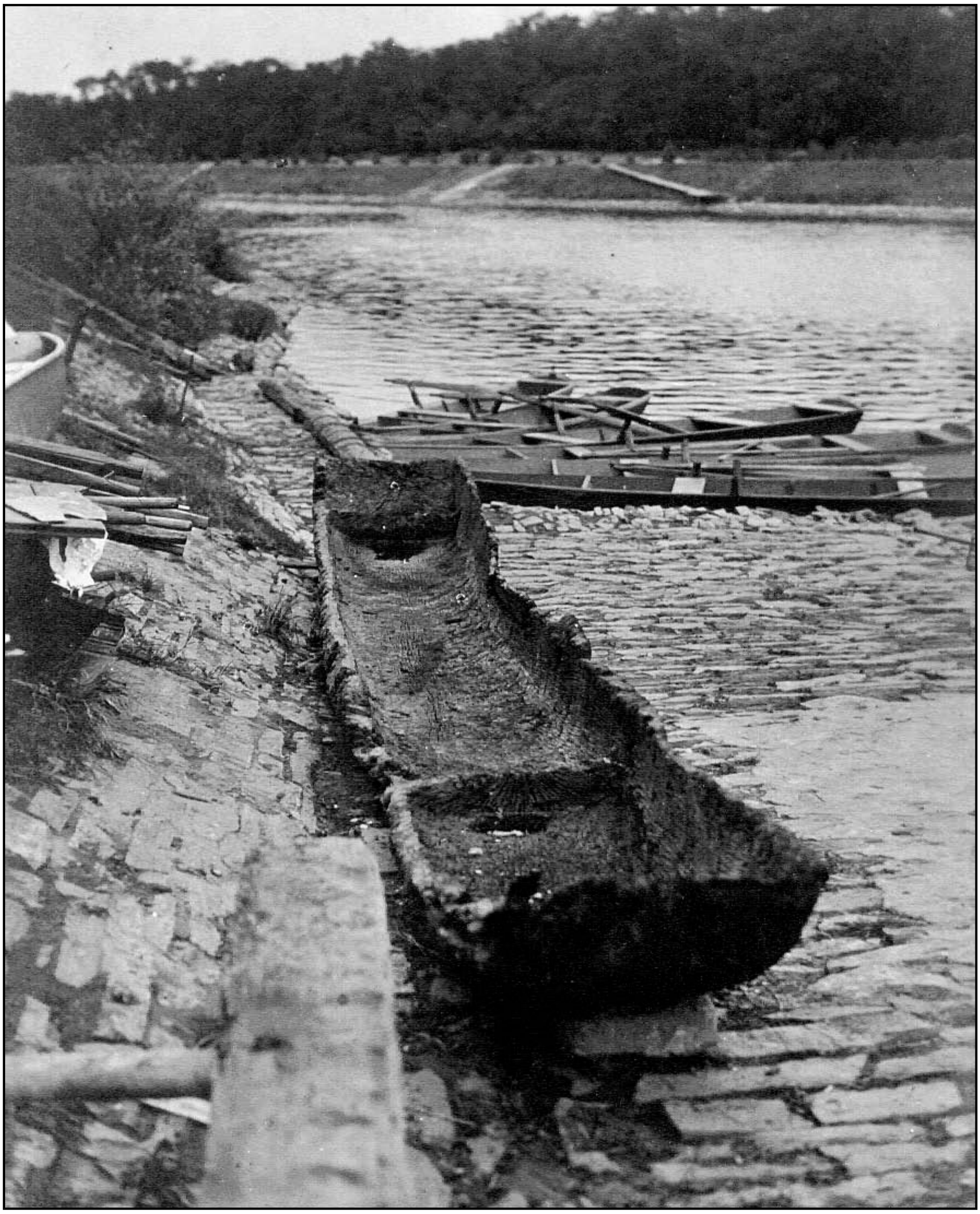


Figure 4.18 Kolín 2 logboat as discovered in the 1920s (photograph courtesy of the Kolín regional museum).

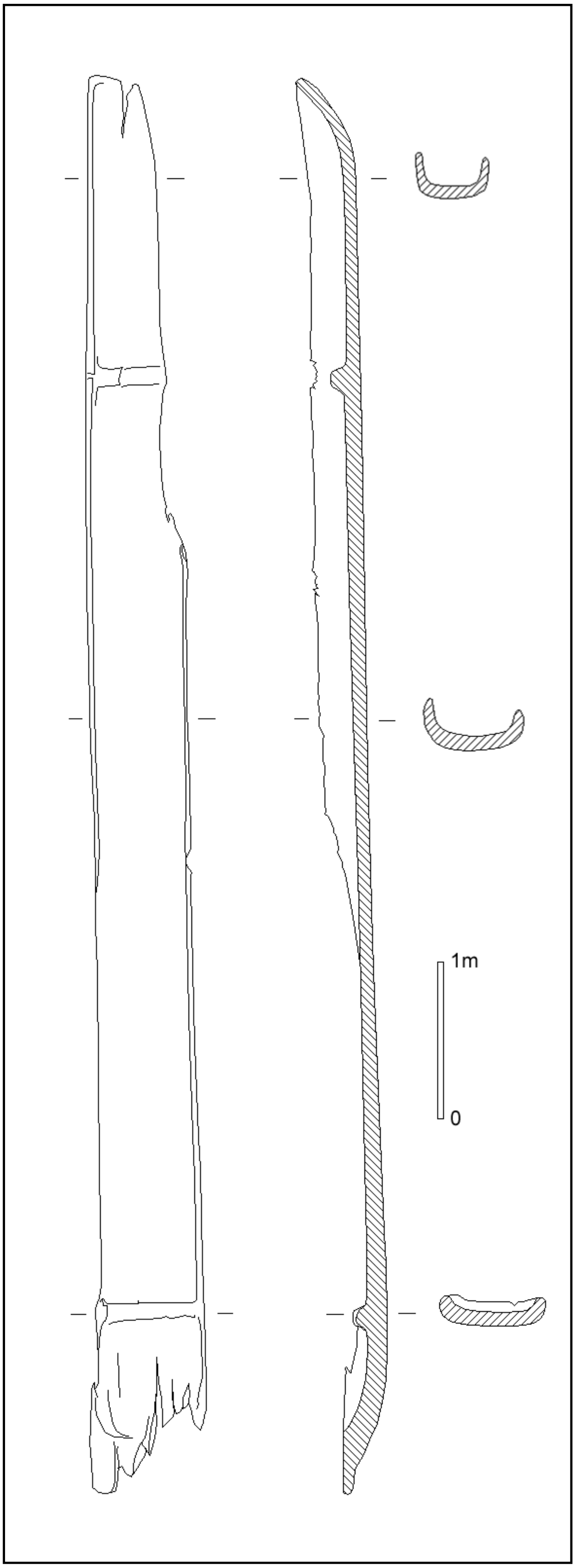


Figure 4.19 Kolín 2 vessel plans (documentation by Jason Rogers).

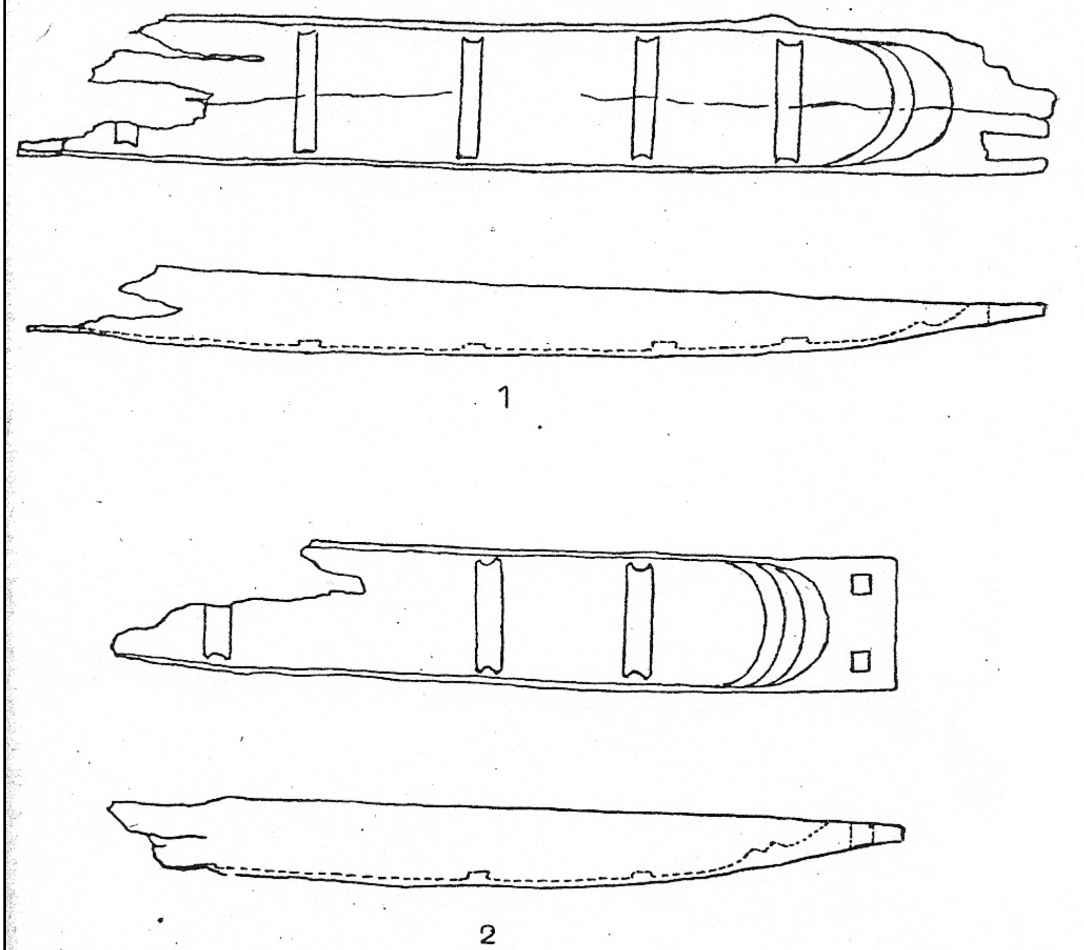
Figure 4.20 Kolín 2 logboat. The flat sloping bow is apparent in this photograph.

Figure 4.21 Kolín 2 stern profile, showing very consistent hull thickness, slight overhanging platform, and aft transverse ridge.

The Kolín 2 logboat is similar in form to those vessels identified by Ossowski (2000b:281) as being used for rapid transport in the early Slavonic period. Long, low, and narrow, the Polish vessels of this type date from the 8th to the 14th centuries AD. The Kolín 2 vessel was conserved in the early 1990s and has not been dated by absolute methods.

Vessel:	Oseček
Catalogue number:	7
Material:	Oak
Condition:	Three large pieces, several smaller fragments
Date:	Not dated
Location:	National Museum Depository, Terezín

In October 1949 workmen digging for sand found an oak logboat in the Elbe River between Kolín and Poděbrady (Novotný 1950:231). The discovery location, near the village of Oseček, is just 1 km from the Elbe's confluence with the Cidlina River. Most of the vessel was pulled free of the sandy bottom, although one end, likely the stern, broke off and remained stuck in the riverbed. The recovered piece measured just over 9 m in length, 85 cm wide, and 30 cm high. Five curving transverse ridges cross the floor. In September 1950, "by happy coincidence", the remaining portion of the vessel, over 4 m in length, was dug from the river bottom. With the recovered stern, the dugout measured 14 m in total length, with seven transverse ridges. Vessel plans made by Novotný in 1950 are shown in Figure 4.22. Two rectangular holes perforated both the overhanging bow and stern platforms, similar to the Jaroměř boat. As fragments of another vessel had been found in 1940 in exactly the same location (later cut up for firewood), Novotný (1950:233) suggested that the two had been joined as a raft.



Obr. 8. Čluny z jednoho kmene. Oseček (o. Poděbrady). 1. nalezen r. 1949, 2. nalezen r. 1950.

Figure 4.22 The Oseček logboat, as documented by B. Novotný in 1950.

The remains of the Oseček vessel (three large pieces and several smaller fragments) are currently stored at the Czech National Museum's offsite storage facility in the town of Terezín (Figure 4.23). The stern portion measures 6.76 m in length, with a maximum width of 84 cm. The bow portion, broken longitudinally in half, is 7.94 cm long and only 78 cm wide. A piece 4 m long and 30 cm wide has split off the bow, along with several much smaller fragments (Figure 4.24). The floor thickness of 6 cm and the 4 cm sidewalls are very consistent. Six transverse ridges are apparent across the floor, and possibly a seventh running through the area where the vessel was broken in half. The ridges are relatively wide (20-30 cm) with low relief (2-3 cm). The two holes perforating the overhanging stern platform are approximately square and measure 10 x 10 cm (Figure 4.25). The stern platform itself has split and opened longitudinally. The bow has also deteriorated to such an extent that the holes, initially with similar dimensions to those at the stern, have become open slots. Although measurement is difficult because the two halves no longer fit precisely together, the vessel's original length was at least 13.75 m, and easily could have been 14 m, as originally presumed by Novotný.

Figure 4.23 Fragment #2 of the Oseček logboat.

The Oseček boat is thus the longest vessel known from the Czech Lands, and indeed one of the largest in Europe.

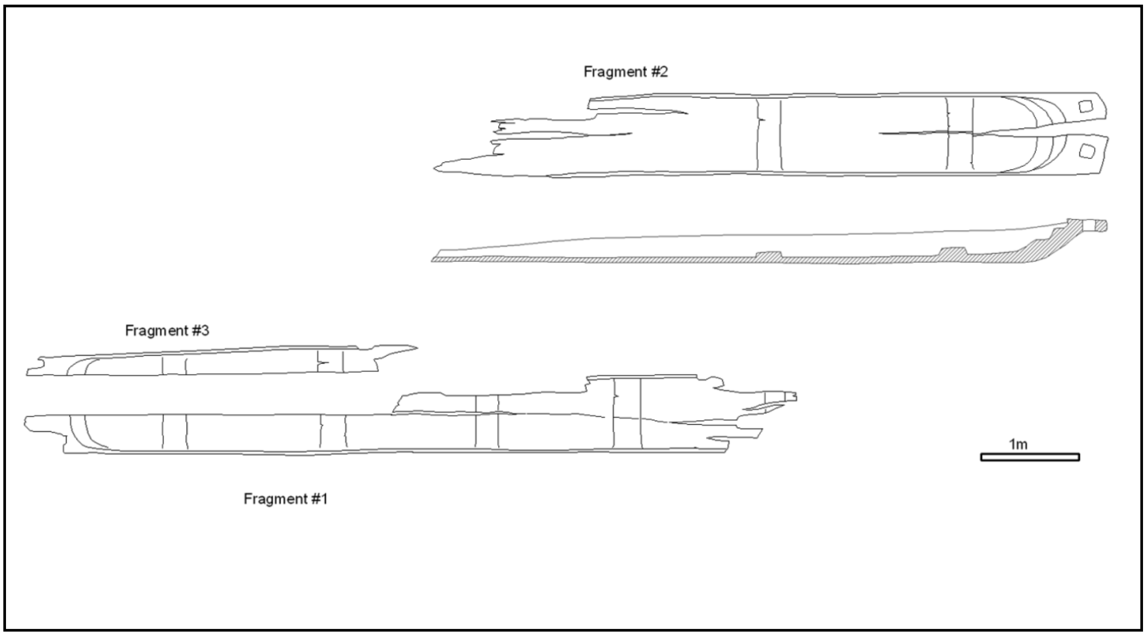


Figure 4.24 Oseček vessel plans (documentation by Jason Rogers).

Figure 4.25 Oseček vessel – square holes cut vertically through overhanging stern platform.

As an interesting footnote to the history of this vessel, several of the fragments are currently undergoing conservation as a result of brief immersion resulting from flooding of the storage facility during the fall of 2002, when both the nearby Ohře and Elbe Rivers overflowed their banks. Only the large stern segment (fragment #2), kept on the upper shelf of a storage rack, was not inundated.

Vessel:	Poděbrady 1
Catalogue number:	8
Material:	Oak
Condition:	Floor fragment
Date:	Not dated
Location:	Polabské muzeum, Poděbrady (zámek)

At least five logboats have been found along the Elbe River near the town of Poděbrady. Portions of three vessels have survived, and are held in the cellar of the Poděbrady castle (Figures 4.26 and 4.27).

Figure 4.26 The three surviving logboats from Poděbrady. Vessel 3 is on the upper rack, vessel 2 is in the middle, and vessel 1 is on the bottom.

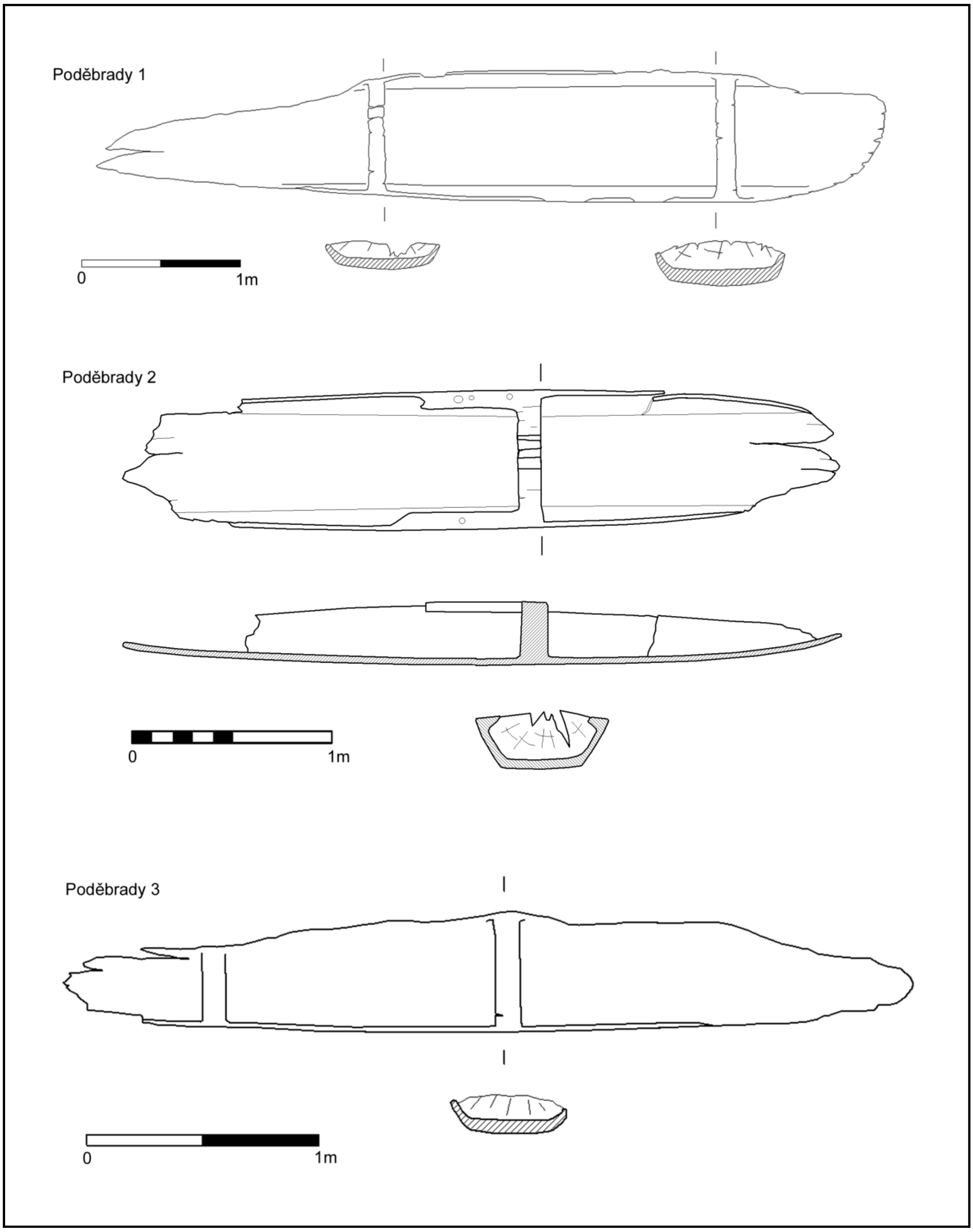


Figure 4.27 Vessel plans for Poděbrady logboats 1, 2 and 3 (documentation by Jason Rogers).

All three Poděbrady logboats were constructed from oak, and differ markedly from many of the previously described Bohemian examples in that they feature bulkheads or transverse ridges. Poděbrady 1 survives only as a floor segment, measuring 4.96 m in length. This fragment features two transverse ridges and a clear chine where the walls meet the floor (Figure 4.27). The original width of this vessel may be estimated at 70 cm, although original length cannot be determined from the surviving fragment. Dr. Jan Hellich, the museum's founder, probably collected Poděbrady 1 sometime in the 1920's or 1930's, and there are indications that it was found by workers digging sand in the riverbank below the castle (Novotný 1951:290).

Vessel:	Poděbrady 2
Catalogue number:	9
Material:	Oak
Condition:	Nearly complete
Date:	Not dated
Location:	Polabské muzeum, Poděbrady (zámek)

One vessel (Poděbrady 2) is nearly complete, and features thwarts and a bulkhead carved from the solid (Figure 4.28). This combination of features is apparent on at least two other Czech logboats (Spytihněv and Příkazy, both from Moravia) and on similar vessels across Europe. According to Ossowski, these are one-man boats used for fishing, where the bulkhead functionally divides the boat into two halves. The 'dry' half was reserved for the fisherman, and the 'wet' portion was used for storing tackle and fish. This type of vessel developed in the early Middle Ages, and in some areas of Poland has survived to the present day (Ossowski 2000b:65).

Poděbrady 2 measures 3.62 m in length, 68 cm in maximum width, and is 40 cm high. The hull is trapezoidal in cross-section, with a sharp chine. Little is known about the provenience of the vessel. It was not a part of the museum's collections as of 1931, although by 1951 it was included (Hellich 1931; Novotný 1951:290).

Figure 4.28 Poděbrady 2 bulkhead, functionally dividing the vessel into wet and dry halves.

Vessel:	Poděbrady 3
Catalogue number:	10
Material:	Oak
Condition:	Floor fragment
Date:	Not dated
Location:	Polabské muzeum, Poděbrady (zámek)

Poděbrady 3 was discovered in 1964 during expansion of the hydroelectric station on the Elbe River at Poděbrady (Justová 1965, Justová 1969) (Figure 4.29). This vessel survives only as a floor fragment measuring 3.64 m in length (Figure 4.27). This vessel is similar in construction to Poděbrady 1, with two transverse ridges and a clear chine where the walls meet the floor. The width of this vessel may be estimated at 60 cm, and the original length cannot be determined from the surviving fragment.

Figure 4.29 The Poděbrady 3 logboat was found during construction work at the town's hydroelectric station in 1964 (far right). The dam, power station sluiceway and locks for boat traffic were originally built from 1913 – 1918 (photograph from the 1930s, published in Vácha and Stegbauer 2006:130).

Vessel:	Přerov nad Labem
Catalogue number:	11
Material:	Oak
Condition:	Fragments
Date:	Not dated
Location:	Kolín Regional Museum, Depository in Český Brod

An oaken logboat was found along the banks of the Elbe near Přerov nad Labem in September 1954, where workers had been clearing the river of fallen and stranded tree trunks. Due to its substantial size and weight, the boat (in three pieces) was recovered only in March of 1957. When fitted together, the three pieces measured 10.3 m in length. Maximum width was 1.3 m, and height 90 cm. The vessel's form is quite similar to the Labětín logboat. In construction, the bark was scraped from the parent tree, and the inside hollowed. The floor is smooth without ridges or bulkheads, and there are holes through the upper walls. At the time of recovery, "a notch for a rudder" was clearly visible (Bednařík 1957:152)

(Figure 4.35). A series of photographs documenting the vessel recovery in 1957 is presented in Figures 4.30 – 4.35.

Figure 4.30 The Přerov logboat prior to recovery in 1957 (photograph courtesy of the Kolín Regional Museum).

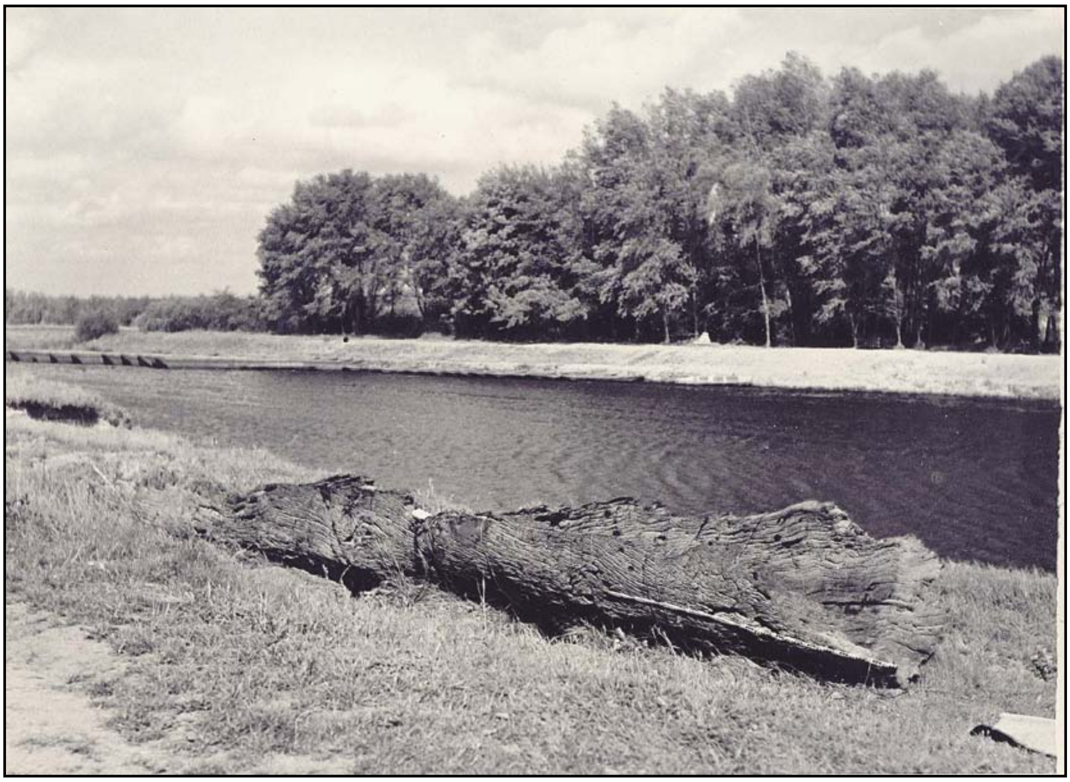


Figure 4.31 The Přerov logboat, righted in preparation for removal (photograph courtesy of the Kolín Regional Museum).

Figure 4.32 Hoisting the Přerov logboat with a mechanical arm (photograph courtesy of the Kolín Regional Museum).

Figure 4.33 Unloading the Přerov vessel at the museum yard in Český Brod (photograph courtesy of the Kolín Regional Museum).

Figure 4.34 Placing the Přerov vessel at the museum yard in Český Brod (photograph courtesy of the Kolín Regional Museum).

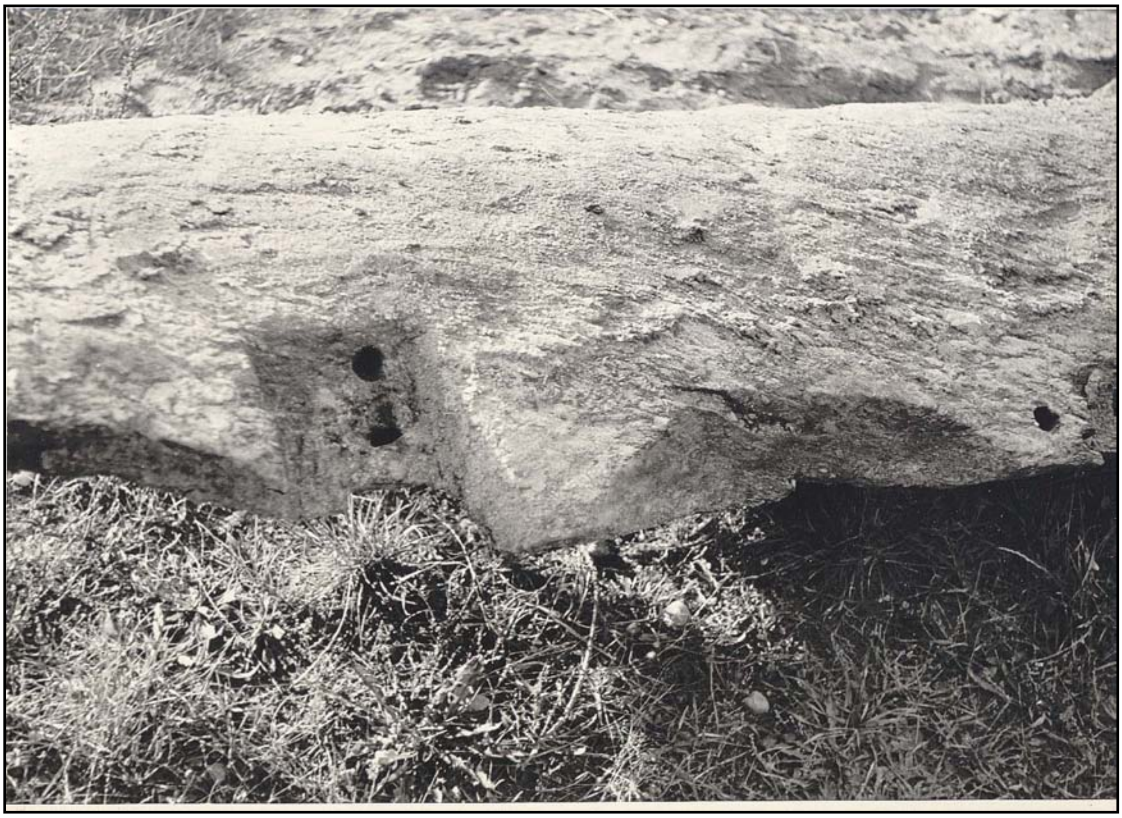


Figure 4.35 The Přerov logboat's "rudder notch" reported by Bednařík (1957) (photograph courtesy of the Kolín Regional Museum).

The logboat was taken from Přerov to the museum in the nearby town of Český Brod. As the vessel was too large to fit into the building, it was kept outside in the museum's yard. As a result of these storage conditions, the vessel has considerably disintegrated and today consists of a number of indistinct fragments (Figures 4.36 and 4.37). The surviving pieces were conserved with PEG in 2003. Following conservation, a low shed was built over the fragments to offer some protection from the elements (Figure 4.38).

Figure 4.36 The Přerov logboat in 2003 prior to conservation (photograph courtesy of the Kolín Regional Museum).

Figure 4.37 The Přerov logboat fragments after application of PEG (photograph courtesy of the Kolín Regional Museum).

Figure 4.38 The shed built to protect the remaining fragments of the Přerov logboat (October 2008).

There are records of other finds from the same location; in 1915 a researcher investigating early ceramic shards recorded how "…years ago a roughly worked boat, more than 10 m long, was found here in an oxbow lake" (Axamit 1915:81). The scanty description indicates similarity to the above vessel in that no ridges or other interior features were apparent. The boat fell apart as it dried, and only the bow, used as a doghouse, survived for a time.

Topographic features of the landscape in the near vicinity offered advantageous settlement sites to early inhabitants. Just to the east of the modern-day village, an isolated hill known as the 'Přerovská hůra' rises nearly one hundred meters above the surrounding Elbe River plain. A Slavonic-period fortress here overlies a much older fortification, possibly dating to Hallstatt times (Sklenář 1993:184). The wide view over the local landscape from this commanding height would have enabled control over travel up and down the river as well as across the surrounding flatlands. As with the archaeologically known settlements near the discovery location of the Jaroměř vessel, fortresses strategically located upon eminent prominences overlooking the Elbe demonstrate the ancient lines of communication upon and along the river.

Vessel:	Otradovice
Catalogue number:	12
Material:	Silver Fir (*Abies alba*)
Condition:	Stern missing
Date:	780±50 BP (Cal AD 1170 to 1290)
Location:	Čelákovice Municipal Museum

In the spring of 2002, the Czech Hydro-Meteorological Institute undertook a survey of Bohemian rivers following the floods of the previous winter. In the course of the survey, an unusual logboat was discovered near the village of Otradovice on the Jizera River just 4.5 km from its confluence with the Elbe. Only a small portion of the vessel protruded from the water, and most of the hull was submerged nearly 2 m below the river's surface, pinned by the trunk of a fallen tree (Šilhová and Špaček 2004:29). Further reconnaissance of nearby terrain revealed that a 5 m section of the riverbank had been washed away by floodwaters, and investigators speculated that this had loosened the monoxyl from its original resting place (Špaček 2003:224). As the water level was forecast to rise by over a meter, archaeologists from the Čelákovice Municipal Museum secured the vessel with a rope (Figure 4.39). Water levels receded by the end of April, and the logboat was pulled from the river with the help of an all-terrain vehicle (Figure 4.40). After five days on the riverbank, the vessel was brought to the museum for conservation. After considerable deliberation, sucrose bulking was chosen as the method of treatment. Following a final surface application of PEG (polyethylene glycol) in July 2003, the vessel was placed in the museum's permanent exhibition gallery (Figure 4.41). The Otradovice boat is the only surviving and accessible vessel from the Jizera River; the only other known logboat from this river was never recovered and presumably remains *in situ* (the Skorkov vessel, described below).

Figure 4.39 Securing the Otradovice logboat (photograph courtesy of the Čelákovice Municipal Museum).

Figure 4.40 Removing the Otradovice logboat from the Jizera River (photograph courtesy of the Čelákovice Municipal Museum).

Figure 4.41 The Otradovice logboat on display in the Čelákovice Municipal Museum, 2006.

The surviving portion, probably the bow, measures 6.65 m in length, 80 cm in maximum width, with a height of 40 cm (Figure 4.42). This vessel also lacks bulkheads or transverse ridges across the floor. The boat's interior is fairly roughly hewn, leaving ripples or waves in the floor's surface. There are two vertical holes drilled into the bow's starboard side, although they do not completely perforate the bottom surface (Figure 4.43). Other holes are apparent along the vessel's upper sides.

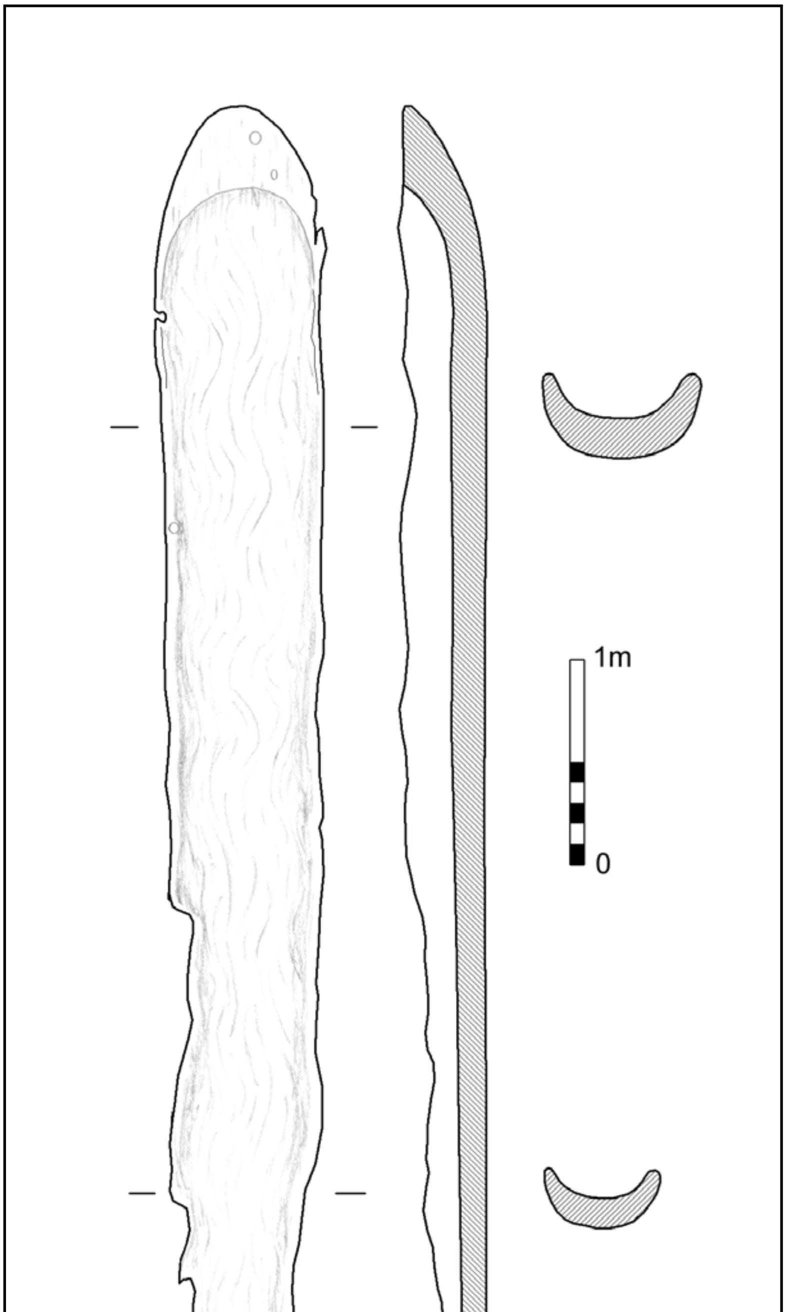


Figure 4.42 Otradovice vessel plans (documentation by Jason Rogers).

Figure 4.43 Vertical holes in the bow of the Otradovice logboat.

The Otradovice vessel is enigmatic in many ways. Numerous other logboat discoveries are known from the immediate vicinity, although the Otradovice find is the sole accessible vessel from the Jizera River. As one of the few European vessels constructed from silver fir (*Abies alba*), it is a rare specimen. Other records of fir logboats come mainly from Alpine regions of Europe, as this species grows only at locations above 300 m in elevation. Vessels constructed both of *Abies alba* and oak (*Quercus* sp.) built on Switzerland's Aegerisee in the 18th and 19th centuries were recorded by early ethnographers. The Aegerisee boats were used primarily for fishing, and occasionally for towing timber rafts. A second type of Aegerisee logboat, the 'Kielenschiff', up to 9m long, was used to bring people from remote lake areas to mass at the local church (Arnold 1983:275). An unfinished logboat from Wessobrun-Blaik in Bavaria was also *Abies* sp. (Weski 2005:273).

All other Czech logboats are of oak (*Quercus* sp.), as are the majority of surviving European logboats (e.g. Arnold 1996; Mowat 1996; Ossowski 1999). There is evidence of many other woods used in logboat construction; McGrail (1987:60) listed eleven species of timber from across Europe from either archaeological or modern dugouts (including oak, but no fir of any species). The 2nd century AD Zwammerdam 3 vessel, a 10.4 m oak logboat from the Netherlands, was extended with a washstrake of silver fir (de Weerd 1978). Another important example of silver fir from an archaeological setting comes from the Bronze Age lake village of Auvernier-Nord (Switzerland), where 37% of the piles and nearly all of the plank boards were made from this wood (Arnold 1982).

Aside from its rarity as a construction material for logboats, silver fir is interesting in this context due to its natural range of occurrence. This species grows only at elevations above 300 m, in an arc from the Carpathian mountain range through the Hercynian massif to the Alps (Atlas Florae Europaeae 2007). The parent tree trunk thus grew in the Krkonoše Mountains along the upper reaches of the Jizera, more than 80 km distant from the discovery location at Otradovice (elevation 175 m). The vessel's initial investigator suggested that the boat was either fabricated in the vicinity from a fallen trunk that had floated down the river, or that it had been constructed at a higher elevation and subsequently sailed downriver (Šilhová and Špaček 2004:30). A third possibility is that the vessel was fabricated for use on the upper Jizera, and swept down by a flood. Of these variants, it is likely that the first can be eliminated. Ethnographic accounts suggest that timber for building a logboat was carefully and deliberately selected. The ideal tree would have straight grain, little taper, and no splits or rot (McGrail 1987:59). It seems unlikely that a fallen and flood-carried trunk would meet such criteria.

As regards construction and morphology, the Otradovice logboat resembles others from the Elbe basin in one important respect: the vessel's floor is completely smooth, with no protrusions such as transverse ridges or bulkheads. Several holes are apparent in the vessel's sides, again matching other Elbe examples. McGrail offers several interpretations for such holes, generally explained as evidence of transverse members such as thwarts, attachments for external features such as rubbing strakes or spray deflectors (1987:80). According to Novotný (1951:269), similar holes on 19th century logboats from Slovakia's Váh River were used to attach fishing nets.

The function of two vertical holes in the bow of the Otradovice vessel is somewhat mysterious. They would not have been used for a painter line or a mooring pole (per McGrail 1987:84), as they do not completely perforate the bow. Attachment for a figurehead or sockets for a torch used in night fishing (Niederle 1923) are other possibilities.

A wood sample from the Otradovice boat analyzed in 2007 (Beta-235739) resulted in a radiocarbon date of 780±50 (Cal AD 1170 to 1290). The discovery location, just 4.5 km from the Jizera's confluence with the Elbe, is near the center of the Bohemian basin. The fertile soils and easy communication routes along the major rivers in this region have provided ideal settlement locations since early prehistoric times, especially from the Neolithic onward (Špaček 2004:145-147). The city of Prague, 30 km distant, has been the Czechs' political and commercial center since the 10th century AD.

Vessel:	Skorkov
Catalogue number:	13
Material:	Unknown
Condition:	Unknown
Date:	Not dated
Location:	Buried *in situ*

In August 1963, the local schoolmaster in the town of Skorkov reported the discovery of a dugout logboat. Skorkov is located on the Jizera River just 3 km from Otradovice and 7 km from the confluence with the Elbe. The vessel protruded from beneath a house on the river's right bank, "…below the old mill" (Nechvátal 1969:812). The vessel had been discovered during low water in July, although at the time it was thought to be a piece of felled timber. Children playing in the river uncovered more of the trunk, and only then did local inhabitants realize that the wood had been worked and that the timber was a boat. The vessel extended some 2.3 m from the mud, and was about 80 cm wide. A transverse ridge approximately 15-20 cm wide was located 70 cm back from the boat's pointed end. The vessel was eventually reburied as the river rose, and is presumed to remain *in situ* (Špaček pers. comm.).

Vessel:	Čelákovice
Catalogue number:	14
Material:	Oak
Condition:	Stern missing
Date:	Not dated
Location:	Čelákovice Municipal Museum

The second logboat at the Čelákovice museum was recovered locally on the Elbe in 1943, during completion of the river course canalization (Špaček 2004:154; Figure 4.44). This vessel has a central transverse ridge and bulkhead walls at either end (Figures 4.45, 4.46, 4.47). The stern does not survive; the bow is completely hollowed and comes to a point. The hull is trapezoidal in cross-section, narrowing to a V-shape at the bow. Surviving length is 6.72 m, maximum width is 62 cm, and height is 34 cm (Figure 4.48). The walls have a very uniform 2-3 cm thickness. Several 2 cm holes perforate the vessel's sides, and there is a 5 cm oval opening near the point of the bow. A roughly rectangular hole has been hewn into the vessel's floor just aft of the forward bulkhead (Figure 4.47). Novotný (1951:284) suggested that this hole was intended to let water into this area of the boat and thus create a fish-well; however, given that there is not a bulkhead but a transverse ridge aft of the hole I consider this explanation unlikely. The hole may have been intended to symbolically 'slay' the boat for deposition or disposal (see Section 5.3), or it may have been cut during the (undocumented) recovery.

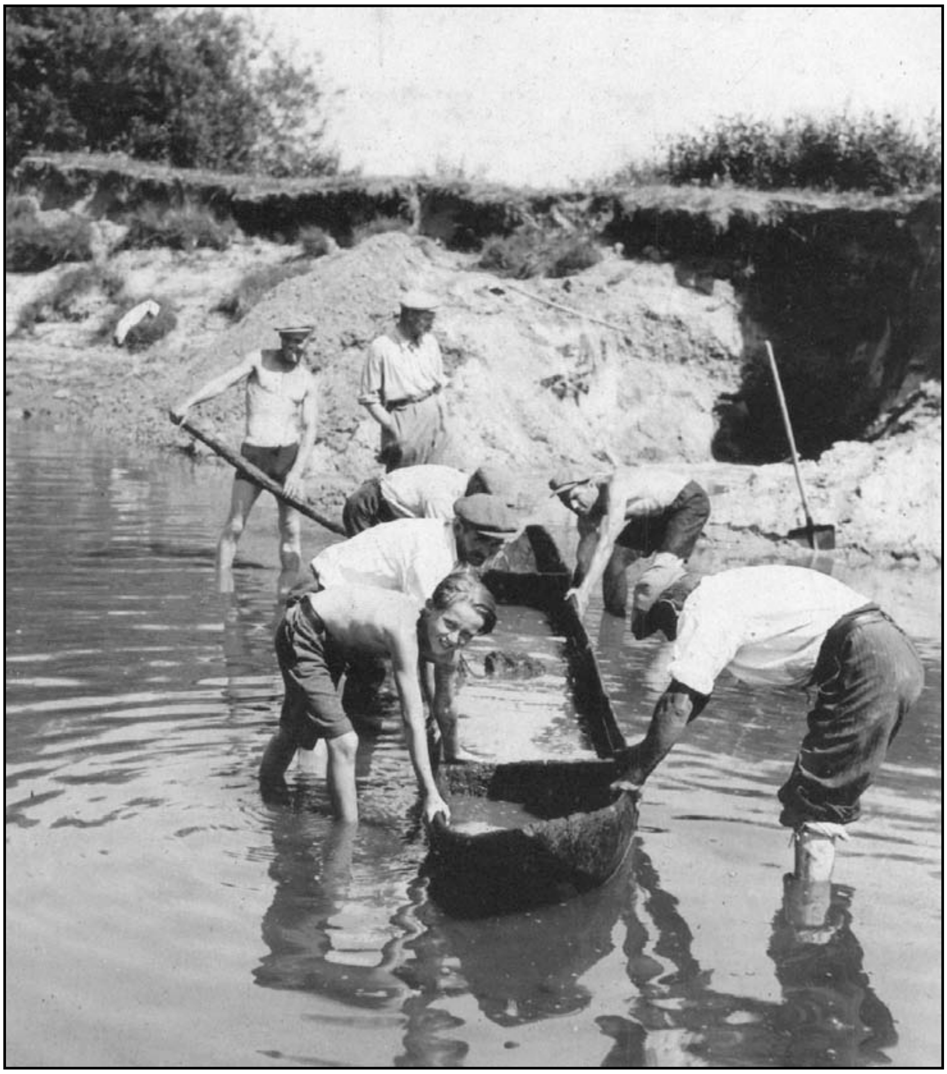


Figure 4.44 The Čelákovice logboat at the time of discovery in 1943 (photograph from Špaček 2004:199).

Figure 4.45 The Čelákovice logboat on exhibit in the Čelákovice Municipal Museum, 2006.

Figure 4.46 The amidships transverse ridge of the Čelákovice logboat.

Figure 4.47 Hole cut in the Čelákovice vessel floor just aft of the forward bulkhead.

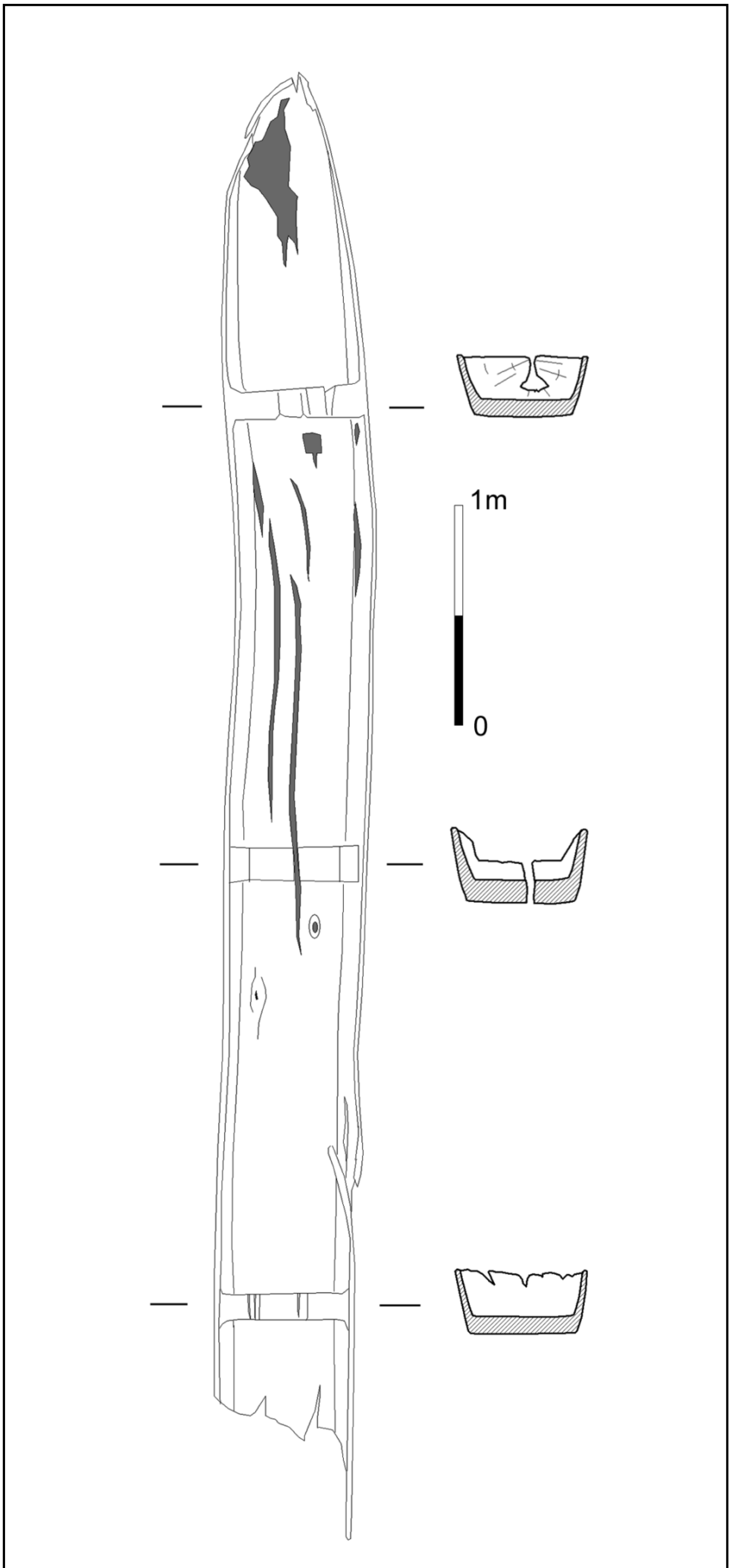


Figure 4.48 Čelákovice vessel plans (documentation by Jason Rogers).

Vessel:	Toušeň
Catalogue number:	15
Material:	Oak
Condition:	Nearly complete
Date:	Not dated
Location:	Eastern Prague District Museum, Brandýs nad Labem

The nearly complete Toušeň logboat was recovered from the left bank of the Elbe around the beginning of WWII (Novotný 1951:291), and is now kept in the Oblastní muzeum Praha-východ in Brandýs nad Labem (Figure 4.49). The surviving length is 6.35 m, although missing portions at the bow and stern mean the vessel was originally nearly 7 m long. Constructed from a trunk split lengthwise in half, the U-shaped hull closely follows that form of the parent tree. There are two large bulkheads, one near the bow and one at the stern. Maximum width is approximately 70 cm, and the vessel's height is 30 cm (Figure 4.50).

Like the Kolín 2 logboat, the Toušeň vessel is similar in form to the long, low, narrow Polish vessels identified by Ossowski (2000b:281) as being used for rapid transport in the early Slavonic period. The Toušeň logboat has not been dated.

Figure 4.49 The Toušeň logboat, used to hold brochures in the entryway of the museum in Brandýs nad Labem.

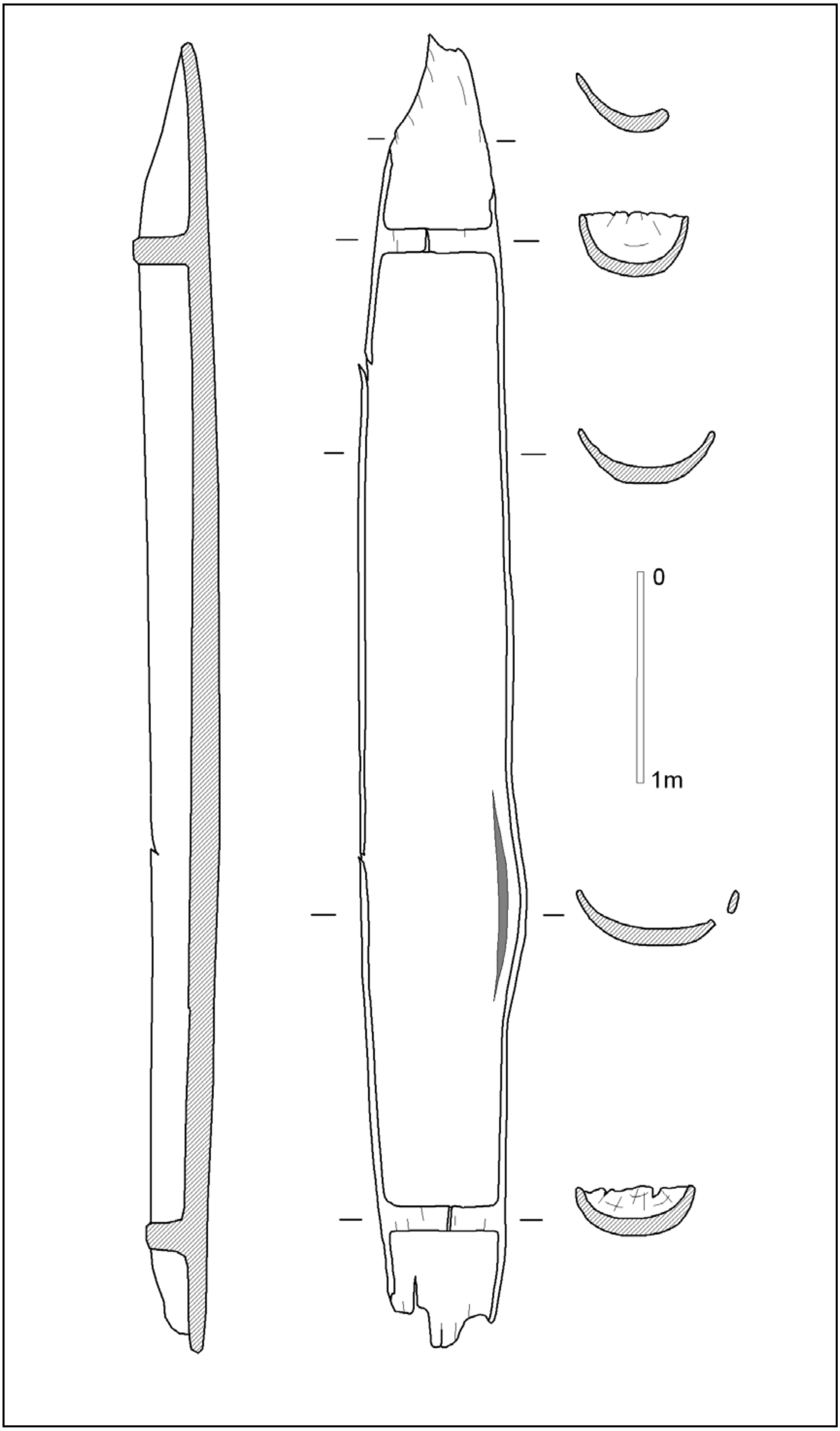


Figure 4.50 Toušeň vessel plans (documentation by Jason Rogers).

Vessel:	Brandýs nad Labem 1
Catalogue number:	16
Material:	Oak
Condition:	Floor fragment
Date:	Not dated
Location:	Eastern Prague District Museum, Brandýs nad Labem

A logboat fragment of unknown provenience is also held in Brandýs nad Labem. The floor portion is nearly 5 m in length, and a maximum width of 56 cm survives. Remains of two transverse ridges and a distinct chine are apparent. The vessel would thus have a trapezoidal profile in cross-section, similar to the Čelákovice boat and Poděbrady 1 and 3 (Figures 4.51 and 4.52).

Figure 4.51 The Brandýs nad Labem 1 logboat.

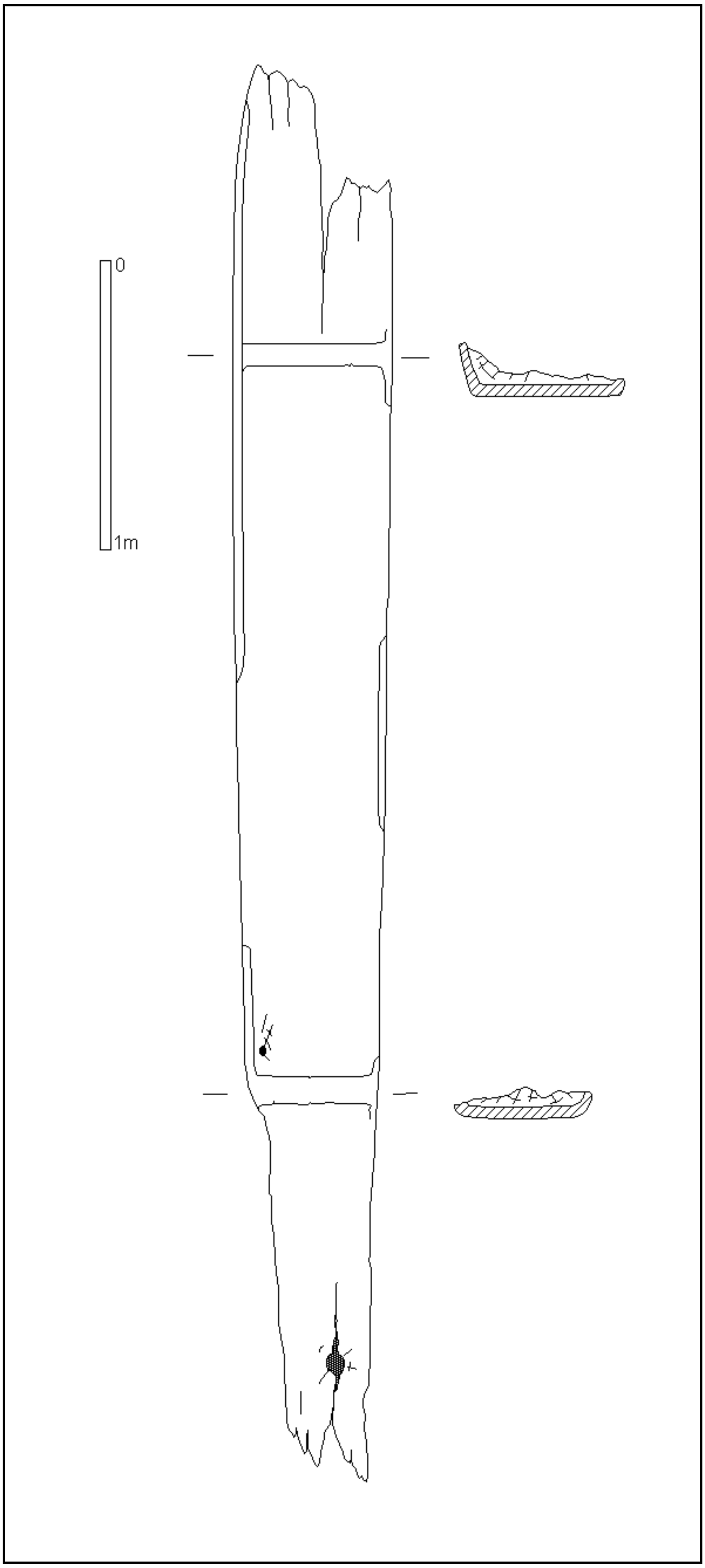


Figure 4.52 Brandýs nad Labem 1 vessel plans (documentation by Jason Rogers).

Vessel:	Brandýs nad Labem 2
Catalogue number:	17
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

According to Novotný (1951:287), a 6 m logboat fragment was found in 1942 in the weir on the Elbe at Brandýs nad Labem. The piece was 80 cm wide, had three transverse ridges across the floor and a 10 x 10 cm hole in one side. The fragment was later destroyed.

Vessel:	Stará Boleslav
Catalogue number:	18
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

In 1942, an 8 m logboat was discovered on the right bank of the Elbe at Šoselov's mill in Stará Boleslav. The roughly hewn vessel had several oval perforations in the sides, and no transverse ridges. After discovery, the boat was cut up and used as firewood (Novotný 1951:291).

Brandýs nad Labem and Stará Boleslav are located on opposite banks of the Elbe River. Stará Boleslav was founded as an early Slavonic fortress in the late ninth century, and the region was extensively utilized and settled from the Neolithic onward.

Vessel:	Jiřice
Catalogue number:	19
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

Novotný (1951:289) relates only that a boat was discovered in 1942 at Jiřice on the Elbe River. The vessel was destroyed and no further information is available.

Vessel:	Tišice
Catalogue number:	20
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

A small logboat was discovered "years ago" in a field near Tišice, on the Elbe River north of Prague (Novotný 1951:291). The 2.5 m vessel had a maximum width of 60 cm. Although in good condition and pulled from the ground undamaged, it was later destroyed.

Vessel:	Neratovice
Catalogue number:	21
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

During grounds maintenance of a factory building in the town of Neratovice (across the Elbe River from Tišice), a mechanical excavator pulled the bow of a logboat from the ground sometime prior to WWII. Apparently well preserved, the fragment was heavily damaged by the machine and was discarded. Novotný (1951:290) speculated that the remainder of the vessel might remain *in-situ*.

Vessel:	Libochovany
Catalogue number:	22
Material:	Oak
Condition:	Does not survive
Date:	Not dated

Zápotocký (1969:315) reported that "in the 90s of the last century [the 1890s], residents of Libochovany found an oaken monoxyl logboat beneath Church Hill, in the sand of the Elbe River. The wood was black and very heavy." The boat was reportedly 9 m long, over 1 m wide and nearly as high. The villagers used two oxen to pull the boat away, and they later chopped it into pieces.

Libochovany is located along the stretch of the river known as the 'Porta Bohemica'. Numerous bronze hoards, mostly excavated from the riverbed during dredging or sand and gravel removal, have been found here (Zápotocký 1969). The importance of the Elbe as a major communications artery during the Iron Age in this region is shown by the spatial distribution of items produced at the La Tène period emporium of nearby Lovosice. Mill stones from Lovosice were exported as far away as Moravia and Lower Austria (Čižmář 2002a:45).

Vessel:	Horní / Dolní Jiřetín (Komořany Lakes)
Catalogue number:	23
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

Extensive open-pit coal mining in northwest Bohemia around the city of Most has dramatically altered the landscape, obliterating several large lakes and entire villages. The former Komořany Lakes were located northwest of Most on the Bílina River, which joins the Elbe at Ustí nad Labem. Fragments of at least six logboats were discovered in this area, though none survives. The records are vague and unclear, but they relate three finds near the former village of Dolní Jiřetín from

1909, 1918, and 1939, and two from nearby Horní Jiřetín in 1906 and 1927 (Novotný 1951:288-289). On the basis of pollen samples from the same context as the Jiřetín vessels, Novotný (1951:280) dated them to the Late Bronze Age. According to the descriptions, all the Komořany fragments were lacking transverse ridges, though one had a seat-step or bench carved from the solid at the stern (Figure 4.53). Also of interest in this context is a paddle fragment recovered from the former Komořany Lakes, curated at the regional museum in Teplice at one point but now lost (Novotný 1951:279).

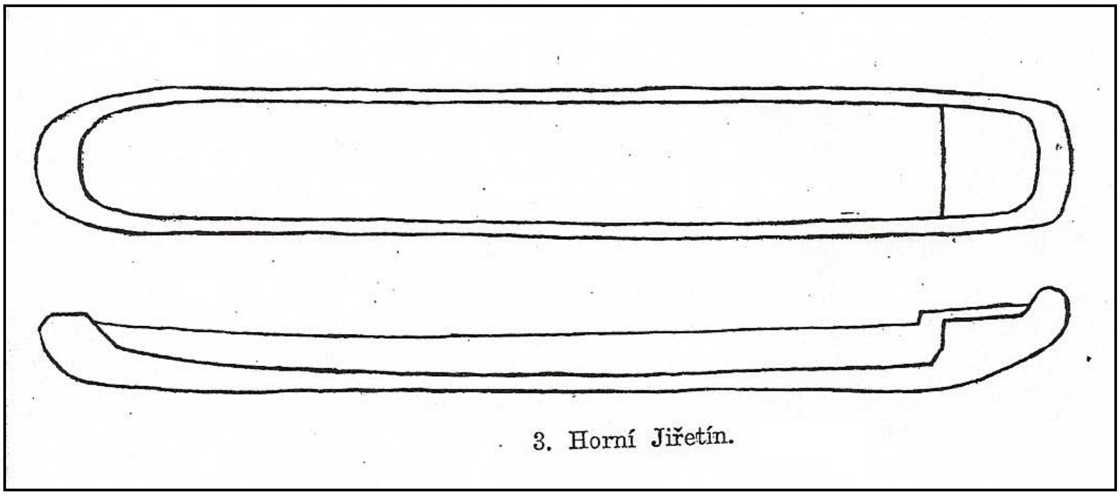


Figure 4.53 Vessel from Horní Jiřetín, recorded by B. Novotný (1951:265).

As with much of Bohemia, the Most basin is quite fertile and in prehistoric times was densely settled, especially along river valleys. Among interesting archaeological monuments in the near vicinity is the 'sacrificial stone' at Jezeří ("The Lakes"). This large boulder, likely a glacial erratic, is associated with ceramic sherds ranging from the Bronze Age to medieval times (Sklenář 1993:100).

4.3 Moravian Logboats

Eight logboats are preserved in Moravia. All known and recorded Moravian vessels were discovered along the Morava River. Five boats are accessible in museums, two are in state repositories, and one remains buried *in situ*. A number of further vessels are known from literature or antiquarian sources. A map of all logboat discovery sites in Moravia is shown in Figure 4.54.

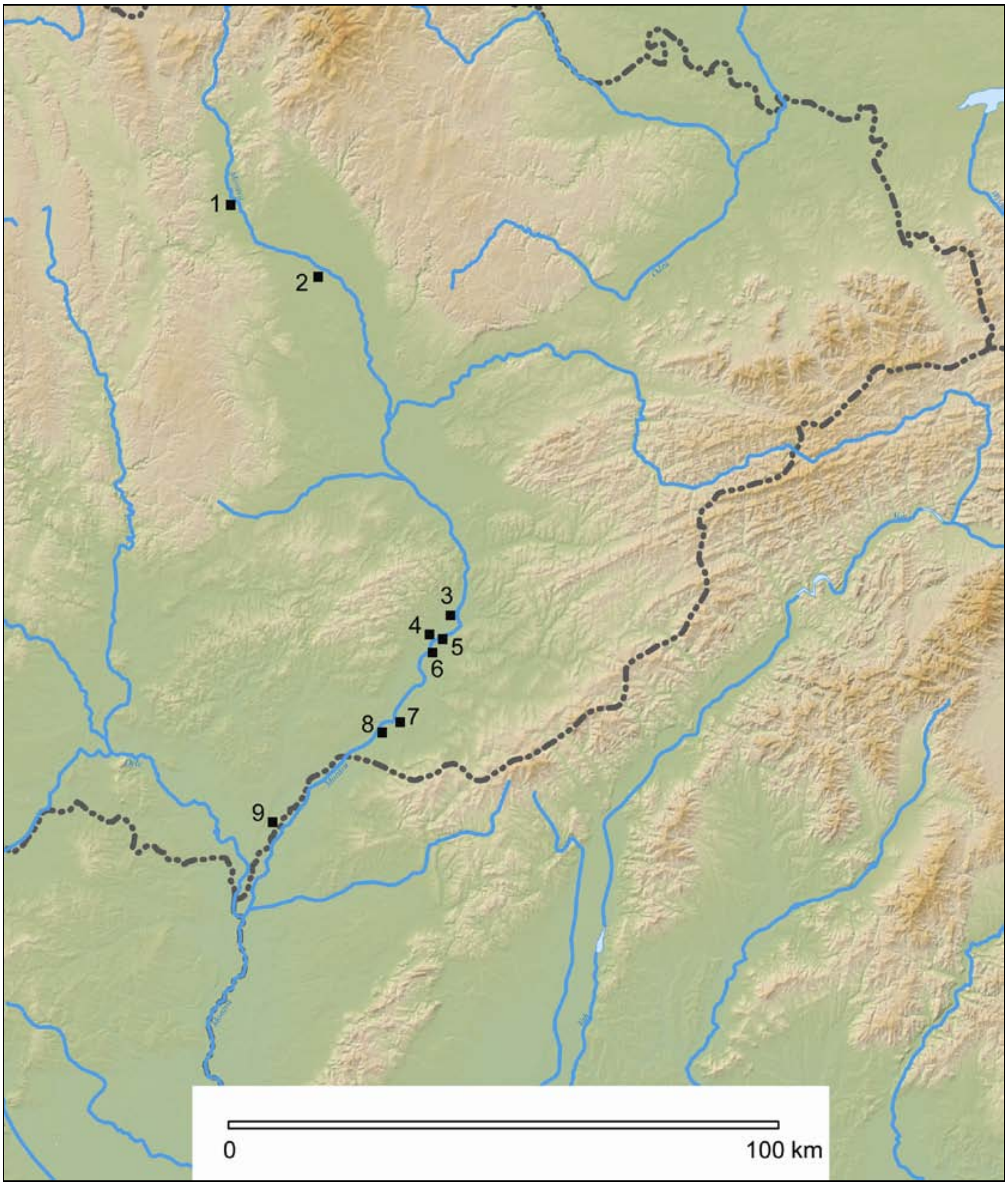


Figure 4.54 Logboat discovery sites in Moravia: 1- Mohelnice; 2- Příkazy; 3- Spytihněv; 4- Staré Město; 5- Uherské Hradistě; 6- Kostelany; 7- Veselí; 8- Lideřovice; 9- Mikulčice.

Vessel:	Mohelnice
Catalogue number:	24
Material:	Oak
Condition:	Complete
Date:	After 281 BC
Location:	Historical Museum, Olomouc

In the spring of 1999, a large oaken logboat was discovered in Mohelnice Lake in northern Moravia (Figure 4.55). Dr Jaroslav Peška, director of the Olomouc Archaeological Centre, discovered the vessel in June of 1999 while on a fishing trip near the town of Mohelnice (Kučerová and Peška 2004:32). Peška encountered a log or tree trunk protruding from the bank of the lake, and upon closer inspection noticed that the wood was worked and looked like a boat turned bottom-up. Further investigation revealed that the object was indeed a logboat.

The discovery location is a former meander of the Morava River, which today is channeled approximately 50 m from the site. The vessel was buried too deeply in the bank to be pulled out by hand, and was finally extracted using two mechanical excavators. As land access to the site was difficult, floats were attached to the vessel and it was pulled across the lake by a small barge. Finally it was lifted with a crane to a flatbed lorry, and transported to the Historical Museum in the city of Olomouc. As there was no space in the museum large enough to house the vessel, a special shed was constructed in the courtyard (Figure 5.56). The vessel was conserved for five years in PEG.

Figure 4.55 Mohelnice Lake, discovery location of the Mohelnice logboat.

Figure 5.56 Mohelnice logboat conservation shed.

This vessel measures 10.46 m in length, 1.05 m in width, with a maximum height of 60 cm (Figure 4.57). Neither bow nor stern are elevated above the level of the gunwales, and there are four transverse ridges carved from the solid across the floor (Figure 4.58).

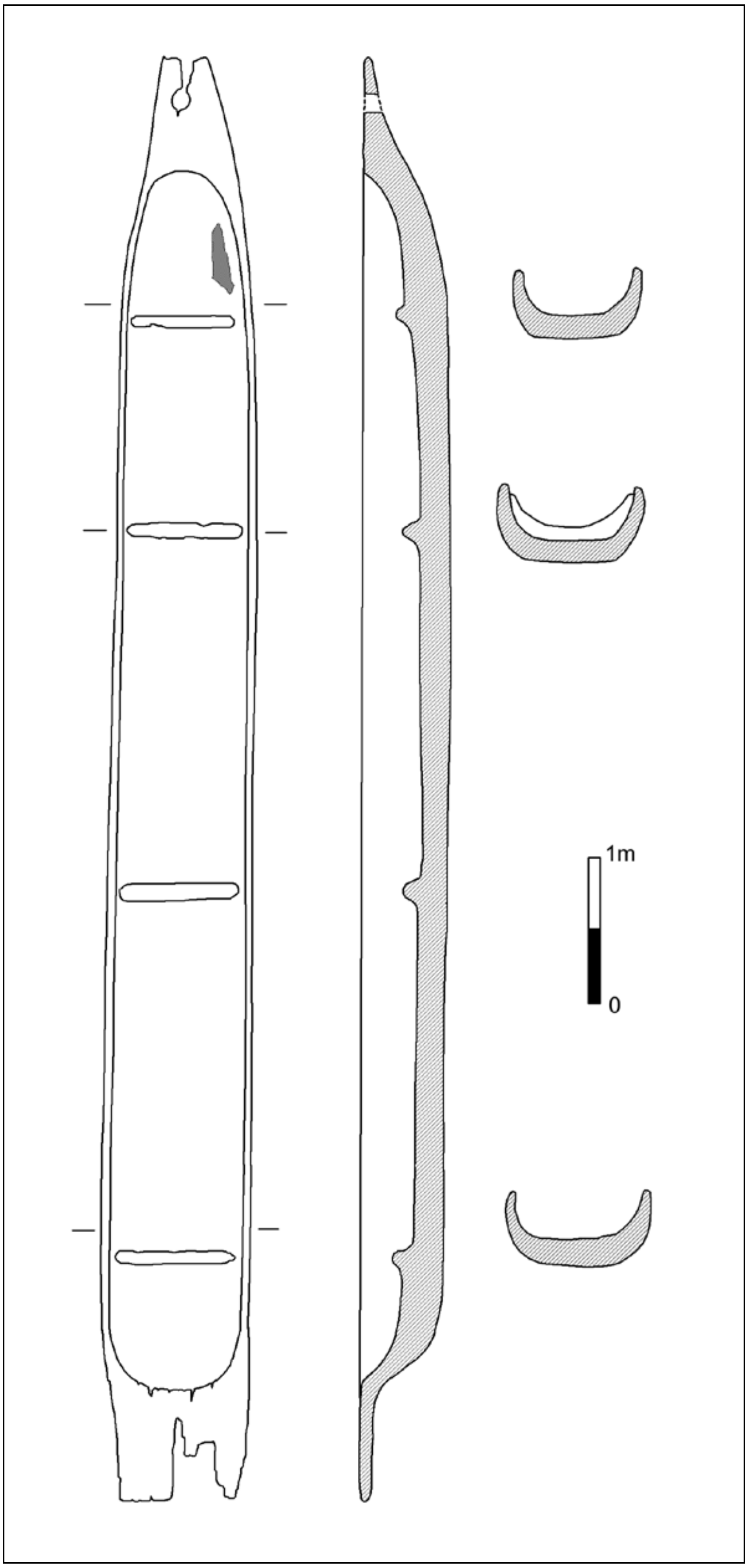


Figure 4.57 Mohelnice vessel plans (after Kučerová and Peška 2004).

Both bow and stern have overhanging platform ends; the bow tapers slightly in plan view, the stern not at all. The vessel's overhanging platform ends may improve sailing performance as well as providing extra flotation and shielding the crew from spray. On New World logboats, raised bow and stern platforms were often used for crewmembers with paddles, poles, or spears (Roberts and Shackleton 1983:28, 69). There is a structural advantage as well; a dugout end shaped like a "duck-bill" resists splitting and cracking caused by differential drying of wood fibre (McKee 1983:56).

Figure 4.58 Mohelnice logboat transverse ridges.

An initial attempt to date the Mohelnice vessel by radiocarbon analysis, carried out at Charles University in Prague, placed it in the Late Bronze Age. A subsequent sample analyzed in Groningen indicated a Late Iron Age date for the logboat. The

Groningen dating was subsequently confirmed by dendrochronology analysis, indicating that the vessel was constructed from an oak tree felled after 281 BC (Kučerová and Peška 2004:34). The Mohelnice boat is thus the Czech Republic's oldest dated example. Using the minimum freeboard method (Fry 2000), the estimated carrying capacity for this vessel was calculated to be approximately 1077 kg (Rogers 2009).

In its initial discovery location, the boat lay bottom-up among wooden poles or pilings driven into the lakebed. The vessel's stern was wedged between a row of pilings, and the bow was leaning against another pole. Similar poles or pilings were found protruding from the lakebed and riverbank in various locations in the near vicinity (Figures 4.59 and 4.60). Dr Peška, the vessel's discoverer, postulated that these pilings were originally a docking or landing location, and that the boat was found *in situ* (Kučerová and Peška 2004:33).

Figure 4.59 Wooden poles in the lakebed in the vicinity of the Mohelnice vessel discovery location.

Figure 4.60 Pointed end of wooden pole from lakebed in the vicinity of the Mohelnice vessel discovery location.

Logboat weight distribution gives them a tendency to turn upright when submerged; the bottom-up orientation of the Mohelnice boat is therefore quite unusual and potentially resulted from a deliberate act. The position of the vessel “wedged between” and “leaning upon” pilings also shows the intentional and purposeful corralling or trapping of the vessel. Future excavation at this extremely interesting site may reveal further details related to the placement of the Mohelnice logboat.

Geographically, Mohelnice is located where the Morava River emerges from the Jeseníky Mountains and begins its passage through the upper Morava Valley. The lake itself is an artificial reservoir formed by excavation of gravel deposits from old meanders of the former riverbed. The discovery location (250 m above sea level), now a small rise or hillock forming one bank of the lake, was originally a river terrace created by an ancient curve in the Morava River. The river today is canalized and runs less than 100 m from the discovery spot. Directly to the east of the lake and river, the steep forested slopes of Jelení Peak rise nearly 100 m above the valley floor; a Slavonic fortress dating to the 10th century was located here (Sklenář 1993:205). One of the Morava River's first major tributaries, the Třebůvka, joins the river at Moravičany just 3 km to the south of Mohelnice.

The Mohelnice region is rich in archaeological finds, from the Paleolithic through Slavonic periods. A Neolithic settlement of more than twenty houses constructed of post-framed houses with walls of wattle and daub was excavated at Mohelnice; these semi-permanent structures are interpreted as evidence of the early transition to a settled agrarian lifestyle (Čižmářová *et al.* 1996:17). Further sites from the LBK, Moravian Painted Ware, Funnel Beaker, and Proto-Únětice cultures are documented in the vicinity (Čižmářová *et al.* 1996:20-33). The first fortified hill-forts appeared in Moravia during the Bronze Age, a tradition that would carry through Hallstatt and culminate in La Tène period *oppida*. Throughout the Bronze Age and early Iron Age, Moravia was split into two cultural spheres- the southern regions gravitating toward the middle Danubian cultures, the north belonging to the Lausitz Urnfield culture. Only during the La Tène period was Moravia culturally united once more (Čižmářová *et al.* 1996:49). Mohelnice was situated in the Lausitz cultural area, and a large Urnfield cemetery, containing at least 1260 graves, was located at nearby Moravičany (Nekvasil 1982).

The vessel's dating of 281 BC places it in Reinecke's La Tène B2 period (310 to 240 BC). The Central European La Tène period is usually equated with 'Celtic' cultures (e.g. Filip 1956, Podborský 2004, etc). There is much discussion over the claim, and as mentioned previously the term 'Celtic' can variously refer to an art style, a language group, a material assemblage, an ethnicity, a designation imposed by classical authors, etc., and that while there may be overlap, these categories are not necessarily one and the same (e.g. Renfrew 1987; Wells 2001; Arnold and Gibson 1995, etc.).

Vessel:	Příkazy
Catalogue number:	25
Material:	Oak
Condition:	Complete
Date:	After 1537 AD
Location:	Provincial Depository, Chudobín

A much smaller logboat was discovered in August 1962 at the village of Příkazy, only 30 km from Mohelnice downstream along the Morava River. Local inhabitants pulled the vessel to shore, and found a wide-bladed iron axe inside the boat. Investigators concluded that the artifact dated the boat to the Middle Ages (Trňáčková 1963). In 2006, wood samples from the vessel were submitted for dendrochronology analysis at the Agricultural University in Brno, using the 'Czges2005' master curve for oak. The analysis revealed that the vessel was constructed from a tree felled after 1537 AD (Rybníček 2006).

The vessel has only minor damage on the stern, and is quite similar to the boats from Spytihněv and Poděbrady with a bulkhead to separate the 'wet' and 'dry' functional spaces. Vessel length is 4.18 m, maximum beam is 65 cm, and height is 30 cm. Walls are a very uniform 2-3 cm in thickness (Figures 4.61 and 4.62).

Figure 4.61 The Příkazy logboat (photograph courtesy of Vladimír Rusnák).

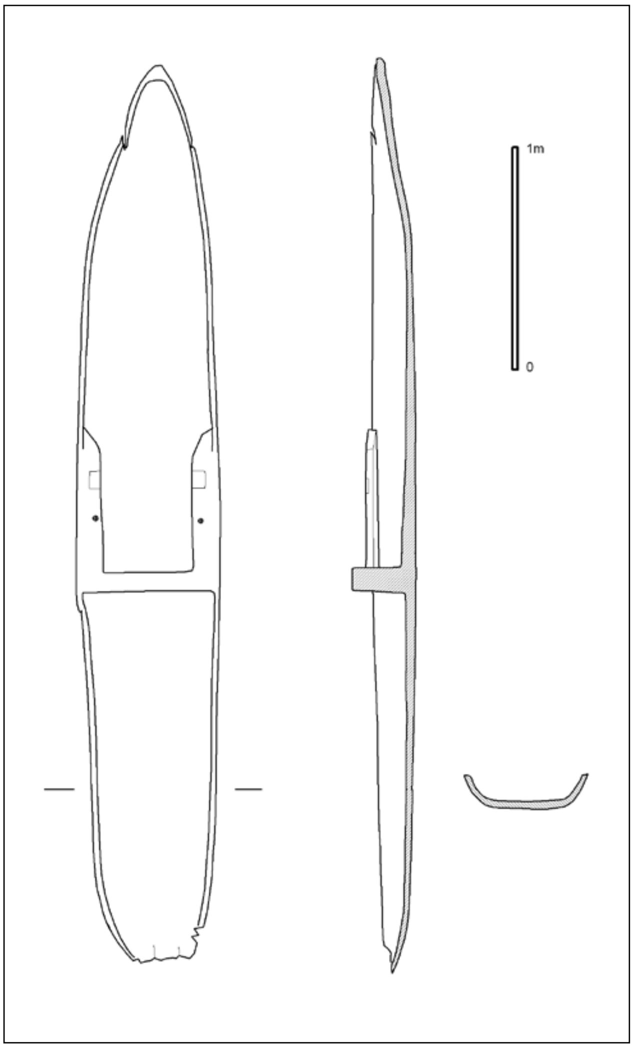


Figure 4.62 Příkazy vessel plans (after Radovan Frait).

Vessel:	Spytihněv
Catalogue number:	26
Material:	Oak
Condition:	Complete
Date:	Not dated
Location:	Slovacké Museum, Staré Město

In June of 1929, an oaken monoxyl was discovered in the bank of the Morava in the village of Spytihněv. The boat lay buried in sand beneath the trunk of an ‘enormous’ fallen oak. The vessel’s surface had a blackened appearance, and had suffered minor damage on the stern (Hanák 1930:19). The vessel was recovered and is now housed at the Slovacké Museum in Staré Město (Figure 4.63). The Spytihněv logboat currently measures 3.83 m in length, with a width of 60 cm and height of 30 cm (Figure 4.64). In form the Spytihněv boat is quite similar to the Příkazy vessel above, featuring a bulkhead and thwart carved from the solid, with apparent grooves for a seat-board. The boat’s ends are slightly elevated above the level of the gunwales. The hull lacks a clear chine and is semi-circular in cross-section. The estimated carrying capacity for this vessel was calculated to be 221 kg (Rogers 2009).

Figure 4.63 The Spytihněv logboat, held at the Slovacké Museum in Staré Město.

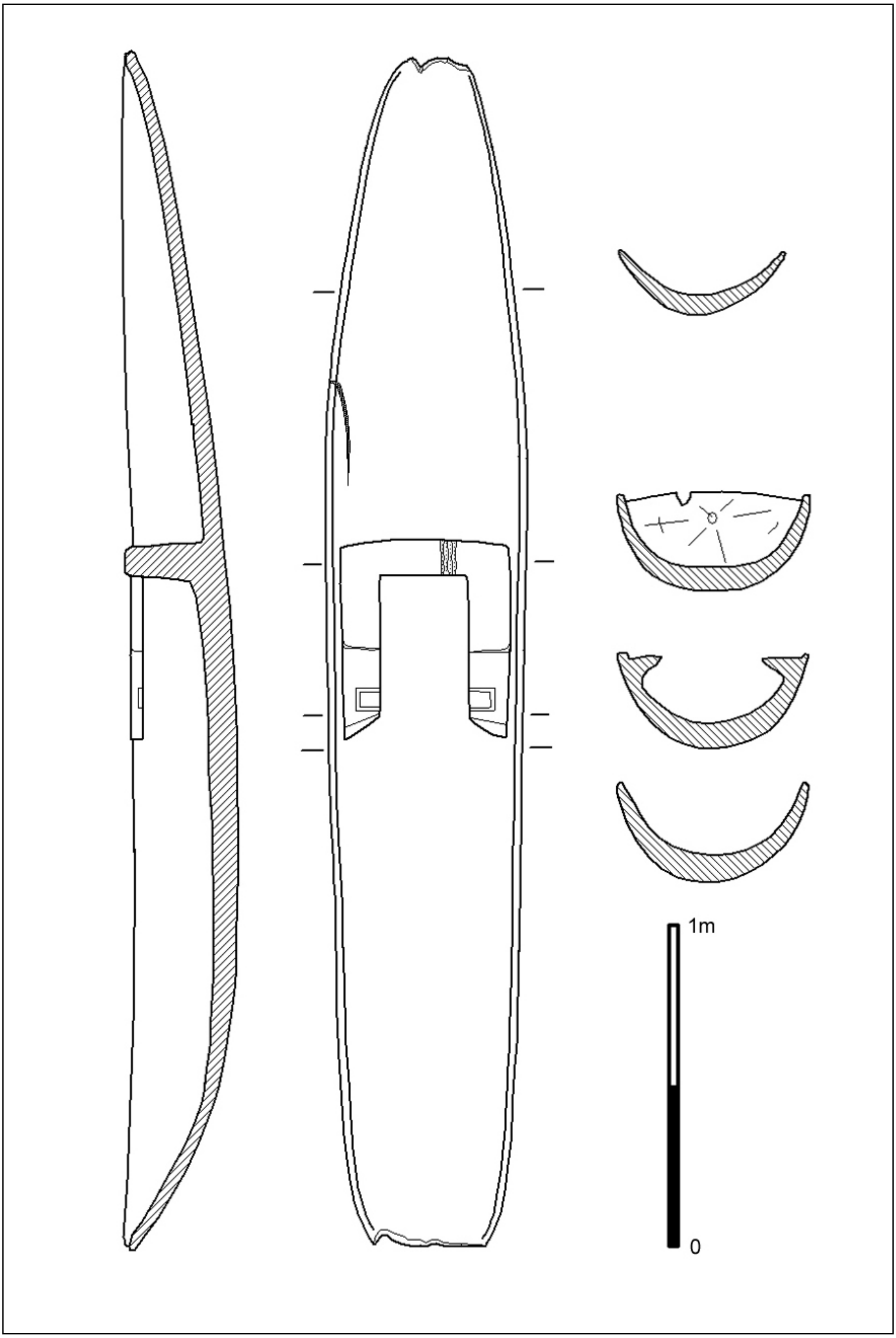


Figure 4.64 Spytihněv vessel plans (documentation by Jason Rogers).

Hanák (1930:20) suggested that this vessel is associated with the Slavonic stronghold at Spytihněv, which was founded in 1028 AD by Duke Břetislav and named after his first-born son. The supposition may be essentially correct, as Ossowski has assigned this type of logboat to the Middle Ages on the basis of numerous dated Polish examples (Ossowski 2000a:65). The quite similar vessel from Příkazy was dated by dendrochronology to 1537 AD.

Vessel:	Staré Město
Catalogue number:	27
Material:	Oak
Condition:	Does not survive
Date:	Not dated

In September 1946, during a period of very low water, a logboat was found in the sandy bottom of the Morava's main channel at Staré Město. One of the finders, Jaroslav Svoboda of Uherské Hradistě, described the vessel thus: "The boat's stern was sticking out of the sand in the direction of the current. After much tugging and pulling, a piece of the boat broke off, about 150 cm long. The rest of the boat was left buried in the riverbed. The old wood was completely blackened, and carved from the trunk of an oak tree. The hewing of the inside left a rippled corrugated surface." The sides were about 30 cm high, the floor was quite thick, and the width of the boat was about 60 cm. There was a sort of tapering tail at the boat's raised stern, cut out in the shape of the letter T (Figure 4.65). The T-shaped stern cutout, possibly intended for a steering oar, matches that of the Kolín boat above, reported by Niederle (1923:34). The remains were left on the riverbank, and within days withered in the sun and fell to pieces (Hrubý 1965:127).

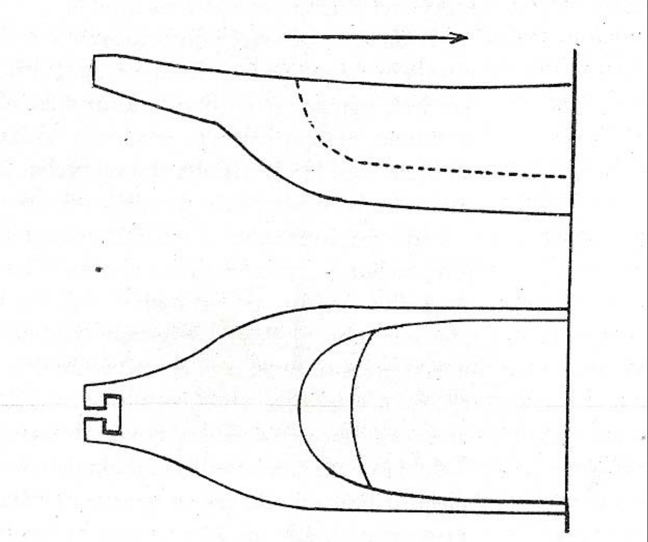


Figure 4.65 Drawing of the Staré Město vessel's stern, showing T-shaped cutout similar to the Kolín 1 vessel (Hrubý 1965:127).

Vessel:	Uherské Hradistě
Catalogue number:	28
Material:	Oak
Condition:	Complete
Date:	Not dated
Location:	Slovacké Museum, Staré Město

In June of 1946, a dugout boat was found in the Morava River at Uherské Hradistě (Figure 4.66). The vessel, though damaged on the stern, was essentially whole and was pulled from the muddy riverbed by members of the Uherské Hradistě rowing club (Hrubý 1965:126). It measures 5.22 m in length, with a maximum beam of 70 cm and a height of 34 cm (Figure 4.67). The floor is thickest in the middle (13 cm), and the transition to the sides is rounded with no appreciable chine. The bottom is slightly flattened although the hull still maintains a nearly semi-circular profile. The side walls narrow to 2 cm thick on the upper portions. A tapering 'block' carved from the solid protrudes from the floor near the bow, and there are two similar blocks near the stern (Figure 4.68). The damaged stern terminates with an overhanging platform end. The estimated carrying capacity for this vessel was calculated at 285 kg (Rogers 2009).

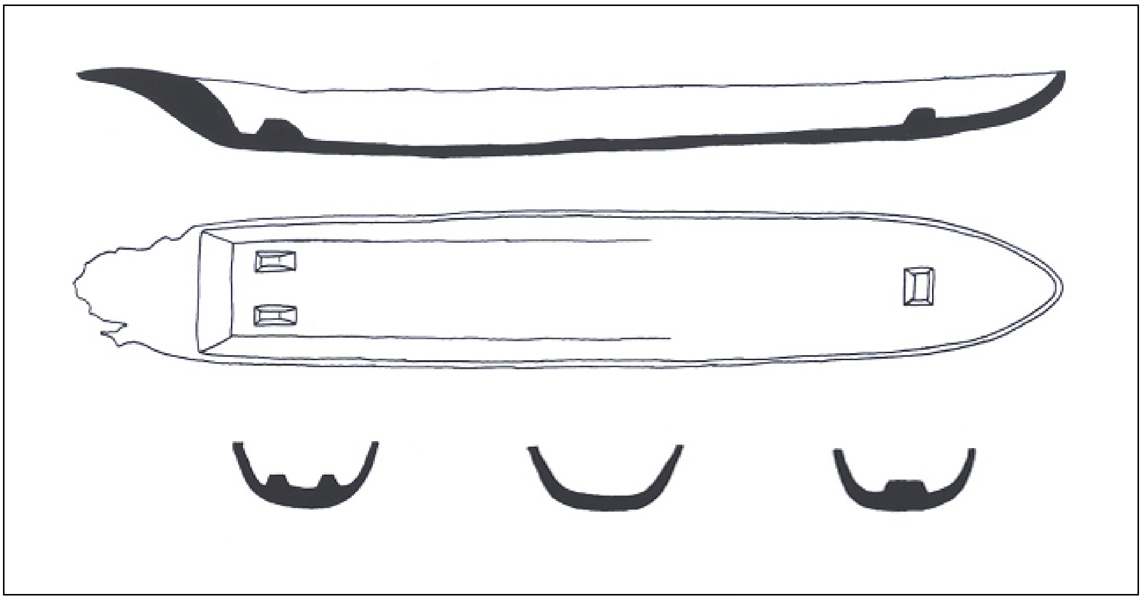


Figure 4.66 Drawing of the Uherské Hradistě logboat at the time of recovery (Hrubý 1965).

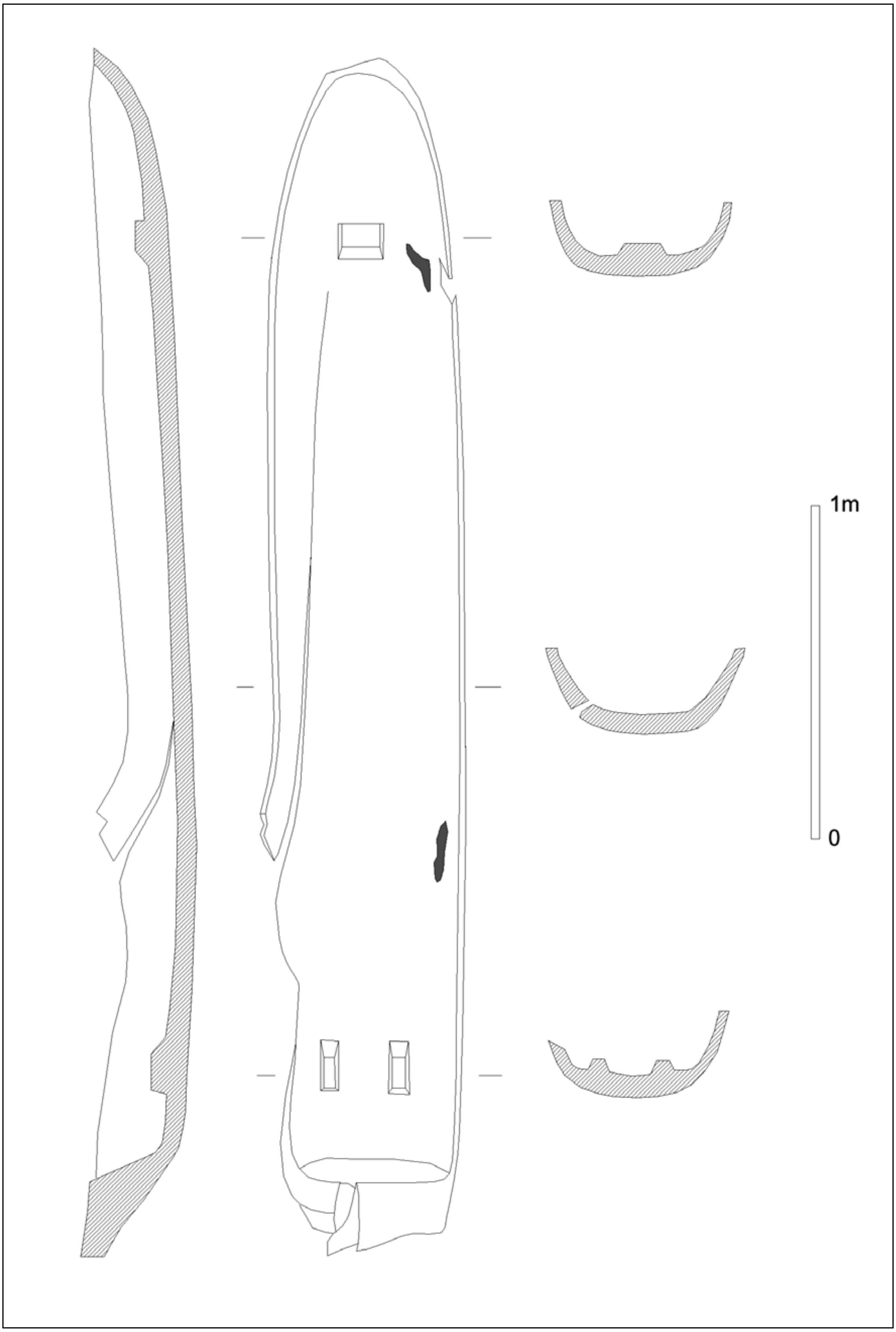


Figure 4.67 Uherské Hradistě vessel plans (documentation by Jason Rogers).

Figure 4.68 Floor block at the bow of the Uherské Hradistě logboat.

Vessel:	Kostelany nad Moravou
Catalogue number(s):	29A/B
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

Hrubý (1965:128) stated that in 1947 he came upon interesting remains in Kostelany, 4 km downriver from Uherské Hradistě. Approximately 100 m south of the Morava River bridge, pieces of “blackened, worked wood”, probably a boat, were turned up by a work crew’s excavator. The fragments had come from the main river course, and were originally approximately 2 m below the existing riverbed. The pieces were cut up by the work crew and used as firewood.

The same workers told Hrubý that the previous year they had come upon a large oak dugout while digging in the river for sand. It lay on the riverbank for some time, approximately 500 m below the bridge, and was an object of curiosity for local inhabitants. Eyewitnesses estimated the boat’s length at 4 to 7 m. The vessel was completely encircled by a metal band just below the gunwale. The bow and stern were completely encased in metal, and were joined down the lengths of both sides by metal strips. At approximately the vessel's mid-point, on either side, the metal strips encircled a round hole in the boat's side. The metal was fastened to the wood by small bronze nails with irregular heads and squared shafts. The vessel had two transverse ridges across the floor, one near the stern and the other near the bow.

Two Hallstatt period ceramic vessels were also pulled from the sandy riverbed at the same time, although Hrubý doubted any connection between the finds. After some time, local people stripped the metal from the boat and threw it in the river. The dugout itself was then chopped into pieces, probably for firewood (Hrubý 1965:128).

Vessel:	Veselí nad Moravou
Catalogue number:	30
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

Workers dredging and straightening the Morava river channel in 1928 came upon a large logboat near Veselí nad Moravou. The boat was buried in approximately 3 m of mud and sand, and stretched nearly from one side of the river to the other. Witnesses stated that it was "about 20 paces" in length, perhaps 12 m. The vessel was completely destroyed by the dredging and excavation work, and no precise description is available (Hrubý 1965:124).

Vessel:	Lideřovice
Catalogue number:	31
Material:	Unknown
Condition:	Does not survive
Date:	Not dated

In July 1922, Hrubý found a logboat along the Morava's bank, just below the Lideřovice railway station. The vessel's bow was exposed, while the stern and floor remained buried in the mud. The pointed bow curved up, and Hrubý noted a blunt chine along the sides. There were two holes at the front, one on either side of the bow. Near the bow, a large bench-like transverse ridge extended across the floor, and tapered out from the top to its base (Figure 4.69). This bench nearly reached to the top of the vessel's sides. After several years, workers at the railway station completely excavated the boat from the mud. After it dried and fell to pieces, they burned it in the station's restaurant (Hrubý 1965:124).

Lideřovice is located just 6 km upriver from the stronghold of Petrov, established during the Great Moravian period as one of the 'Břetislavian' fortresses. Petrov was an important station along the 'Magna Via' leading from Vienna and Bratislava upriver as far as Olomouc. The location was carefully chosen to safeguard long-distance trade as well as providing a defensive position in case of an enemy attack up the valley of the Morava River (Sklenář 1993:166).

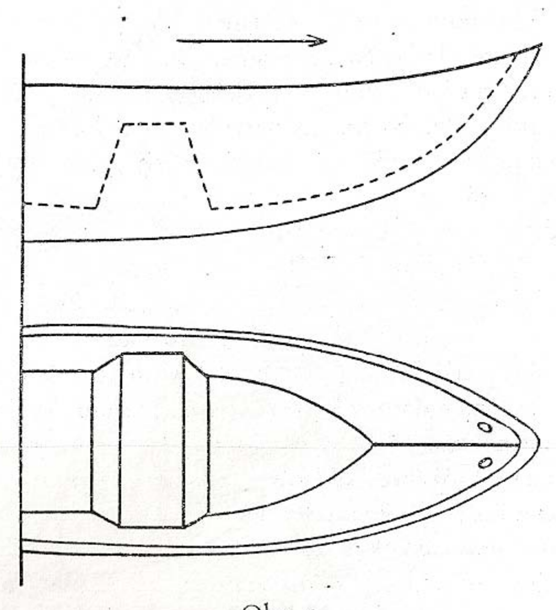

Obr. 5.
Přibližný vzhled přídě člunu z Bzence.

Figure 4.69 Drawing of Lideřovice vessel bow (Hrubý 1965:124).

Vessels:	Mikulčice 1-4
Catalogue numbers:	32-35
Material:	Oak
Condition:	Varies
Date:	9th – 10th centuries AD

Excavations at the Great Moravian citadel near the modern village of Mikulčice in southern Moravia started in 1954 and continue to the present day. The fortified settlement, which reached its peak during the 8th and 9th centuries AD, was situated on two large islands in former meanders of the Morava River. More than five hectares of land have been excavated, producing hundreds of thousands of artifacts. Among the discoveries were four oaken monoxyl logboats and an assortment of related objects such as paddles, fishhooks, and fish traps.

During the 1967 season, the citadel's northwest entrance was uncovered. The bow end of a dugout boat (Mikulčice 1, inventory number K-666/67) was found in an older stratum of river sediment on the island near the end of the causeway. Excavation director Zdeněk Klanica inferred from the location of the fragment inside the palisade that the fortified wall had been rebuilt to accomodate changes in the river channel, and the find was described thus:

> Archaeologically, the first vessel is the most significant. It was located in square KB-19, at 157 m above sea level. Most interesting, the find was situated behind the outer palisade on the inside of the citadel. A cut through the ramparts revealed that they were not built on the elevated rise, but rather on older river sediment. This means that the fortified wall changed position along with changes in the river channel. The vessel lay beneath both phases of the stone wall, and beneath two layers of ash and charcoal (burned remains of the wooden palisade), therefore between the wooden palisade and the settlement site (Klanica 1968:62-63).

The fragment measured 2.83 m in length, 75 cm in beam, and 26 cm high and included a transverse ridge 11 cm in height curving from wall to wall. A large crack ran lengthwise from the tip of the bow to the aft end of the artifact (Figure 4.70).

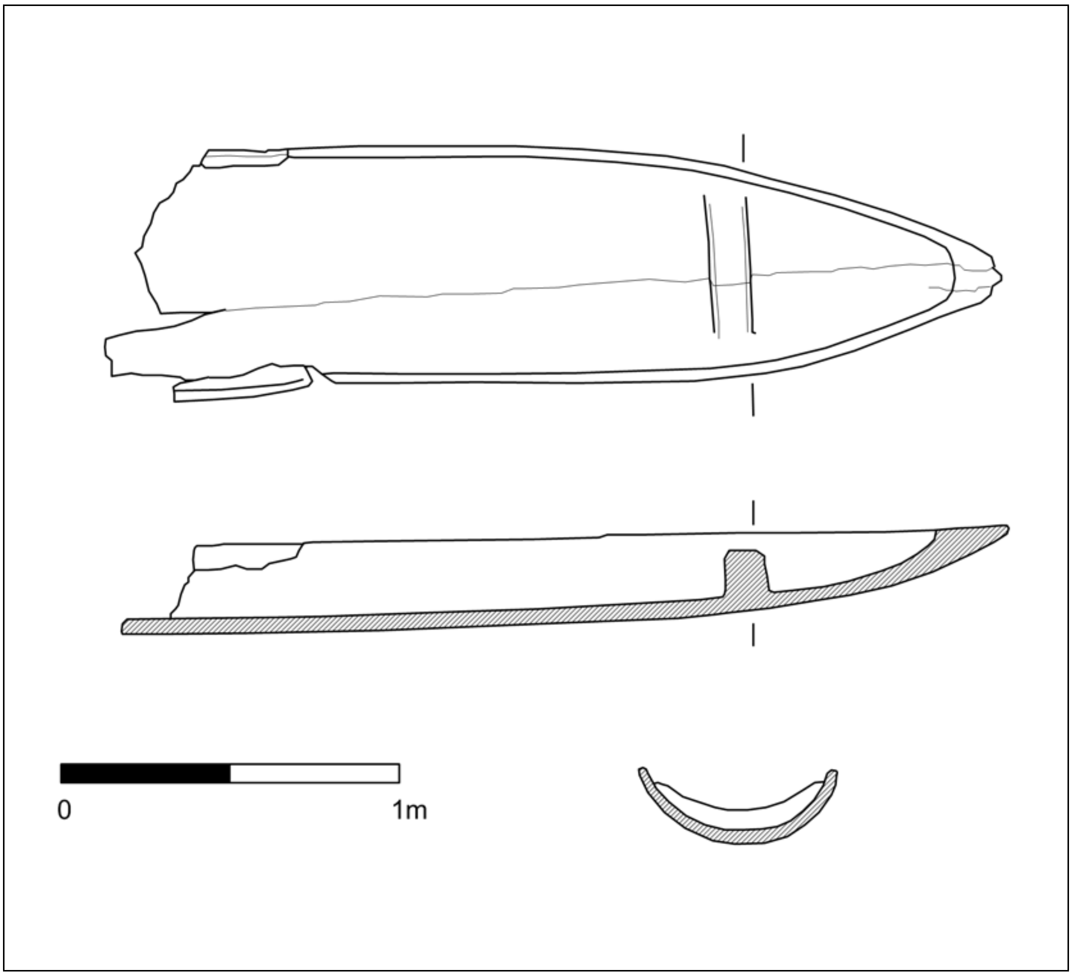


Figure 4.70 Mikulčice 1 vessel plans (after L. Poláček).

Also uncovered during the 1967 season, two large, well-preserved dugout vessels were found lodged against the causeway pilings. The first of these (Mikulčice 2, K-884/67) was 8.83 m long, 66 cm wide, and 36 cm high. Two transverse ridges cross the floor, and a square hole 8 cm per side perforates the bow (Figure 4.71).

The second vessel found in the causeway (Mikulčice 3, K-1212/67) was located immediately beneath the first, lodged against a bridge piling. It was 9.88 m in length, 71 cm at the broadest point, and 45 cm high (Figure 4.72). There are three transverse ridges across the floor, and a 12 cm peg with an asymmetrical head was found inserted through the hole in the bow (Figure 4.73).

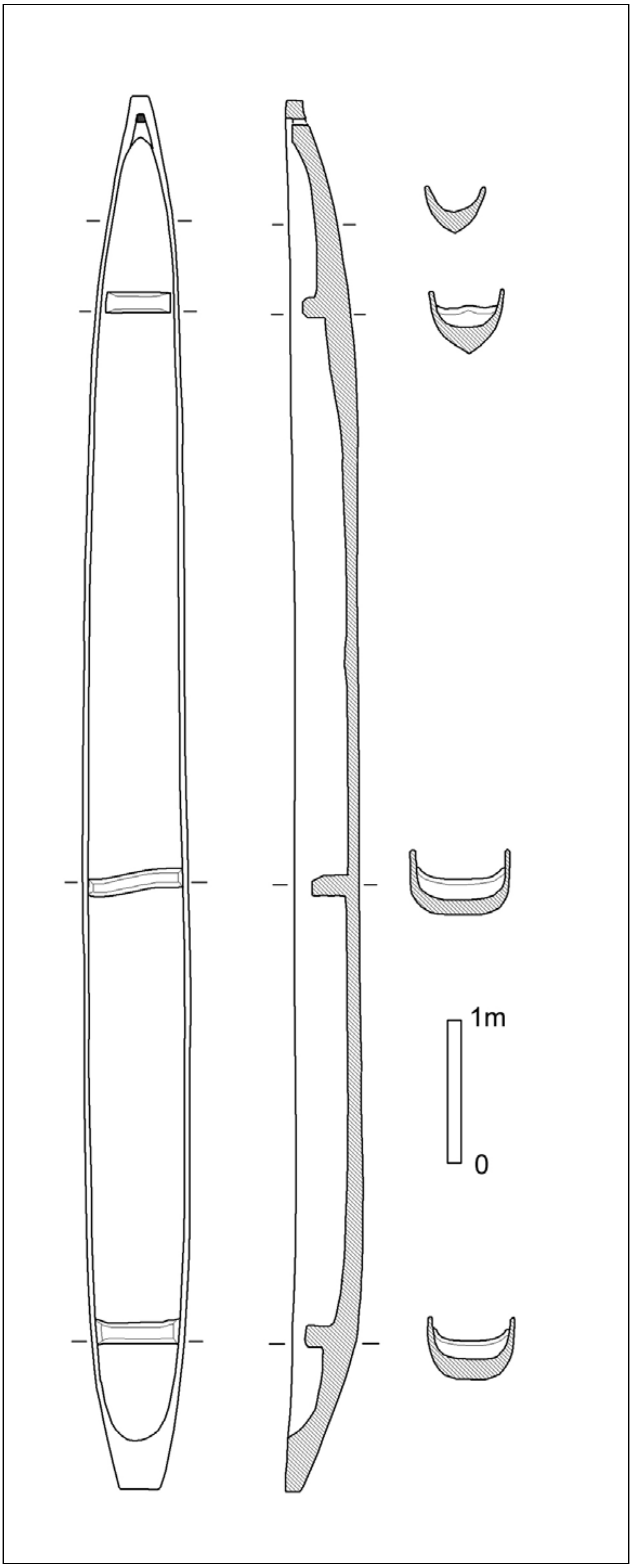


Figure 4.71 Mikulčice 2 vessel plans (after L. Poláček).

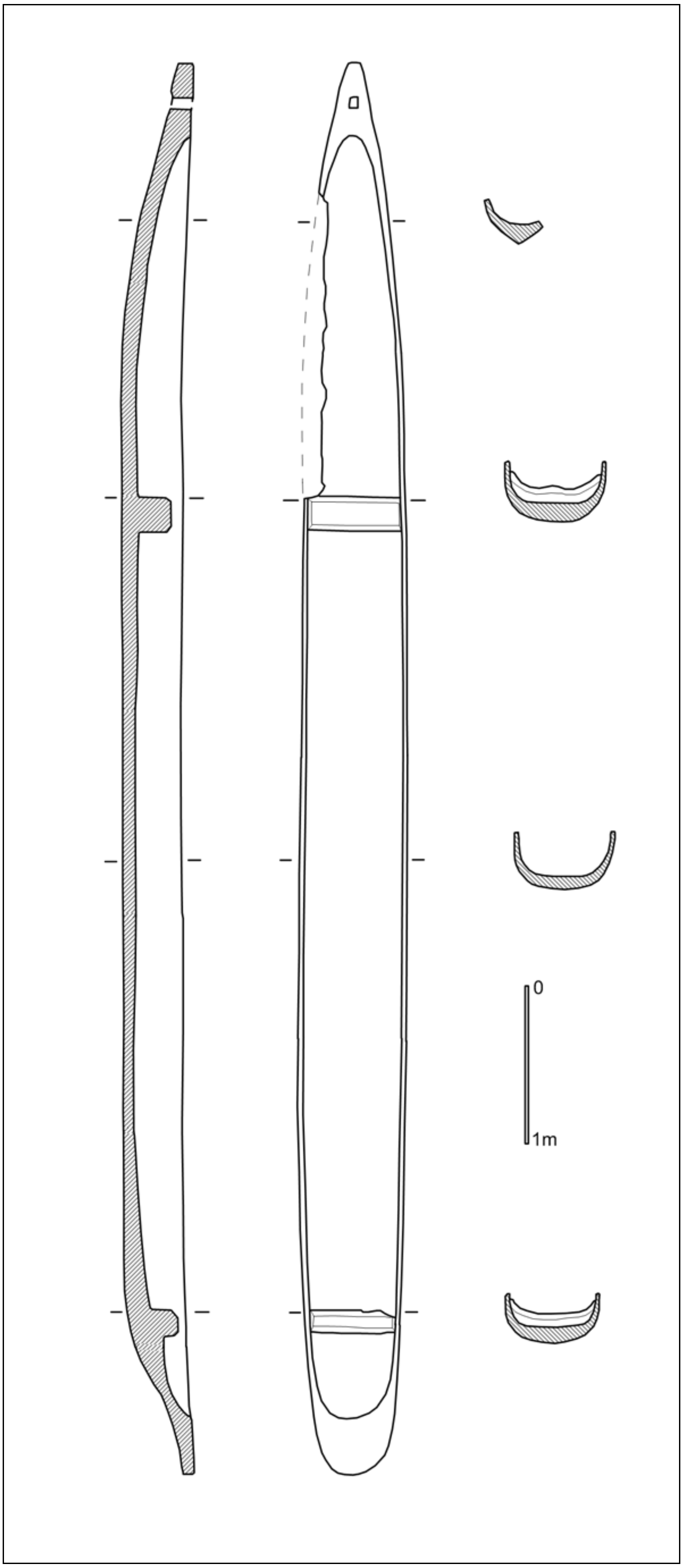


Figure 4.72 Mikulčice 3 vessel plans (after L. Poláček).

Figure 4.73 Bow of Mikulčice 3 logboat, showing peg inserted through vertical hole.

Both Mikulčice 2 and 3 have U-shaped cross-sections sloping to V-shaped ends. Small platform ends overhang both bow and stern. The transverse ridges of all three vessels are beveled along the top edges. Dendrochronology analysis of wood from the causeway pilings provides a date range from the last three quarters of the 9th century AD. River and flood sediment began filling the channels around the fortified islands by the first half of the 10th century, providing an age estimate for the logboats as well (Poláček 2000:206). The bow fragment and both complete vessels were conserved in PEG, and are displayed at the Mikulčice National Cultural Monument museum.

The fourth and final logboat found at Mikulčice (inventory number 210/98) was uncovered in 1984, nearly 30 years after the first discoveries. It was located some distance from the previous boats, in the former river channel near a small bridge. The vessel, measuring 6.72 m in length, was exceptionally fragile and in some places consisted of little more than an imprint in the soil (Figure 4.74). Despite the poor state of preservation, the boat's form was for the most part visible. The vessel appears similar to Mikulčice 2, with a pointed bow, two transverse ridges, and a rounded, overhanging stern platform. In cross-section it is somewhat flatter than vessels 2 and 3, with a more fully hollowed-out stern. Due to its extremely delicate nature, Mikulčice 4 was left *in-situ* and reburied. Reconstructed dimensions are 6.72 m in length, 75 cm maximum width, with a height of 26 cm (Figure 4.75). Wood samples were taken from the vessel for radiocarbon analysis, resulting in an age of 1180±40 (Cal AD 710-980) (GrA-9465) (Poláček 2000:206; Lanting 1998:639). Estimated carrying capacities for the these vessels were calculated as follows: 563 kg for Mikulčice 2, 635 kg for Mikulčice 3, and 492 kg for Mikulčice 4 (Rogers 2009).

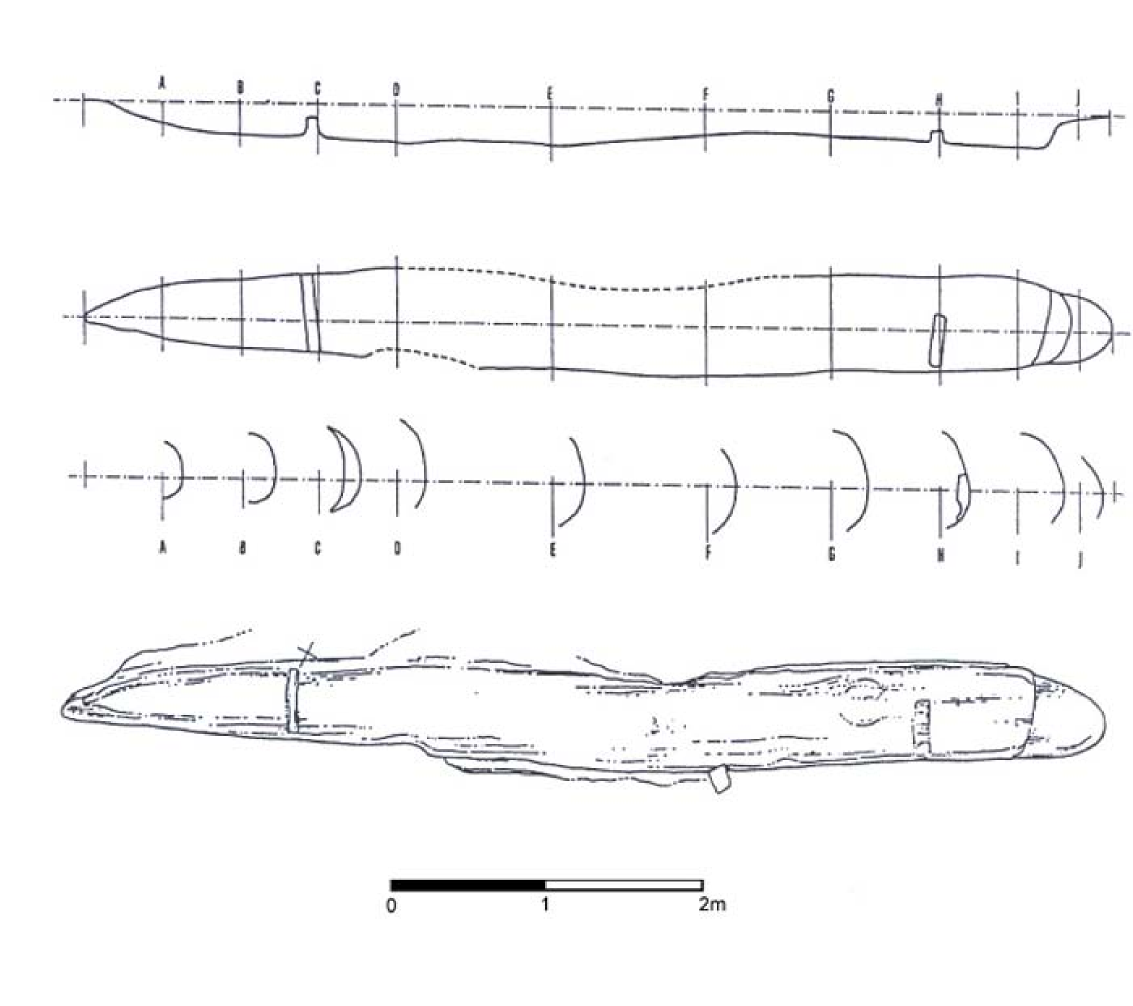


Figure 4.74 Documented remains of the Mikulčice 4 logboat (Poláček 2000:268).

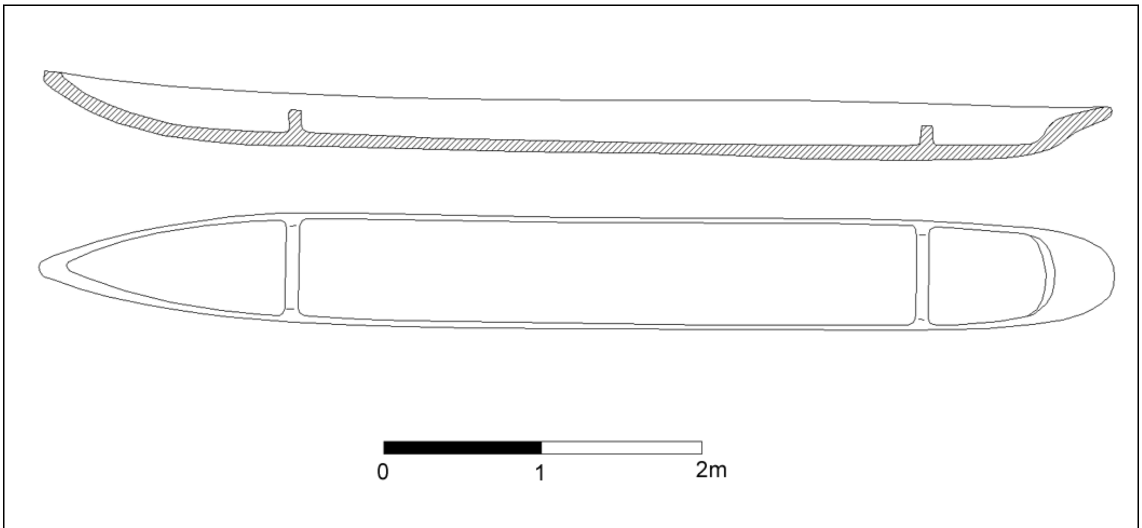


Figure 4.75 Reconstructed vessel plans for the Mikulčice 4 logboat (after Poláček 2000:268).

A number of associated implements were also discovered at Mikulčice, including three paddles, numerous fishhooks, and a barbed wooden spear for hunting fish (Andreska 1975:132). The paddles, two of oak (*Quercus* sp.) and one of maple (*Acer* sp.), were rather small with narrow leaf-shaped blades (Figure 4.76). The blades measured 10 cm in width and 70 cm in length. The handle length was approximately 100 cm, resulting in an overall length of approximately 170 cm.

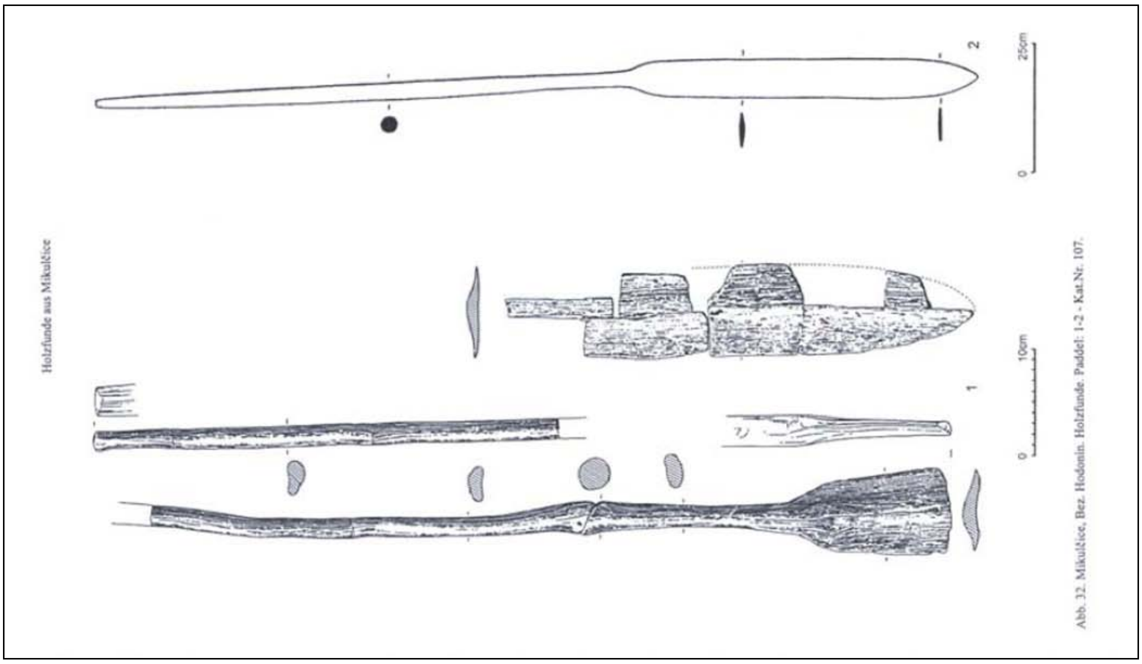


Figure 4.76 Paddles excavated at the Mikulčice site (Poláček 2000:271).

Numerous fishhooks were recovered at Mikulčice, all but one made from iron (the exception being a single bronze hook) (Andreska 1975:133). One wooden spearhead for hunting fish was found. The spearhead had two barbed points, carved from an unspecified wood. The spear was 14.5 cm long, with a spread of 6 cm between the points (Andreska 1975:132). The excavations also uncovered at least 14 basketry fish-traps, woven from willow branches (*Salix* sp.) (Poláček 2000:202). Several well-preserved examples show elongated arched necks and wide bodies. The baskets, like the logboats, were located in the former riverbed, all but two amongst the piers and pilings of the main causeway bridge.

Andreska (1975:135-136) interpreted several perforated sandstone and ceramic objects from Mikulčice as weights for fishing nets. The nets could be fastened to the shore by one end, and pulled out into the river by the other. Wooden floats were fastened to the net's top edge, the bottom was pulled down by the weights, and the net thus extended from the water's surface to the riverbed. In this context, Andreska asserted that the Mikulčice vessels' main function was fishing, either with nets or spears (1975:136).

I consider it unlikely that fishing would be the primary purpose of a 9 or 10 metre-long river vessel; it is much more likely that these boats were used for transportation. This view is supported by Poláček (2003:206), who suggested that the larger vessels were suited for longer trips on larger bodies of water, while smaller boats were intended for fishing or normal traffic in the smaller, intertwined river tributaries close to the fortress.

4.4 Catalogue Summary

Of the 40 or so reported logboats from the Czech Republic, all but 21 are lost or destroyed (two are buried *in-situ*). Of the 21 surviving vessels, 16 are accessible in museums and the remaining examples are kept in non-public repositories or collections. Conditions of storage and conservation vary widely and at least one example, stored outside for many years without adequate shelter, has decayed and disintegrated into fragments.

It is likely that many vessels were lost during deepening and straightening of the rivers channel in the 1920's and 30's. As noted by numerous authors (e.g. Mowat 1996:116), logboats, especially if fragmentary or poorly preserved, can be difficult to identify. Even when identified, many were allowed to decay or were deliberately destroyed. The number of recovered and preserved examples is surely only a small fraction of those deposited and buried along Bohemian and Moravian waterways.

This chapter has offered a comprehensive overview of known or recorded Czech logboats. Tremendous variety is evident in form, construction, age, and circumstances of deposition. Patterns of similarity and uniformity are also evident. The following chapter provides an analysis of the features and contexts of the vessels described above, intended to enhance our understanding of these patterns, and so also our knowledge of the people who built and operated the boats.

CHAPTER FIVE – ANALYSIS

From the data and information presented in previous chapters, it is evident that there is considerable variation in construction, form, function, dating and utilization of pre-modern Bohemian and Moravian watercraft. Both disparity and similarity reflect various social and geographic contexts of construction and usage. Intended usage and purpose may be deduced from analysis and examinations of the vessels and operating environments. Although the geographic environment is perhaps better understood than the human (social) context, in combination they comprise the riverine cognitive landscape and should be described and understood together. As Pål Nymoen (2008) has shown in his recent study of three Norwegian logboats, a thorough comprehension of regional topography and climate can be a key to understanding vessel use and hence the behavior of the boats' builders and operators. Vessel features and construction styles, indicating skill sets and traditions, must also be examined. This chapter offers analysis of specific categories of logboat context and features, intended to refine our understanding of the people who built and used them. Vessels are contextualized through description and comparison with similar as well as disparate examples from other European regions.

5.1 Dating and Chronology

Logboat chronology, as mentioned in Chapter Two, is difficult (if not impossible) to ascertain solely from typology. Classification of vessel morphology and features remains a useful tool, although stylistic categorization is unlikely to produce ancestor-descendent forms except on a small (local) scale. European logboats, representing nearly limitless combinations of needs, environments, and skill sets, are simply too diverse for such typology to be successful on a large scale. While logboats may have functioned as prototypes for some types of planked vessels, there is no evidence for a strictly evolutionary interpretation, which consequently should be discarded.

Logboats, as described in Chapters 1 and 2, have been built and used in Europe from at least the Mesolithic until modern times. On the basis of assembled radiocarbon dates from around Europe, Lanting (1998) proposed that logboats originated and spread from two core areas (northwest Europe, and the northern Balkans) before 7500 BP. In Lanting's model, dugout vessels appear in Holland and Denmark before 6500 BP, and in Poland and the southern Baltic ca. 5000 BP. By 3000 BP, logboats were in use across all of Europe with the exception of northern Scandinavia (Lanting 1998:644). While Lanting's model is essentially uncontextualized (see critique in Section 2.1), the chronological range remains valid and useful. That logboats were used in Austria, Poland, and Finland in the early 20th century demonstrates the difficulty of typological dating of these vessels. A non-linear evolutionary perspective is even more significant when Czech logboat contexts (inland terrain and topographic transport zones) are taken into account (see Nymoen 2008). Vessel dating analysis should therefore be understood within the context of the local transport landscape.

Five Czech logboats (two from Bohemia and three from Moravia) have been dated by absolute methods. Several more vessels have been assigned tentative dates on the basis of context or close similarity to other dated vessels. The oldest dated example is the Mohelnice boat, constructed from a tree felled after 281 BC. It is certain, however, that dugout vessels were in use on Central European waterways far earlier. The oldest Polish logboats are dated to the Bronze Age, for example the vessels from Chwalimskie Bagno and Cieśle (both ca. 3700 years old) (Ossowski 2000a:61). On the basis of pollen analysis, Novotný claimed that the destroyed Jiřetín boats dated from the Bronze Age (1951:280; see Section 4.2). This analysis is apparently not published or available for critical evaluation, and while I consider it possible and even likely that logboats were utilized in Czech regions during the Bronze Age, more substantial evidence is needed.

Dates have been tentatively assigned to several vessels on the basis of close morphological and constructional similarity to dated examples. The Jaroměř logboat, for example, closely resembles Polish *Lewin*-type vessels, dating from the early centuries AD (Ossowski 2006). *Lewin*-type logboats, like the Jaroměř vessel, have square platform ends perforated by rectangular holes, and no internal partitions or transverse ridges. The identification of the Jaroměř logboat as such is supported by the geographic proximity of the discovery location to those of the *Lewin*-type vessels. *Lewin*-type logboats were previously known from three finds along the upper Oder (see Chapter 4). The identification of the Jaroměř logboat as a *Lewin*-type vessel extends the range of this category to Bohemia. Similar holes on the Oseček logboat may also indicate a constructional relation to the *Lewin*-type vessels.

The Mikulčice 2 and 3 logboats, excavated in 1967, were conserved in PEG and were not sampled for radiocarbon dating analysis. Ceramic vessels and an assortment of iron axes and blades found in close proximity to the boats were "safely dated to the 8th and 9th centuries [AD]" (Klanica 1968:63). The boats were lodged against causeway pilings in a former arm of the Morava River. Wood from the causeway bridge was dated by dendrochronology analysis to the last three quarters of the 9th century AD, and the river channel began filling with sediment and debris during the first half of the 10th century. The vessels can be roughly dated by this context, and radiocarbon dating of vessel 4, the final logboat discovered at the Mikulčice citadel, resulted in an age of 1180±40 (Cal AD 710-980) (GrA-9465) (Poláček 2000:206; Lanting 1998:639).

The Kolín 1 and Otradovice vessels have been radiocarbon dated to the 11th and 12th centuries (Cal AD 990-1160 and Cal AD 1170-1290, respectively, see Table 5.1). Constructional similarities between these two vessels as well as a number of other logboats from the Elbe River are apparent. The Kolín 1, Otradovice, Labětín, and Přerov nad Labem vessels were all constructed with little or no exterior shaping aside from the bow and stern, and retain a circular or semi-circular shape in cross-section. As with many vessels from the Elbe watershed, these boats all lack interior partitions such as bulkheads or transverse ridges.

The logboats from Spytihněv and Poděbrady (2) were likely constructed during a period from the Middle Ages to early modern times. The features indicating use as a one-person fishing vessel (i.e. bulkheads with thwarts, 'wet' and 'dry' internal partitions) are well documented from other regions (i.e. Ossowski 2000a:65), and are well preserved on these particular vessels. Constructional features of these boats are very similar to those of the Příkazy vessel, dated after 1537 AD (Rybníček 2006, see Table 5.1).

The Příkazy vessel is the youngest surviving dated Czech logboat. However, dugouts were recorded on the Elbe as late as the 1940s, when Novotný observed a vessel belonging to 'grandfather' Hulík in Kolín, who said the boat had belonged to *his* grandfather (1951:257-258). Logboats were also used in the modern era on Austria's Mondsee, Slovakia's Váh River, and on the Dunajec River in Poland. The results of dating analyses thus demonstrate that Czech logboats were built and utilized over a tremendous span of time – at least 2,300 years and very likely for much more.

Vessel	Cat. No.	14C Age	Date	Method	Lab No. or Reference
Mohelnice	24		After 281 BC	Dendrochronology	Kučerová and Peška 2004
Kolín 1	5	1030±40	Cal AD 990-1160	Radiocarbon	Beta-235738
Otradovice	12	780±50	Cal AD 1170-1290	Radiocarbon	Beta-237539
Mikulčice 4	35	1180±40	Cal AD 710-980	Radiocarbon	GrA-9465; Poláček 2000
Příkazy	25		After 1537 AD	Dendrochronology	Rybníček 2006

Table 5.1 Absolute dating of Czech logboats. Cat. No.

5.2 Distribution and Geography

There are records of approximately 40 logboats from the Czech Republic, 28 from Bohemia and 12 from Moravia. Twenty are preserved in museums or repositories, 13 in Bohemia and seven in Moravia.

Across the study area as a whole, one distribution pattern is immediately evident: prehistoric and early historic vessels have been found overwhelmingly along the banks and in the immediate vicinity of the respective watershed's dominant river, while discoveries along tributaries are quite few. In Bohemia, 19 vessels come from the Elbe itself, three from its tributaries, and several (possibly six) from the Komořany Lakes region. Those found on tributaries (two on the Jizera and a possible single find from the Orlice) were located within several kilometers of the confluence with the River Elbe. The pattern is similar in Moravia, where all recorded vessels (12) were found along the Morava River itself. The frequency of finds reflects not only actual prehistoric and early historic distribution, but modern usage and disturbance along heavily canalized or utilized segments of river. A map overview of logboat discoveries for both catchment areas is shown in Figure 5.1.

Within each region, clustering and patterns of distribution are also evident. In Bohemia, the highest elevation of a logboat discovery location along the Elbe River is 240 m asl (Černozice, findspot of the Jaroměř boat); the lowest is Libochovany at

140 m, for an average of one vessel every 10.5 km along a river distance of 231 km. The highest density of logboat finds is along the 70 km stretch of river between Kolín and Neratovice, accounting for 17 of the 22 vessels from the Elbe and its tributaries. The region of central Bohemia where this clustering occurs has historically contained the most productive agricultural land and hence high human populations.

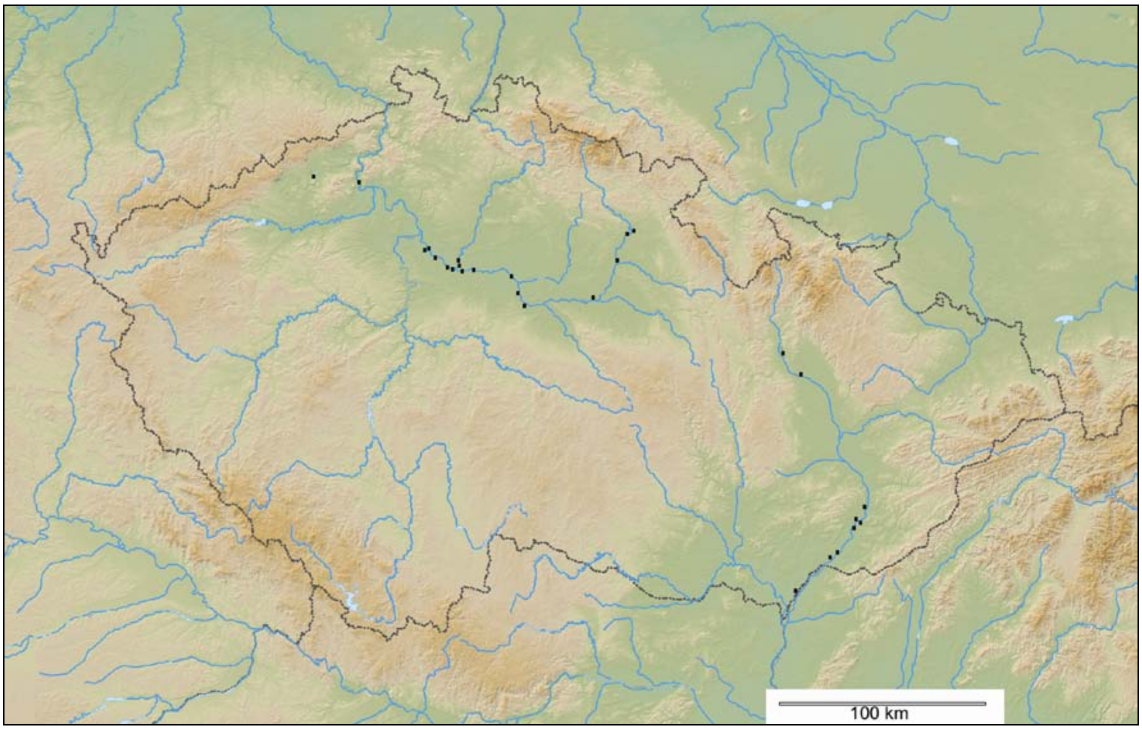


Figure 5.1 Logboat discovery locations in the Czech Republic. Detailed maps of each catchment basin are provided in Chapter 4.

In Moravia, the highest findspot elevation is Mohelnice (250 m); the lowest is Mikulčice (160 m), for a distance of 170 km along the Morava River (an average of one vessel every 14 km). Tight clustering of discovery locations is evident between Spytihněv and Mikulčice (a 60 km distance), accounting for 10 of Moravia's 12 logboats.

Importantly, although not surprisingly, in both regions the discovery clusters are in areas of high fertility soils resulting from post-glacial loess deposition and accumulation of river sediments. Such agriculturally productive regions have been attractive for human settlement since the Neolithic, and have always been areas of high population density. In addition to relatively dense settlement areas, both river systems were also essential corridors for traffic of people, cargo, and ideas.

During the medieval Slavonic Period, major settlements were located almost exclusively along the major rivers of the region. Several of the most important political and commercial centers were situated near locations where logboats have been discovered. In Bohemia, for example, the ancient Slavonic center at Libice nad Cidlinou and the ruined fortress of Oldřiš are both located along the 14 km stretch of the River Elbe between Poděbrady and Kolín, and less than a kilometer from Oseček (accounting for at least six logboat discovery locations). Libice was among the first Slavonic settlements in Central Bohemia, and became the preeminent stronghold of the Slavník dynasty. The Slavníks were defeated in the late tenth century by the rival Přemyslid clan, first kings of Bohemia. Following the Slavník defeat, the victorious Přemyslid dynasty established their own fortress at Oldřiš, just 5 km from the destroyed Libice. By the 14th century Oldřiš was abandoned and almost entirely swept away by a new course of the meandering Elbe River (Sklenář 1993:157). Both Libice and Oldřiš were well located to take advantage of and control the land and water communication routes through the populous and productive central Bohemian region.

The main Slavonic period settlements in Moravia were likewise located along the lower reaches of the Morava River, from Spytihněv nearly to the Danube confluence. Major early political centers at Staré Město and Mikulčice coincide, too, with concentrations of logboat finds.

5.3 Deposition and Discovery

Nearly all of the vessels described in this thesis were discovered unintentionally, most often during dredging or digging activities. Just four Czech logboats (the Mikulčice vessels) have been recovered from controlled archaeological excavations. Some contextual documentation was also achieved for the Mohelnice vessel and the logboat from Otradovice. Recovery circumstances for all other vessels are vague at best. However, some conclusions can still be drawn regarding depositional processes for the logboats in this study.

Some vessels were certainly lost in the course of everyday operation. Logboats can be quite unstable, and prone to sinking when overtopped and filled with water. It is likely that many of the vessels dredged from river bottoms were lost in this way. Artifact deposition may also attest to accidents, for example Zápotocký (1969) considered several of the large bronze hoards recovered from the Elbe in the 'Porta Bohemica' region to be the result of unintentional capsizing or sinking. Zápotocký's arguments are persuasive, and I consider this to be good evidence for utilization of major Czech waterways during the Bronze Age.

Interestingly, of those vessels recovered from controlled contexts, there are several indications of deliberate placement. The Mohelnice logboat, which was found upside down and wedged into a row of pilings, is the clearest example of intentional deposition. Logboats, due to their buoyancy characteristics and weight distribution, do not easily turn bottom-up and have a tendency to right themselves when submerged. Very few logboats have been found upside down; one notable example is the 10.5 m Vergulde Hand boat from Vlaardingen in South Holland (Eijskoot and De Ridder 2004, cited in Van de Noort in press). The Mohelnice vessel's bottom-up orientation and situation among the poles and pilings suggest that this boat was deliberately confined in this location. Reasons for such behavior may reflect formalized or ritualized boundaries or restrictions on travel, particularly in the highly significant watershed boundary in the vicinity of the Moravian Gate. Westerdahl (pers. comm.) also suggests that upside-down storage had a practical function, to prevent damage to the fragile gunwale edges.

Further indications of deliberate discard or even ritualized deposition may be found in accounts of vessels found 'trapped' or 'ensnared' beneath large branches or timbers. For example, the Holme Pierpont logboats from the River Trent in Great Britain were found pinned by oak branches and beams (McGrail 1978). Another example from Great Britain is the Fiskerton 2 logboat, which appears to have been ritually destroyed with a piece of timber through the hull pegging it to the ground (Van de Noort in press). Francis Pryor (2004:33) suggests similar ritual destruction in the case of the Shardlow (Nottinghamshire) logboat, which was sunk "jam-packed" full of boulders and sandstone blocks. Charlie Christensen (1990:123) records human skeletal remains found inside or alongside Scandinavian dugout vessels containing burnt offering and held in position by hazel poles thrust into the mud around the boat. Pointed sticks of hazel (*Corylys avanella*) were also found around the Tybrind Vig 1 logboat, which contained a 30 kg stone interpreted as ballast (Anderson 1987:88, 94). Of the Czech logboats, the vessel from Spytihněv was clearly documented as being trapped or pinned by the trunk of an 'enormous oak' (Hanák 1930:19). Although the deposition could conceivably have a natural explanation, the possibility of intentional placement cannot be ruled out.

One further example of likely deliberate discard among the Czech vessels is the Čelákovice logboat, which has a rectangular hole hewn in the bottom of the floor just aft of the forward bulkhead (see Figures 4.47 and 4.48 in Section 4.2). The purposeful cutting of such a hole would result in slow submersion as the vessel's interior filled with water, and could be hastened if the boat were loaded with rocks or other heavy material. Ritualized destruction of weapons and watercraft, especially in 'watery' places such as bogs, lakes and rivers, is fairly common from the Bronze Age onward. One particularly well-known example is the Hjortspring boat, which was deposited as a bog offering, likely as a victory sacrifice following a battle (Randsborg 1995; Crumlin-Pedersen and Trakadas 2003). Although the recovery circumstances of the Čelákovice logboat are vague and poorly documented, it is probable that the hole in the floor played some part in its deposition.

Van de Noort (2006, in press) has suggested that such treatment of boats has to do with past perceptions of the importance of travel. In this interpretation, a crew not adhering to the socio-political or cosmological boundaries of travel was punished with the ritual destruction of their boat. This behavior may have been particularly prevalent in the later part of the first millennium BC, as directional long-distance voyages were replaced by 'down-the-line' exchange of goods, ideas and people in defined segments and restricted regions (Van de Noort in press). The deliberate destruction of boats also suggests that at least some vessels were perceived as having 'agency' of sorts, linked to specific people or crews. Vessel building and construction gave life to the vehicle, which under certain circumstances or transgressions must then be 'killed'.

5.4 Construction Materials

Building a logboat starts with selecting a suitable tree. Ideal timber for a logboat has straight grain, little taper, durability, relatively easy working characteristics, and no 'shakes' (internal damage to the wood fibre from wind and weather). In addition, the tree should be situated where it can be easily felled in proximity to a watercourse (McGrail 1978:117). Many researchers have commented on the constraints raw material places on logboat design. Without addition or expansion, the builder can do nothing to fundamentally alter the height, breadth, or beam of a dugout vessel. Fewer limits are placed on length, although vessels with an excessive length to breadth ratio are quite unstable and handle poorly in the water. Fry observed that, "…whereas makers of planked boats are able to fit raw materials to suit the particular design of their craft, makers of single-piece hulls are obliged to adapt the design to the material at hand" (Fry 2000:14).

Nineteen of the surviving 20 Czech logboats were constructed of oak (*Quercus* sp.); the sole exception is the Otradovice vessel, built from Silver Fir (*Abies alba*). Across Europe, oak is the most common timber for use in logboat construction. There are many reasons for the prevalence of oak. In comparison with other species, oak has an ideal combination of size, grain, strength, workability and durability for building logboats (McGrail 1978:118). Regarding the durability of oak, it may be that this species simply endures longer in the archaeological record than other species (McGrail 1978:118; Switsur 1989:1017), although two of the oldest European logboats, from Pesse in the Netherlands (8th millenium BC) and Noyen-sur-Seine in France (7th millenium BC), were made of pine (*Pinus* sp.) (Ellmers 1996a:15; Mordant and Mordant 1992:61). Most pre-Bronze Age logboats were made from softer woods. The two logboats from Tybrind Vig in Denmark, dated to the 4th millenium BC, were fashioned from lime (*Tilia* sp.) (Anderson 1987), as were the three Swiss dugouts dating from the 6th millennium BC (Arnold 1993:5). The Early Bronze Age (3550±15 BP, 1940 – 1790 cal BC) vessel from the Degersee lake in Southern Germany was fashioned from alder (*Alnus* sp.)

(Mainberger 2009), as are the undated vessels from Aamosen, Denmark (Troels-Smith 1946).

It has often been assumed that while stone tools may have sufficed to work softwoods, metal tools would be required for hardwoods such as oak (McGrail 1978:36; Johnstone 1980:46). Reappraisal of this view has occurred since the discovery of oak vessels from the Stone Age, for example the ten Neolithic oak logboats found at Paris-Bercy in 1991-1992. In the case of the Paris-Bercy vessels, it is likely that the hollowing process was accomplished at least partly through the use of fire (Arnold 2006).

Oak was used extensively for the Bronze Age logboats from Lake Neuchâtel in Switzerland, but other species were also present, namely pine (*Pinus* sp.) and poplar (*Populus* sp.) (Arnold 2000:203). From a boat-builder's perspective, fir has the advantage of a long straight bole in mature examples, as well as being relatively easy to work and shape. Arnold (1982; also cited in McGrail 1987:30) remarks that silver fir splits easily along the growth rings. Steffy (1998:257) notes that silver fir, although not as durable as other timbers, was used for building ancient Mediterranean triremes because of its light weight and availability in great lengths.

5.5 Construction and Morphology

Description and analysis of vessel construction, form and morphology are among the most significant elements of the model presented in this thesis, and will here be examined in detail. The diversity and uniformity of Czech logboats represent skill sets and building practices of pre-modern populations, and are the key to tracing the spread and adoption of design traditions. Understanding the practices of vessel construction is therefore of great importance.

Prehistoric or non-literate boatbuilders did not follow engineering rules or calculations when constructing a vessel, and we must bear in mind that modern techniques of analysis are simply constructs that serve our interpretation. The process of building a boat was far more organic and often consisted of replication of the most successful or highly valued example available for first-hand experience or observation. In this way, "knowledge becomes technology…by virtue of a 'practical orientation to the material world'" (Ingold 1986:43). The boat builder "shaped the hull according to the lines established in his mind, more sculpture than engineering" (Westerdahl 2008:18). Boat building was thus a creative process, accomplished through the skill and experience of the builder. The cognitive aspects of design, construction and usage must therefore be consistently borne in mind by the modern investigator.

Both uniformity and diversity are apparent in watercraft design. Some elements of diversity are no doubt due to specialization; however, innovation and the adoption of new features or techniques are still problematic. As noted by Vandkilde (2007:12), 'culture' (defined as everything non-biological) tends to be transmitted from generation to generation. As such, it also tends towards conservatism and uniformity. Diversity in the form and features of material artifacts reflects cultural change. Boats are a particularly interesting type of artifact in this context, as being notably resistant to change in form. Specific forms and general morphology tend to be reproduced based on examples at hand, while still adapting to the unique characteristics of the parent material.

In the context of boat construction, conservatism of design characteristics is especially prevalent (i.e. Ossowski 2000b:280). The typical and inherent conservatism of maritime communities has been noted in numerous ethnographic studies of aboriginal communities, as well as modern day fishing ports (see for example Malinowski 1961; McKee 1983; Gilmore 1986). Persistence of design is a deep-rooted characteristic (perhaps even a defining feature) of small vernacular watercraft. Boats are built to a specific design, one which is demonstrated and verified through use and experience, and deviation from the accepted model is considered to be undesirable. New models or vessel types are suspect in craftsmanship or materials until thoroughly proven through use. This slow acceptance of innovations results in an ingrained attitude of "if it works, don't fix it", and steadfast retention of a limited number of designs. At a very basic level, there is a clear and compelling reason for retention of proven designs: if something goes wrong with the boat, the vessel's operators, passengers and cargo are put at great risk. Vessels made by builders who can produce a predictably reliable boat time after time are copied and emulated, thus discouraging proliferation of design. The forthcoming generations are conditioned to appreciate "proper" boat features and qualities through experience and exposure to the preferences of peers and elders (Gilmore 1986:19, 47).

Boat builders and operators are intensely aware of minute details and characteristics not just of their own boats, but of the general corpus of vessels being operated in the area. This is no doubt at least partly due to the oral lore and intense interest that even in modern times permeates boat-building and -using communities. Early ethnographic accounts of maritime communities are especially striking in this regard. In *Argonauts of the Western Pacific*, Bronislaw Malinowski describes the building, naming, and launching of a new Trobriand dugout canoe:

> The canoe, painted and decorated, stands now ready to be launched, a source of pride to the owners and to the makers, and an object of admiration to the other beholders. A new sailing craft is not only another

> utility created; it is more: it is a new entity sprung into being, something with which the future destinies of the sailors will be bound up, and on which they will depend. The canoe receives a personal name, it becomes an object of intense interest to the whole district. Its qualities, points of beauty, and of probable perfection or faultiness are canvassed round the fires at night. The owner and his kinsmen or fellow villagers will speak of it with the usual boasting and exaggerations, and the others will all be very keen to see it, and to watch its performances (Malinowski 1961:146).

Malinowski also recounts the later use of the canoe, and the complex communal association with its 'toli-waga' (owner):

> The natives, to whom the Kula and the sailing expeditions are so important, will associate the name of the canoe with that of its toli-waga; they will identify his magical powers and its good luck in sailing and in the Kula; they will often speak of So-and-so's sailing here and there, of his being very fast in sailing, etc., using in this the man's name for that of the canoe (Malinowski 1961:118).

Similar knowledge and interest is apparent even in the modern Western context. Referring to the fishing port of Coos Bay, Oregon in the mid-1980s, Janet Gilmore wrote:

> Locals who have not necessarily worked a particular boat frequently know a boat by name, know its location and usually its present owner and possibly past owners, and know something of its physical makeup, general condition, handling characteristics, and present and original uses. At the slightest provocation they can rattle off some of the more idiosyncratic or striking features of a specific boat and its history, or they may offer an opinion regarding how well it is kept up, or whether it is a pretty, ugly, strongly built, or a ludicrous example of a commercial fishing vessel (Gilmore 1986:113).

Individual boats thus achieve personalities and acquire associations and life histories, which are incorporated into the oral lore of the community. This propensity is strikingly illustrated in the case of Maori war canoes, which were given names and recorded in the genealogies describing the history and ancestry of a clan. Some Maori canoes were even regarded as personifications of important gods (Lewis and Forman 1982).

The tendency to perpetuate a successful design is common to maritime communities around the world. The mechanics of this tendency are shown by recent examples of logboats from the Bug River and Kashubian Lakes district of Poland (dating to the 1980s and even into the 1990s). When a builder is ready construct a new logboat, he chooses the exact vessel he wants to reproduce, and uses it as a model. Placing the existing vessel next to the parent log, he uses it as a guide to inscribe the vessel profile and outline directly onto the trunk. Then hoisting it above the trunk, he does the same in plan view. Rough shaping and reduction of the parent trunk is done with a chainsaw, using the inscribed outlines as a template. The fine shaping and finishing is subsequently performed with hand tools, especially adzes. Although technology has changed, the design process remains identical to that used for millennia. Preferred designs are thus propagated and spread by direct replication (Ossowski 1999:52; 2006; see also Greenhill and Morrison 1995:102).

Long term continuity of design tradition is especially apparent in regions such as Scandinavia, where long convoluted coastlines, numerous islands, and rugged interior topography have made people dependent on ships and boats for millennia. Scandinavia has been particularly well-studied from an archaeological point of view (in both constructional and symbolic contexts), demonstrating the remarkable lineage and endurance of local and regional boat-building (i.e. A. Christensen 1996; A. Christensen 2000; Crumlin-Pedersen and Thye 1995; Crumlin-Pedersen 1999; Westerdahl 2008). In some rural areas, boats are still being constructed by these methods, providing unrivalled ethnographic evidence for the retention of proven technology. As Arne Emil Christensen (1996:77) has noted, "Scholars studying ancient Scandinavian naval architecture are in a privileged position among archaeologists; 1500-year old technical solutions can be explained by living craftsmen who still use them."

Given the above-mentioned tendencies for conservatism and persistence of design, the occurrence of variations in construction, form, and morphology is particularly interesting and requires explanation. Forms may vary depending on intended utilization, technological parameters, or stylistic conventions. Forms may also change over time depending in response to external factors such as climate and geography. McKee (1983:18) has suggested that if all physical and social elements of a given environment are being satisfied, then change to watercraft design will be minimal. Yet boat types are not static, and if changes in the operating environment are not responsible, then one must seek answers in the social or even political milieu (although see O'Sullivan (2003), who suggests that continuity and conservatism may demonstrate the ability and will of local communities to deliberately continue customary practices in the face of change). The question of social identity in various wetland or maritime communities has been explored both in archaeological (i.e. Coles and Coles 1989; O'Sullivan 2003; Van de Noort and O'Sullivan 2006) as well as ethnographic contexts (Smith 1977; McCay 1978).

Morphological variation in watercraft design may have functioned as an element of community identity as well. In the inland context, Novotný (1951:262) noted that in parts of Russia and Eastern Europe, logboats (and watercraft in general) were named after the river system or lake where they were built and sailed; a boat from Lake Ilmen would thus be called an 'Ilmen-er', and so forth. This particular naming tradition indicates both that vessels from different watersheds had different morphologies, and that the varying design elements were clearly distinguishable and recognized by the knowledgeable observer.

Variation in logboat form is especially interesting, as morphology is inherently limited by the dimensions of the parent material (i.e., a tree trunk, see Section 5.4). Without addition or expansion, the builder can do nothing to fundamentally alter the height, breadth, or beam of a dugout vessel (McGrail 1987:66, Fry 2000:14). Within these parameters, however, a considerable amount of variation is possible as regards construction, shaping, internal and external features, and so on. Consistent application of particular elements and details can be taken as evidence of specific local customs or construction technologies. It should also be emphasized that the use of specific constructional features does not necessarily imply technological development or progress; rather it demonstrates the transfer and adoption of a certain skill set or combination of design elements.

Czech logboats exhibit a variety of forms and features (see vessel plans in Chapter 4). The complete examples range from 3.62 m to around 14 m in length, and 50 cm to 130 cm in width. The largest grouping is the 6-8 m category, and the next largest is the 8-10 m group. Construction styles vary considerably, as do features and morphology.

Substantial uniformity within local territories is common. For example, the construction and morphology of many vessels from Bohemia's central Elbe region is quite similar. Logboats from Labětín, Kolín, and Přerov nad Labem were all hollowed from single oak logs, retain a circular or semi-circular shape in cross-section, and lack bulkheads and transverse ridges. Internal partitions are present on many other vessels, as are various holes and perforations. Hull form varies as well, from a U-shape reflecting the parent trunk (Labětín, Přerov, Kolín 1) to vessels with straight sidewalls and a sharp chine (all three Poděbrady boats, Brandýs). The Mikulčice boats all have U-shaped hulls narrowing to a V-profile at the bow (and sometimes stern). The Jaroměř vessel is square both in plan and cross section, matching the Polish *Lewin*-type logboats. Details such as platform ends (Mohelnice, Uherské Hradistě, Kolín 2) and a steering oar notch (Kolín 1, Staré Město) occur on vessels from both major Czech watersheds.

One category in particular illustrates uniformity and diversity of Czech boatbuilding skills, technology and traditions: the presence or absence of internal features or partitions such as transverse ridges or bulkheads. A comparison of selected features from surviving Czech vessels is provided in Table 5.2 below (in the order presented in Chapter 4):

Vessel	**Cat. No.**	**Region and River System**	**General Description**	**Ridges or Bulkheads**
Jaroměř	1	Bohemia – Elbe	Complete	None
Labětín	4	Bohemia – Elbe	Stern missing	None
Kolín 1	5	Bohemia – Elbe	Complete	None
Kolín 2	6	Bohemia – Elbe	Nearly complete	2 Ridges
Oseček	7	Bohemia – Elbe	3 fragments	7 Ridges
Poděbrady 1	8	Bohemia – Elbe	Floor fragment	2 Ridges
Poděbrady 2	9	Bohemia – Elbe	Nearly complete	1 Bulkhead
Poděbrady 3	10	Bohemia – Elbe	Floor fragment	2 Ridges
Přerov	11	Bohemia – Elbe	Fragments	None
Otradovice	12	Bohemia – Jizera	Bow section	None
Čelákovice	14	Bohemia – Elbe	Stern missing	2 Ridges and 1 bulkhead
Toušeň	15	Bohemia – Elbe	Nearly complete	2 Bulkheads
Brandýs	16	Bohemia – Elbe	Floor fragment	2 Ridges
Mohelnice	24	Moravia – Morava	Complete	4 Ridges
Příkazy	25	Moravia – Morava	Complete	1 Bulkhead
Spytihněv	26	Moravia – Morava	Complete	1 Bulkhead
U. Hradistě	28	Moravia – Morava	Nearly complete	Floor Blocks
Mikulčice 1	32	Moravia – Morava	Bow only	1 Ridge
Mikulčice 2	33	Moravia – Morava	Complete	2 Ridges
Mikulčice 3	34	Moravia – Morava	Complete	3 Ridges
Mikulčice 4	35	Moravia – Morava	Torso	2 Ridges

Table 5.2 Presence and absence of internal partition features of Czech logboats.

Variation is considerably more apparent when comparisons are made between logboats from different watersheds. All vessels found in the Morava River watershed and catchment area feature some form of internal division such as ridges or bulkheads. In Bohemia, five of 12 surviving vessels have no ridges, bulkheads, or any form of internal division. Moreover, dating shows that at least two of the Bohemian logboats in question (Kolín and Otradovice) are more or less contemporary with the Mikulčice vessels of the 10th to 12th centuries AD, all showing evidence of highly developed internal space demarcation. Designs including transverse ridges and other features indicating demarcation of internal space were persistently utilized by Moravian boatbuilders, while a separate tradition prevailed in Bohemia. The distribution of vessels with internal partitions reflects local boatbuilding techniques and traditions specific to each region.

Design traditions and vessel features representing internal partitions are known throughout Europe (McGrail 1987:75). Transverse ridges or ribs cut from the solid are seen on many European logboats and have even been reported on dugouts from Asia (Hornell 1946:187) and North America (Wheeler et al. 2003:540). The function and utility of transverse ridges remain controversial. Most early investigations asserted that ridges would strengthen the vessel (Munro 1882:9, Fox 1926:129, Nechvátal 1969:812). This view was challenged as researchers realized that ridges cut across the grain would have little effect on transverse strength (Clark 1952:287, McGrail 1987:75), although Owain Roberts (2004:41) contends that ridges are a "reinforcement of the weak angle between the bottom and sides". Greenhill (1995:102) considered it likely that ridges provided a toe-hold and helped the crew avoid slipping on wet wood. Alternate explanations include ridges as skeuomorphic representations of (bark canoe) frames (Hornell 1940:118; 1946:187), spacers for floor planks (Clark 1952:287), and demarcation of various types of functional space (Beaudoin 1970:76-87). McGrail, while tending towards the latter view, noted, "The precise function of each space may never be known…" (1987:76).

In any case, the presence or absence of internal features is of great significance when examining the spread and adoption of construction styles. These are two quite different conceptually approaches to vessel design, possibly reflecting profound differences in technological and social concepts. All known Moravian vessels were constructed with internal partitions or other internal demarcation features, while nearly half of the Bohemian vessels have none (Figure 5.2). A clear geographic dichotomy exists, which can be explained as evidence of localized boatbuilding culture. The spread and adoption of varying morphology and features reflects both continuity and diversity.

Due to lack of dating and the difficulty (if not impossibility) of establishing chronology based on typology, it is not possible to say which style was earlier. It may not even be possible to say that one style was native and the other imported. The presence of internal partition on all Moravian logboats, but only half of the Bohemian vessels, may indicate that the construction style transferred from east to west. For reasons that are subject to speculation, the reverse did not occur. A very broad and generalized statement may be made about a long-term flow of social structures and technology in prehistoric Europe from south-east to northwest (cf. Sherratt 1997), as design traditions were carried along rivers and were transferred from watershed to watershed. The construction pattern seen in surviving examples of Czech logboats is a reflection of the long-term meeting and mixing of skills in the Bohemian basin and Morava River valley.

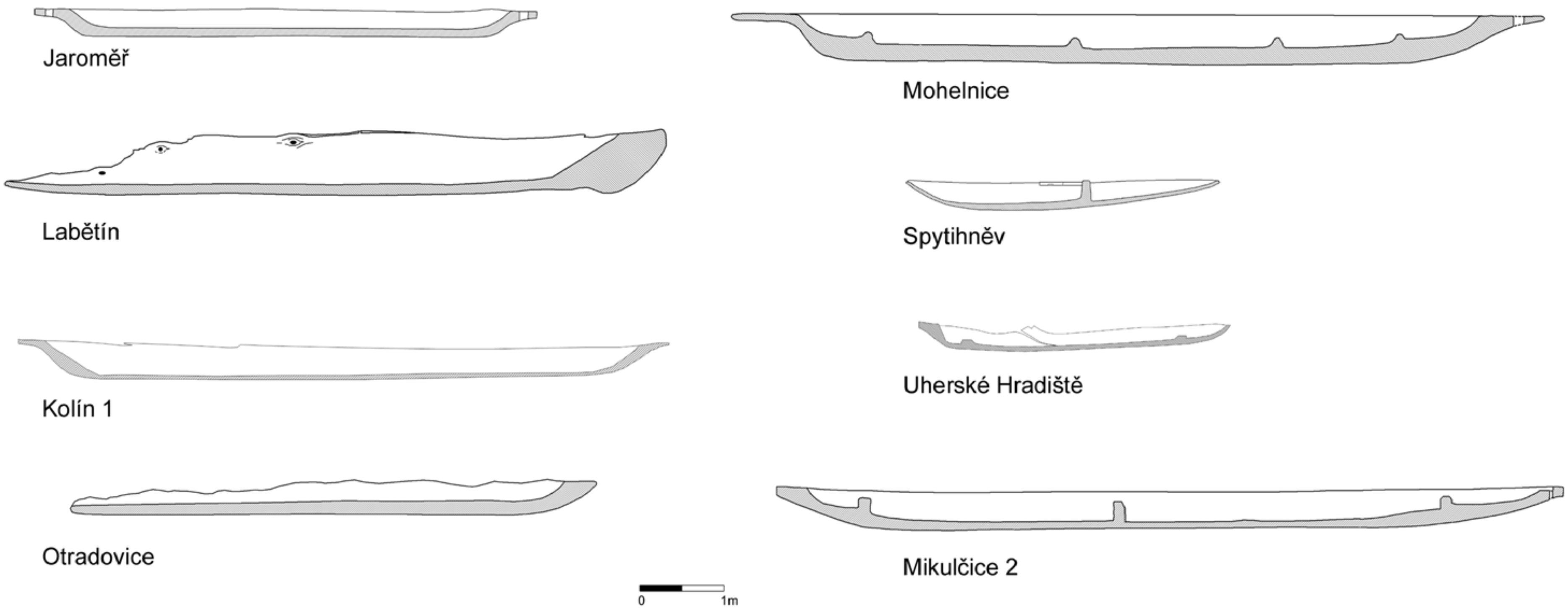


Figure 5.2 Cross-sectional viewsof logboats from Bohemia (left), and Moravia (right), showing internal features and partitioning.

5.6 Utilization

The utilization of logboats (i.e. what did they carry, and how much?) has been an obvious and oft-repeated question (McGrail 1987; Fry 2000). Basic indicators are size, location, carrying capacity, and internal and external morphology and features. There are some indications that size may be taken as a rough indicator of function; i.e. smaller and more maneuverable boats were likely used for fishing and local resource procurement, and larger vessels for cargo or transport. Ossowski (2000a:64) has postulated three basic categories of Polish logboats, differentiated by size: small, one-man dugouts for fishing (approximately 3-5 m in length); medium sized craft for transport (6-11 m); and large boats (often paired), used for moving cargo (10 m and larger). Two of the largest logboats known from the British Isles are the Late Bronze Age Brigg and Iron Age Hasholme vessels, respectively 14 m and 13 m in length. Based on the size and discovery locations, Owain Roberts supposed that these boats were intended for estuaries rather than rivers, as their dimensions would make them "unhandy in rivers, where even turning could be fraught with the possibility of capsize" (2004:46). A more persuasive argument, I believe, is that vessels this large are intended for, and used by, social structures larger than that of a single household. Smaller boats, capable of being used by an individual or two, could serve a single family for subsistence needs. Larger vessels, requiring much greater outlay during construction and a large crew for operation, would likely perform a different function. The 14 m Oseček logboat, for example, was clearly used in a river (the Elbe), although almost certainly for cargo transport rather than fishing, and possibly as part of a paired vessel. Construction, maintenance and utilization would likely have occurred at the village or community level.

Ethnographic evidence from other regions of the world is in general agreement regarding the functionality of interior riverine watercraft. For example, North American birch-bark canoes in use on Canadian lakes and rivers at the time of European contact were used both for fishing and transport, and measured between 3.6 and 5.8 m in length. Some extremely large examples measured up to 8 m. Following European colonization and the development of the fur trade, cargo requirements increased considerably, and the massive '*canots du maître*' were developed. The largest of these, the '6-fathom' canoes, measured just over 11 m in length, required a crew of 7-12, and could carry over 3.5 tons of cargo (Adney and Chappelle 2007:145-147). These large vessels were used exclusively for transporting bulky and heavy cargos. Boats this big belonged to entire tribes, groups of specialists, or in the case of the *canots du maître* were commissioned and owned outright by European fur-trading companies.

In general, the evidence suggests that the difficulty in handling and maneuvering a vessel larger than about 8 or 10 m on inland rivers indicate that transport rather than fishing was the likely primary purpose of these boats (cf. Novotný 1951:262). Both subsistence and transport are considered in detail below.

Subsistence Activities:

Logboats were undoubtedly used for resource procurement activities. Fishing, hunting, and other marine resource extraction strategies were made possible or greatly enhanced by the development of suitable watercraft. Ellmers (1996a:11) suggested that the first boats in Central and Northern Europe were used to hunt reindeer at the end of the last Ice Age, as these animals are easy to kill by spear when they swim across a river or lake. There are modern ethnographic analogies to support this supposition; for example the inland Nunamiut Eskimo of Alaska, whose main subsistence food until very recently was caribou hunted while swimming in lakes (Zimmerly 2000:69). In Ellmers' interpretation, the European reindeer-hunters turned to fishing during the Mesolithic and found their boats to be extremely useful for a wide range of marine subsistence and resource extraction activities. Aquatic resource utilization in general gained in importance during the Mesolithic (Tringham 1974; Mithen 1994). As long distance trade routes developed, the technology was adapted and utilized for these new purposes.

Ellmers' hypothesis and chronology may be disputed, but clearly logboats and other watercraft were used for maritime resource procurement throughout prehistory, and indeed up to the modern era. As the road network became more established from Roman times onward, the significance of wheeled transport became greater (at least for military purposes). The use of watercraft for cargo and transportation did not diminish, however, and boats continued to be extensively used for local subsistence and communication. The likely primary purpose of at least three vessels in this study (Příkazy, Spytihněv, and Poděbrady 2) was fishing. On the basis of net weights and fish traps found nearby, Andreska (1975:136) asserted that the Mikulčice logboats were also mainly used for fishing. However, in view of the Mikulčice citadel's island location and function as a major market and trade center (Poulík 1975) it is likely that these vessels were also intended for a transport role. A 10 m vessel would be quite unwieldy as a fishing boat on a river; size alone seems to rule out subsistence as the main purpose of the Mikulčice logboats. There are at least eight vessels in this study with lengths of around 8m or greater, and several more whose original size was likely in the same range. I consider that these boats were intended primarily for transport of goods or people, likely in the context of trade and exchange.

Transport, Trade and Exchange:

Trade and exchange offer external stimulation to a community or society, as well as economically important commodities. Curtin (1984:1) suggested that such stimulus is the single most important source of change and development of culture and society. Material culture, especially those objects made of exotic materials or displaying the influence of foreign technologies, is evidence of trade and exchange. The spread of specific material assemblages (i.e. LBK, Beakers, and other ceramics, weapons and ornaments, metals, etc.) and the transport of essential or luxury commodities (flint, salt, furs, metals, amber, wine) all require a conveyance mechanism. The processes of trade and exchange, responsible for importation of exotic objects and materials, are similar or identical to those responsible for the transfer of information and ideas.

Extensive research has been undertaken investigating various details of prehistoric trade and exchange (e.g. Childe 1950, Clark 1952, Sabloff and Lamberg-Karlovsky 1975, Earle and Ericson 1977, Curtin 1984, Scarre and Healy 1993). Clark (1952:241) suggested that the ultimate origins of trade lay in the desire of migratory peoples to maintain supplies of materials to which they had become accustomed but which were no longer immediately available. *Spondylus* shells, native to the Black Sea and the Aegean but distributed archaeologically throughout the Danubian loess lands, are offered as an example of early long-distance trade to meet older traditional cultural needs. An alternate view is that the exotic nature of *spondylus* ornaments is exactly what made them attractive to resident Danubian populations. In addition to objects of personal adornment, early trade items also included raw materials for production and manufacture of tools and weapons. Flint, obsidian and other lithic materials were especially highly valued in this context. Bulk manufacture at the source would imply extensive trade networks and considerable transport needs. Sustained long-distance contacts, not only between northern Europe and the Mediterranean but also within temperate Europe, served both to transfer goods and products as well as skills and technology.

Trade, as Colin Refrew (1979:28) has noted, consists of two kinds: material commodities whose natural occurrence or distribution is limited, or those, which through superior know-how are produced in a limited area. Trade of commodities of any type may also have the secondary effect of transferring knowledge and skills, as people see first-hand unknown products and materials, or methods of production and manufacture. This applies not only to the commodities being traded, but also to the vehicles of trade themselves.

Trade and exchange at a distance requires transport. Water transport is the most efficient means for moving heavy, large or bulky items. Various analyses demonstrate the effectiveness and even necessity of moving such cargos by water (i.e. Cederlund 2000, Teigelake 2003, Bass 1972:9-10, etc). The results show the tremendous advantages of waterborne haulage: Bass (1972:9) calculates that the cargo carried by a 35-foot birch bark canoe would require 35 men if carried overland, and that of a small Norwegian sloop sailed by two men and a boy would be equal to 110 sledgeloads or 340 packs for horses. The estimated carrying capacity of the Mohelnice logboat is 1077 kg (Rogers 2009); hauling this load by land would require at least 12 people or 6 horses (and their handlers). Teigelake (2003:156) calculates that even in Roman times, land transport was over ten times more costly than inland water transport, while sea transport was more than 60 times cheaper than land haulage.

Cargos likely to have been moved by water include heavy and bulky items such as salt, grindstones, ores and metals (especially tin, copper and iron). Considerable movement of metals, both in ore or ingot form, took place beginning in the Bronze

Age (Harding 2000:195). Grindstones at Staré Hradisko in Moravia were imported from distant regions such as Kunětice (100 km distant) and Lovosice (240 km distant) in Bohemia, and Austria's Burgenland (220 km distant) (Čižmář 2002a:45) (Figure 5.4).

Salt was being mined at Hallstatt and Dürrnberg in Upper Austria's Salzkammergut since at least the late Bronze Age (Harding 2000:253). Massive quantities were produced and exported, requiring reliable bulk transport. The previously mentioned Raffelstetten Codex (903-904 AD) testifies to the importance of waterborne transport of this commodity in the early medieval period (Třeštík 1973:874, see Section 3.4).

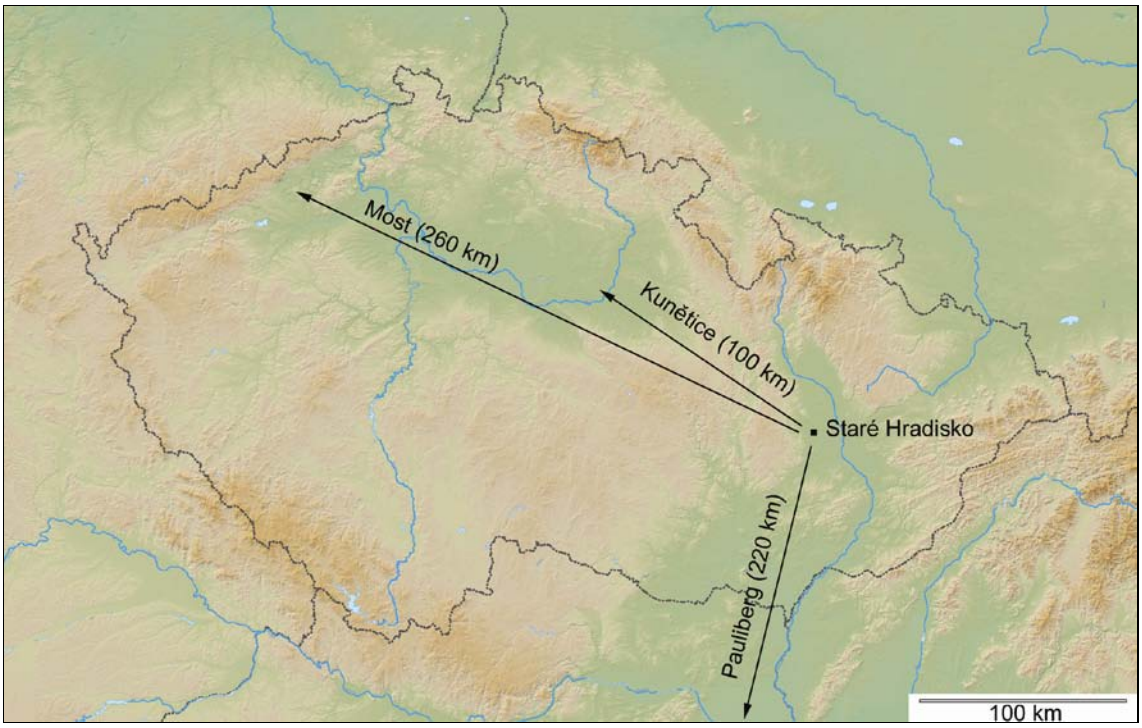


Figure 5.3 Grindstones found at the Staré Hradisko *oppidum* in Moravia were imported from as far as Austria's Burgenland and western Bohemia. (after Čižmář 2002a:45).

The Austrian salt was imported for use in the population centers of Great Moravia. The most significant Great Moravian settlements were the 'ringwall fortresses' constructed along the rivers of south Moravia. Archaeological investigations have been conducted at several sites, including Mikulčice (see section 3.4, also the Mikulčice logboats in Chapter 4) and Staré Město, both on the Morava River, and at Pohansko u Břeclavi, on the Dyje River. Recent investigations at Pohansko have determined the origin of the stone used to construct the impressive fortifications surrounding the core of the settlement. Tremendous amounts of materials were utilized – the excavators estimate that approximately 5100 m^3 of limestone slabs were used in the walls, weighing approximately 13,500 tons in total. The rock was quarried in the area of Holíč and Skalica (on the Morava's east bank, now in Slovakia), and transported overland to Mikulčice. Boats were used to carry the material some 25 km downstream to the Morava's confluence with the Dyje, and approximately 12.5 km back upstream along the Dyje to Pohansko (Macháček *et al*. 2007:303-304). The necessity and significance of watercraft in this context is obvious.

Other goods imported or carried through Central Europe from long distances include luxury items from the Mediterranean, furs from the northern taiga, and Baltic amber. Amber is particularly interesting in this context, as Moravia lies on the main 'Amber Road' leading from the Baltic to the Mediterranean. The earliest amber known in Moravia are fragments dating to the Magdalenian Paleolithic, found in Levels 5 and 6 at Kůlna cave in the Moravian karst (Mrázek 1996:30). Analyses demonstrating that amber in Mycenaean and Greek graves originated along the Baltic coast are well documented (e.g. Harbottle 1982; Harding 1984). Kristiansen and Larsson (2005:139, 186) suggest that the amber trade was a main element of the Scandinavian Bronze Age, connecting Europe's northernmost regions to the Aegean. Vandkilde (2007:103) noted that the large scale of the bronze trade meant that both bronze and amber likely travelled as valuable commodities as well as elite gifts. At the southern end of the amber road, a cycle of trade, prestige and power based on the possession and use of longboats were the economic and social basis for Cycladic island communities during the EBII (Broodbank 1989).

Amber was highly valued not only as jewelry, but for use in medicaments, was burnt during ritual ceremonies, and used for protection against disease and bad magic. Ancient writers spoke of the material in connection with solar deities, especially the 'Hyperborean Apollo' (Bouzek 1990:141). Amber comes in various qualities: transparent, cloudy, osseous, etc., each containing a larger or smaller amount of air bubbles. Ancient peoples valued transparent amber with a minimal amount of air bubbles above all (Du Gardin 1993:132-133). Its appearance in graves indicates high wealth and prestige. It had incredible value linked to its social and ritual role, and could be profitably traded over enormous distances. The distant northern origin of Baltic amber added to the substance's mystique and allure.

Based mainly on cemetery and grave goods, De Navarro (1925:484) proposed two main transport routes for amber: the Central or Western Route running south from Denmark to the Elbe, up to the Vltava, and over the Bohemian Forest divide to the Danube; and the Eastern Route from the Polish Baltic coast up the Oder, through the Moravian Gate, and down the Morava to the Danube (Figure 5.4). Childe (1957:128) suggested an extensive trade network linking the Baltic and Central Europe in a commercial system with branches to the tin-lodes of Cornwall and the gold deposits of Transylvania (although completely bypassing the Balkans). Later evaluations (i.e. Milisauskas 1978:226; Mrázek 1996:96-99; Čižmářová 2004:65) have refined and revised these routes, which probably also included a later course around the northern curve of the Carpathians to the Black Sea (Ossowski 2003:182).

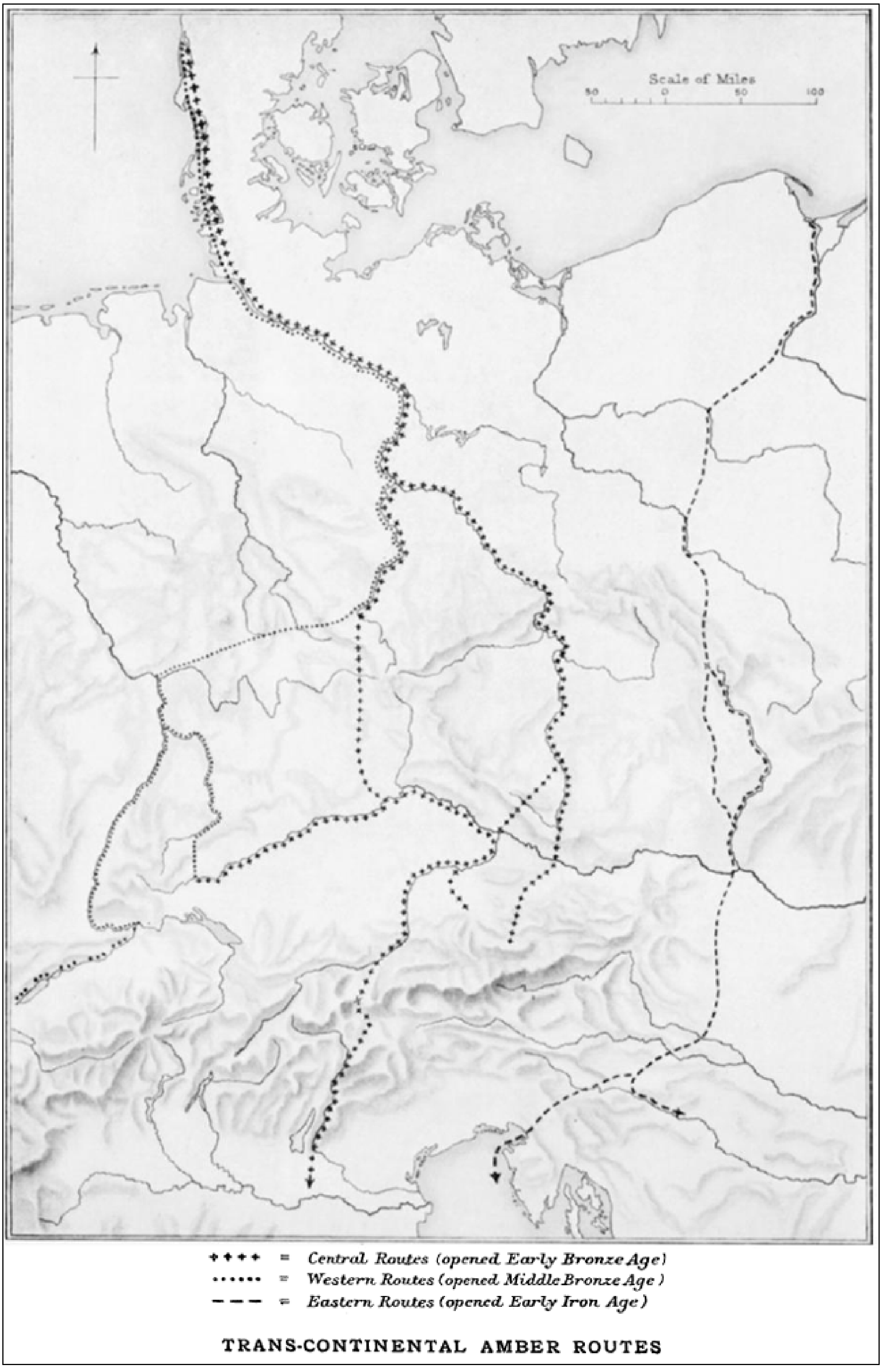


Figure 5.4 J.M. de Navarro's map of the amber routes from the Baltic to the Mediterranean. In de Navarro's analysis, both main routes cross the Czech lands: one up the Elbe and Vltava and overland to the Danube, and one up the Oder and down the Morava (de Navarro 1925:484).

In Bohemia, amber is present but rare in the Neolithic period (i.e. Ehrich and Pleslová-Štiková 1968:179), but is not uncommon in late Tumulus or Early Urnfield times (Harding *et al*. 2007:78). Amber and gold are such common features in Únětice graves that De Navarro (1925:486) supposed the Bohemians traded local tin for Jutland amber, and the amber for Transylvanian gold. The exact relationship between metals production and the amber trade is not clear, although the first wide dispersal of amber from the Baltic region coincided with the initial large flow of metals (and associated technologies) from the south. Vandkilde (2007:118) asserts that the exchange of metals and amber firmly incorporated the north into the European Bronze Age, linking Scandinavia with the Mediterranean via Central Europe.

Although the substance is found in graves and settlement sites throughout the Czech Lands, amber distribution is especially apparent along the Morava River corridor (Květ 2002:23-25). Over a thousand amber beads were found in the Hallstatt levels in the cave at Byčí Skála (on the Morava's tributary Svitava), along with bronzes of Mediterranean origin (Mrázek 1996:89; Podborský 2004:197-200). Čižmářová (2004:65) reports that a "large piece of raw amber, together with Greek coins" was found at Pustějov, in the Moravian Gate region less than one kilometer from the present banks of the Oder River.

Oppida in Bohemia and Moravia, dating to around 200 BC or later, were centres of trade and craft, and the amber trade was particularly significant for Moravian settlements of the period (Bouzek 2003). Large quantities of amber in various stages of finish were found at the Staré Hradisko *oppidum*, clearly a center of manufacture and transshipment (Čižmář 2002a:38). Raw amber stores at Staré Hradisko were so great that the location was known from the 16th century, and J.A. Comenius marked it on his 1627 map of Moravia as '*Hradisco, ubi myrrha effoditur*'

(Hradisko, where myrrh [amber] is found) (Čižmář 2002a:8). Further north, a logboat from Serachowice in Poland was supposedly unearthed still containing its cargo, "blocks of amber and a bag of Roman denarii" (Cynkałowski 1961, quoted in Ossowski 2000a:60). These examples demonstrate that the 'Amber Road' was not necessarily a road; along much of its length it was a river.

5.7 Other Motives and Aims: Distance, Prestige, and Ideological Factors

Evidence for symbolic usage of Czech watercraft can be difficult to ascertain from the many finds lacking adequate discovery context. The Mohelnice logboat stands out in this respect, as the unusual context was fully recorded (see description in Chapter 4 as well as analysis in Section 5.3). However, even for vessels removed from context, evidence for symbolic significance may be investigated through other means. The very presence of large boats intended for cargo transport or simply as prestige items may be helpful in this regard. The simple ability to travel long distances may be highly significant in and of itself.

For example, Mary Helms (1988) has suggested that long-distance travel can imbue powerful foreign knowledge on the traveler. Exotic prestige items are the tangible embodiments of this foreign knowledge and power, and can be used to enhance the status of local elites. Control over the flow of exotic goods is therefore extremely powerful within local communities. This does not necessarily set up an opposition between the symbolic and ritual aspects of trade and exchange on one hand, and practical commodities on the other. Indeed, as Renfrew (1993:10) has pointed out, "it is the conjunction of the two that is so powerful, and in the formation of that conjunction that concepts of value, and of the symbolic power of material goods are developed."

Ritual behavior, often formalized, leaves traces in the archaeological record, resulting from physical actions of people in the past. Richard Bradley (2005:119) views such acts as "performances…composed out of elements that had a wider resonance, for this is how they would have gained their social significance and why they could have been understood." Analysis of ritual behavior, and factors such as prestige and ideology, can help to bring out details relevant to information spread and transfer.

Social rather than economic needs were responsible for creation and maintenance of high quality prestige items. Material objects, especially high-status trade goods, are recognized as having "…a symbolic value which transcends any of the dimensions of their physical or material existence" (Renfrew 1993:15). The flow and consumption of these items "was clearly vital to social reproduction as much as material survival" (Sherratt 1997:139). The proliferation of items with ritual association, especially those indicating social rank in the Bronze Age and later, was made possible by long distance trade and exchange in which information-carrying items took precedence over more basic commodities.

A related motive for long distance travel was the belief that things, information, and experience obtained from afar have great potency. Beyond trade and exchange, the journey itself, bringing the individual to distant and new places, can enhance prestige simply through exposure to exotic strangeness. This idea has been most fully articulated by Mary Helms (1988), who espoused the concept that in traditional societies, esoteric knowledge and elite goods obtained through long distance travel formed an important part of the corpus of material controlled by learned political-religious elites. Long distance travel was thus highly significant not only for tangible economic reasons (import/export of essential subsistence and trade goods), but also for intangible non-economic purposes (acquisition of esoteric knowledge, legitimizing and validating the positions of elites).

The vessels that carried the people and goods, literally as vehicles for obtaining status and wealth, surely manifest symbolic value as well. During the Bronze Age especially (and especially in Scandinavia), the ship became a symbol of "the long journey" (Vandkilde 2007:103), equated with voyages to the gods or ancestors (Helms 1988; Van de Noort 2004, 2006). Coastal communities, or those along major riverine transport corridors, were often gateways for social and economic exchange. In this respect, Jeanne Arnold (1995) has suggested that watercraft came to play a significant role in "facilitating practical as well as symbolic exchanges that ultimately stimulated increased integration. As tools representing wealth and high standing within a community, sophisticated forms of watercraft could become part of the strategy of aspiring elites to dominate others." Watercraft were central for many people's understanding of the world, and their place in it. This concept is well expressed by Barry Cunliffe: "In such a system those able to command the vessels and the navigational skills were the important people" (2001:207), and by Flemming Kaul: "The ship [was] a paramount symbol of everything powerful and positive…the general vehicle of status and power, both earthly and divine" (1998:111). Due to size limitations and the availability of other potential means of transportation, Central European watercraft likely never assumed the highly charged religious-mystical symbolism that boats were accorded in some regions (e.g. Bronze Age Scandinavia). Nonetheless, the skills and abilities needed to construct and operate a boat would have made their builders people of significance to the communities that relied on them for subsistence, trade, and communication.

Certain goods and skills were charged with prestige and status simply due to their distant origins. Kristiansen and Larsson (2005:139) envision elite travels and trading ventures over long distances, creating lines of exchange linking the Bronze Age Mediterranean with Scandinavia via Central Europe. Political and religious leaders acquired and maintained their stations via access to distant knowledge, objects, and magic. The rapid spread of metallurgy across the continent was one result; new ideologies and social structures was another. The element of physical distance requires physical transportation, which in many parts of prehistoric Europe meant traveling by boat.

Even activities that may appear strictly functional may have had highly symbolic aspects. For example, stone used to construct ramparts at the *oppida* of Nevězice was transported from a distant quarry despite the presence of suitable local material (Drda and Rybová 1998). Fortifications were intended to convey prestige by monumentality (Audouze and Büchsenschütz 1992:25). The very act of building was significant in its own right, and should not be seen as purely functional (Cumberpatch 1995:75). Likewise, the very act of transporting material, bringing it from afar, added to its special significance, and was itself highly symbolic.

The discussion and examples outlined above demonstrate that symbolic aspects of long-distance travel are certainly apparent in the Czech context. The precise role of logboats and the extent to which Czech watercraft were utilized in this regard likely varied considerably from period to period, and would be fruitful topic for further investigation.

5.8 Other Types of Watercraft, and Related Evidence

Although a strictly evolutionary interpretation of watercraft development has been discarded in this thesis (see Section 5.1), plank boats were certainly introduced to Czech rivers at some point, possibly in the Early Middle Ages. Whether local logboats were utilized as prototypes for the first Czech plank vessels is unknown, and no transitional forms (logboats extended with the addition of washstrakes or built-up sides and ends) are apparent in the archaeological record. In Poland, Ossowski (1999:221) has determined that plank-built craft were present along the coast by the 9th century AD and on inland waterways by the 13th century AD. A major motivation for the construction of plank boats in Poland (as in other regions of Europe, see for example Arnold 1983), was the increasing difficulty in obtaining tree trunks large enough to construct logboats.

Historical and iconographic sources are few, but may indicate the presence of early plank vessels by the 10th century AD. There are no archaeological examples of early plank-built boats in the Czech Republic, although a small ceramic boat model was excavated from a Hallstatt-period site near the city of Strakonice (on the Otava River). The model is fragmentary, measuring approximately 11 cm in length and just over 4 cm wide. It shows a flat bottom and hollowed-out interior; conceivably either a logboat or a plank-built vessel (Figures 5.5, 5.6 and 5.7). The fragment's end tapers to a narrow oval point, likely representing the bow. Such votive or model boats are potentially a rich source of information regarding early watercraft. For example, the well-known boat model from a grave at Dürrnberg in the Austrian Hallein is believed to represent a La Tène-period cargo vessel (Ellmers 1996b:60), and the numerous wooden boat models known from Gdańsk

(Poland) and Hedeby (Schleswig, Germany) are likely design and construction aides (Roach 2008).

Figure 5.5 Ceramic boat model from the Otava River, top view (photograph courtesy of Blanka Kreibichová, Czech National Museum, Prague).

Figure 5.6 Ceramic boat model from Otava River, seen from the side (photograph courtesy of Blanka Kreibichová, Czech National Museum, Prague).

Figure 5.7 Ceramic boat model from the Otava River, showing cross-sectional profile (photograph courtesy of Blanka Kreibichová, Czech National Museum, Prague).

Early historical sources may also be helpful in fixing the introduction of plank-built vessels to the Czech Lands. In 997 AD, a mission to Christianize heathen Poles and Prussians was initiated, headed by Bishop (later Saint) Adalbert of Prague. According to legend as well as some modern historians (i.e. Zbierski 2000), Adalbert's mission travelled to Gdańsk in a "Vistula boat", a plank vessel propelled by a simple square sail in tandem with oars. This tradition is depicted on the doors of Gniezno Cathedral, cast in bronze in 1180. Adalbert may have travelled by similar vessels on the Elbe, although the sources do not relate the Bohemian leg of his journey.

The previously mentioned Raffelstetten Codex (903-904 AD, see Section 3.4) describes salt boats (*naves salinariae*) sailing down the Danube and up the Morava to the Moravian market; these vessels may have been plank-built. The best historical evidence for early plank boats in Bohemia is the Litoměřice Act of 1057, describing the three types of boats used for carrying salt on the Elbe (*navicula*, *navis mediocra*, and *navis magna*) (Zápotocký 1969:277; also previously described in Section 3.4). The *navis magna* at least can be assumed to be plank-built, and possibly the *navis mediocra* as well. *Navicula* may well refer to logboats, which were certainly in use along the both the Elbe and the Morava rivers at the time. Also from the late 11th century, a wall fresco from the church of St Kliment in Stará Boleslav (at the Elbe – Jizera confluence) shows a vessel with steering oars at either end, clearly of plank-built construction.

Certainly by the 16th century, Austrian builders were operating boat yards in České Budějovice in connection with the salt trade. Craftsmen from the local populace were employed in the Austrian yards, and quickly learned the craft. Boat-building became an important industry in numerous towns along the Vltava River, as local yards copied the Austrian salt boats and started their own production (see Section 3.4).

5.9 Alternative Methods of Travel: Wheeled Vehicles

At this juncture it is appropriate to consider that other important transport technology of prehistory, the wheeled cart or wagon. In his classic study of Old World animal management, Andrew Sherratt (1981) suggested that the development of the wagon was connected with advances in agriculture, specifically the utilization of animals after the initial provision of a captive meat supply.

Sherratt's concept of a 'Secondary Products Revolution' traced emergent properties, including traction and transport, resulting from an intensification of farming production and animal husbandry. People began using animals for riding and transport during the 4th millennium BC, spreading northwest into temperate Europe during the 3rd millennium. Both Sherratt (1997:170-171) and Piggott (1983:63-64) assert that disc-wheeled vehicles originated in Mesopotamia at the end of the 4th millennium BC and the technology spread to the farthest reaches of Europe within five centuries or so. This may be essentially supported by recent bog finds in Denmark, Germany and Holland indicating the presence of wheels in the late Neolithic. A wheel from Achse in Germany, for example, dates to 4412±32 (3320 – 2920 calBC), one from Bjerregårde in Denmark to 4210±120 (3310 – 2470 calBC), and from Ubbena (Netherlands) to 4185±60 (2900 – 2590 calBC) (Burmeister 2004:329).

Evidence for wheeled transport in Central Europe exists from the Early Bronze Age in the form of clay models and disc wheels. Reconstructions based on models and the wheels preserved at wet sites such as Biskupin and Buchau indicate the wagons contained enormous amounts of wood, usually oak, and weighed up to 700 kg. It seems unlikely that such immensely heavy vehicles would travel very far or very fast. Smaller and lighter chariots were likely vehicles of military and political elites, especially the ceremonial versions and 'cult wagons'. Harding (2000:176) concludes "…wheeled vehicles in the Bronze Age had primarily a local role, either in agriculture or for use in battle" (Figure 5.8).

By the 7th century BC, wheeled vehicle technology had made considerable progress. Piggott (1983:148) considered the competence of Hallstatt wheelwrights to be "professional", especially in terms of the ironwork, i.e. fitting a red-hot hoop tyre to the wooden rim, allowing just the right space and timing for shrinkage. By

Ha D and La Tène periods it is clear that spoked wheels were the norm, and wheeled vehicles were widespread.

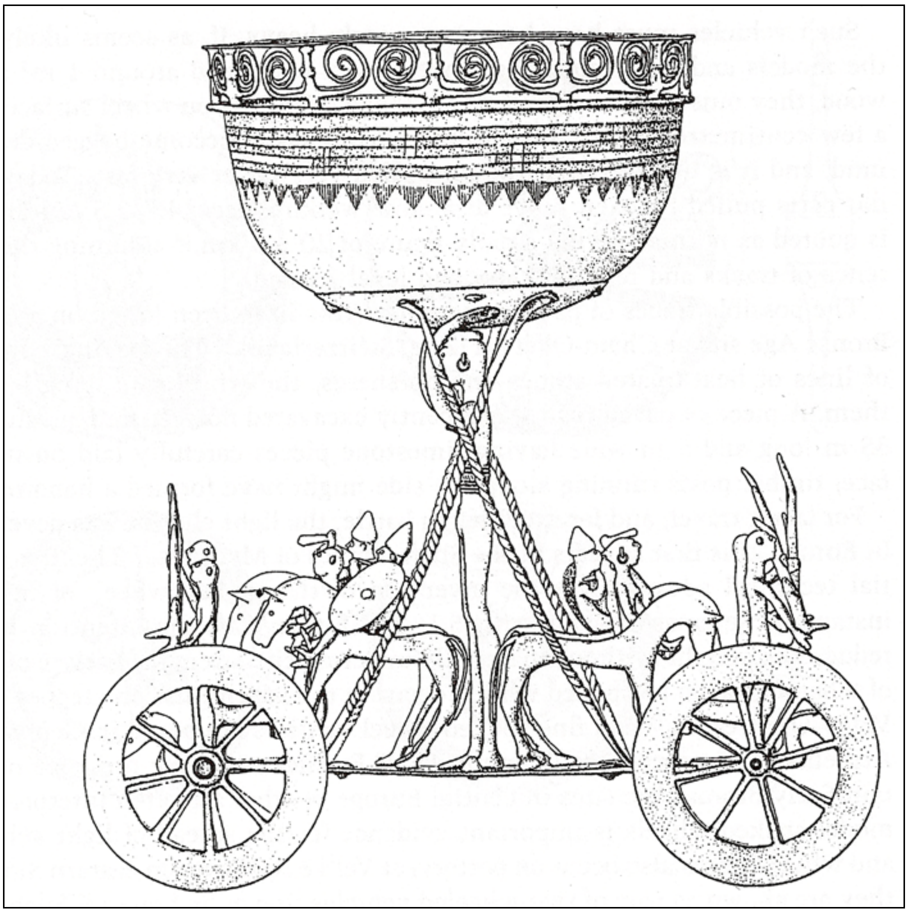


Figure 5.8 'Cult Wagon' model from Strettweg, Austria (Harding 2000:168).

The question at this point becomes one of infrastructure. The amount and quality of roads north of the Roman *limes* are unlikely to have been favorable for significant vehicular traffic: "The purpose of the wagons in the Hallstatt and Early La Tène periods remains obscure. Considering the lack of roads and the slight traffic we can hardly attribute any economic significance to them. Their extraordinary position in the princely graves suggests a function as war chariots, if indeed their significance was not purely symbolic" (Neustupný and Neustupný 1961:138). Chariots, i.e. light horse-drawn two-wheeled vehicles, also introduced from the Near East, fulfilled a specific social function "…proper to the emergence of class with a prestige economy demonstrated in display, hunting, and war" (Piggott 1983:241). Chariots were undoubtedly status objects for the elite, and not intended to be used for cargo or long distance trade or exchange.

Despite the wheel's rapid diffusion across Europe, its lack of utility in many regions meant sparse and uneven distribution of the technology. As roads and tracks became more common from Roman times onward, the significance of wheeled transport likely increased, although Roman road were primarily intended for the quick movement of military units. As Piggott (1983:240) concludes, "...there is no reason to assume wholesale adoption [of the wheel], and even in later prehistory and beyond, wheeled vehicles need not have been universally employed over the whole of Europe."

In general, wheeled vehicles had utility as cargo carriers only in those places with appropriate geography (preferably flat and open terrain) and infrastructure (roads or trackways). This for the most part eliminates precisely those areas where boats are most efficient and useful: natural junctions of land and water routes, and the upper reaches of river valleys, especially those penetrating important watershed divides such as the Moravian Gate.

5. 10 Towards a Model of Transmission of Boatbuilding Skills

The archaeological record indicates the past spread of material goods and information across Europe, as well as the transfer and adoption of various technologies. The transmittal of these elements of culture required a transport mechanism. Watercraft were a key component in the spread and diffusion of culture in pre-modern Europe. And perhaps more importantly for purposes of understanding the processes involved, the vessels themselves may be used as direct evidence for movement of knowledge, skill and technology.

The occurrence and distribution of specific logboat types and features (both geographically and chronologically) indicate the spread of knowledge and information, as such features are more likely to be adapted after the builder or craftsman had actually seen or experienced them firsthand. Direct skill and knowledge was spread on a personal basis, "not through transmission of formulae… but through practical, 'hands-on' experience" (Ingold 2000:291). This insight has great relevance to the spread of technology in general, and may potentially be applied to the great technical 'revolutions' of prehistory, such as agriculture and metallurgy.

There is direct evidence of dugout watercraft from Czech rivers dating back more than two thousand years. Indirect evidence strongly suggests that regional and local boat-building traditions go back much further, likely to the Mesolithic, and possibly the Paleolithic. Although a precise date for the introduction of planked vessels cannot be fixed, they were likely present by the 10th or 11th century AD. The region's physical characteristics – i.e. topography and hydrographic features – make waterborne travel an extremely efficient and advantageous means of transport and communication. Distribution of logboat remains indicates areas of usage in fertile high-density settlement districts, and along heavily trafficked transport corridors. Motivations for building watercraft are varied, but include subsistence, trade, cargo carriage, and long-distance travel. The efficiency and utility of water travel made boats economically significant, but logboat usage need not have been purely economic in nature. Watercraft could also fulfill a social role as vehicles used to obtain prestigious objects and esoteric knowledge from afar, providing important legitimization of religious and political elites.

As suggested in section 3.6, the Czech vessels' geographic and human contexts can be viewed as a series of adjoining or interlocking transport zones (c.f. Westerdahl 2000, Nymoen 2008). The three main watersheds (the Elbe basin, the Morava Valley, and the Oder) can be viewed as primary zones of waterborne transport. Overland routes connected these zones to each other and to neighboring regions. Three such routes are of special significance: the Moravian Gate, connecting the Morava River to the Oder; the route between the eastern Bohemian Basin and the Morava Valley; and the overland trail between the headwaters of the Vltava to the Danube, in the modern region of Upper Austria (Figure 5.9).

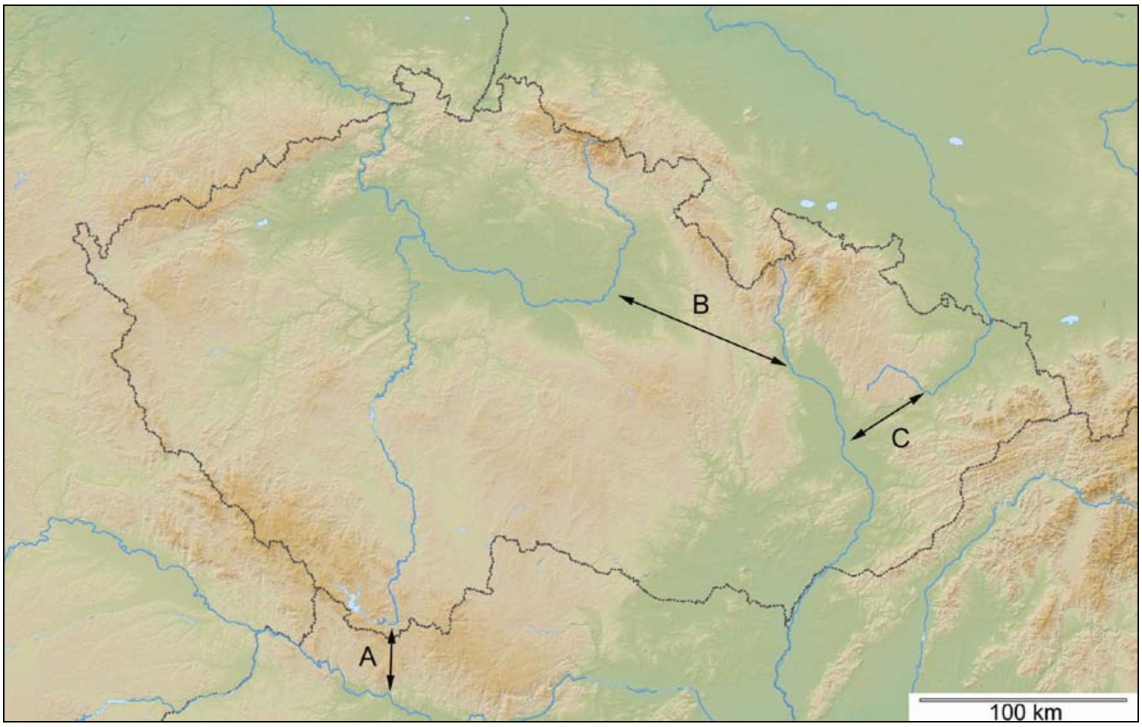


Figure 5.9 Key overland connections from Bohemian and Moravian river basins: A- route connecting the Vltava and Danube Rivers; B- route connecting the Elbe and Morava Rivers; C- route connecting the Morava and Oder Rivers.

These are the region's key transport zones and the paths by which knowledge and skills were transmitted through Central Europe. Only with the building of railroads in the 19th century was waterborne trade along these routes superseded by overland haulage (see section 3.4). Traditions of usage (*sensu* Westerdahl 1992:8) extend chronologically along these routes for many millennia, in some cases into the Middle Paleolithic (for example through the Moravian Gate at the Předmosti site, cf. Svoboda *et al.* 1994; also Oliva 2007).

In this thesis I have argued that previous logboat investigations have greatly focused on technical elements of vessels and boat construction, or in the case of Lanting (1998) have ignored them altogether in favor of a 'meta-narrative' chronological approach. While the technical details of boats remain the essential foundation for watercraft investigations, a more relevant understanding of the transmission and adoption of skill must consider a deeper context, particularly the people who built and operated the vessels. With this understanding, the next step is the development of a model explaining the mechanisms by which boats can change.

Evidence assembled in this and previous chapters suggests that there are several key elements to such a model. The first element is the inherent conservatism of boat design and construction. Reasons for conservatism and reluctance to accept innovation or variation are explored in Section 5.5. At a basic level, there is a very obvious and compelling reason for such conservatism: if a vessel is not constructed in the 'proper' manner, something may go wrong and the boat's operators and cargos are put at great risk. Successful, proven and familiar designs will be replicated; unknown and unfamiliar designs will be viewed with skepticism.

Alteration and innovation, however, does occur, and there are several ways in which design changes come about. Internal change can be driven by both environmental and social factors. Deforestation, for example, led to new construction techniques in many regions (i.e. replacement of monoxylous craft with plank-built boats) (Clark 1952; Arnold 1985a; Ossowski 1999; also see Chapter 2). Watercraft also reflect the requirements of the operators, as shown by the differences between small fishing craft, and large cargo or transport vessels, for example. As social organization changed, different vessel forms were created to reflect the needs of builders and operators.

External sources can undoubtedly be very powerful factors effecting change in watercraft design, under very specific circumstances. Innovative features or construction techniques can be adopted, providing the builders (and likely the operators as well) can see, experience, and test them first-hand. Experiential evidence, on a personal or individual level, is therefore the critical factor in accepting external design changes. These factors will be taken into consideration by the boat builder, and design and construction decisions will hinge on personal experience and observation.

Geography also plays a significant role. By the nature of watercraft, individual design traditions are generally restricted to a given watershed or catchment area. However, it is possible for designs to 'jump' the divide as skills (boat-builders, actually) are transferred between watersheds. Land routes or inland portages between major watersheds are thus extremely significant as corridors for the spread and transmission of boat-building traditions (cf. Westerdahl 2006).

The model described above provides an explanation for the distribution of Czech logboat morphologies and construction styles. Three key elements (inherent conservatism, internal innovation, and adoption of personally observed external features) are identified as fundamental to the model. The relationship between the three elements is visually expressed in Figure 5.10. The interplay between the elements determines the rate and type of change, as balance is achieved between the three positions. Some elements will be stronger and some weaker at any given time, as the social and environmental factors change and develop.

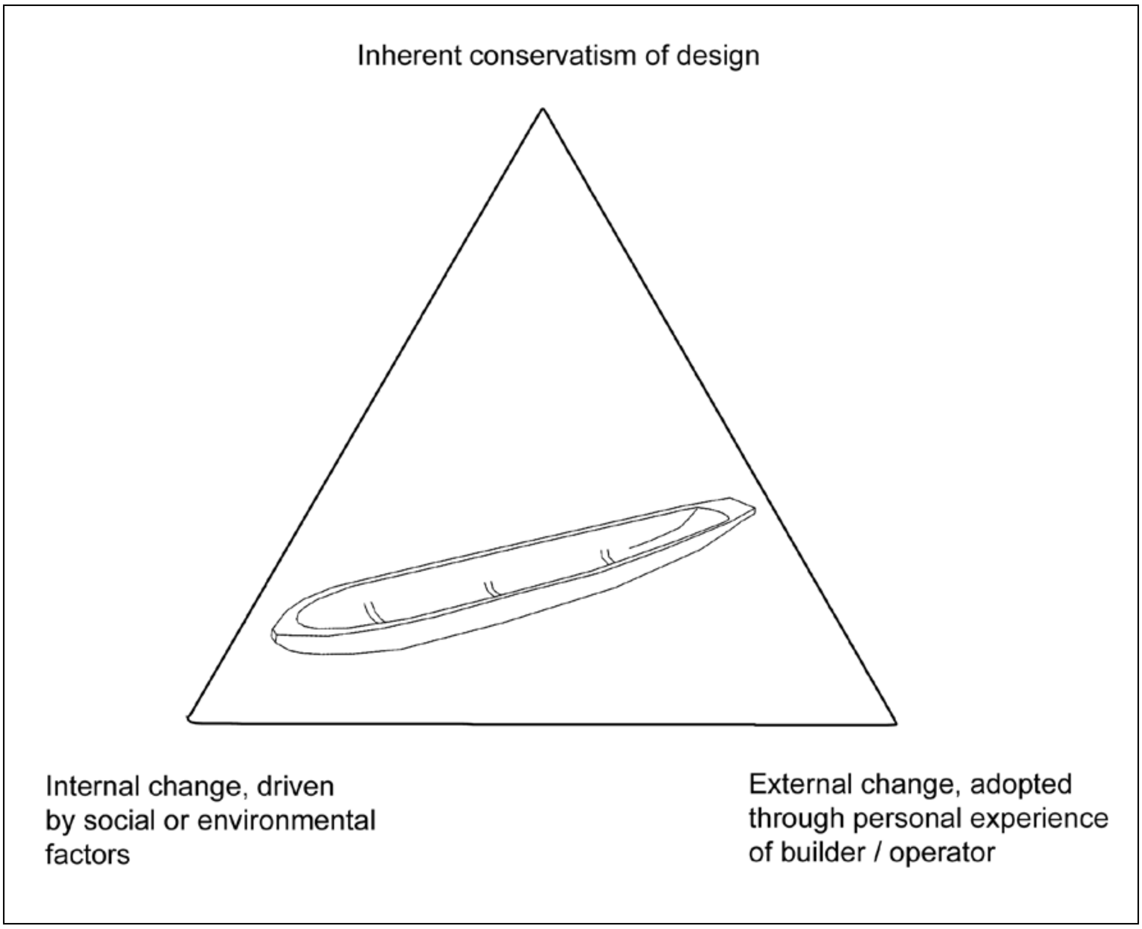


Figure 5.10 Interrelationship of the three key concepts applicable to change in watercraft design.

The following chapter will test this model by applying it to other regions of Europe, as well as other boat types. The chapter consists of a number of shorter case studies examining watercraft from other catchment areas, seeking to ascertain whether similar results can be identified from varying and diverse environments. As in earlier chapters, the focus is on processes of information spread and transfer, the influence of geography, and the role of the boat builder and operator in effecting change.

CHAPTER SIX – TRANSMISSION AND REPLICATION: CASE STUDIES IN EUROPEAN BOAT-BUILDING TRADITIONS

Previous chapters have described surviving pre-modern Bohemian and Moravian watercraft. The vessels were further contextualized through examinations of the physical and historical social environments. Data and analysis were used to construct a model describing how boatbuilding innovations were adopted by builders. Morphological analysis showed that certain logboat features and construction methods were at times specific to a particular river system or catchment area. Comparisons of Bohemian and Moravian vessels, geographically separated by watershed divides, show clear differences reflecting localized boatbuilding skills and traditions. The static constraint or conversely the spread of constructional elements show patterns, correlated to geography. Skills, design and constructional knowledge were conveyed along lines of communication and via transport channels, which in turn were largely determined by regional landforms and topography. Personal observation and experience were key elements in replicating boat design.

A further step in developing the ideas described above involves testing the findings against data from other areas of Europe. If watercraft features and construction methods can be traced in a similar manner in multiple regions and other environments, it will support the core ideas presented in this thesis. This chapter discusses case studies from various periods and other European watersheds, seeking verification of the model articulated in Chapter 5.

The first case study is a group of logboats from the Loire River of France. A sub-set of extremely homogenous vessels from this region was used by Joncheray (1986) to develop a local chronology. Although just five of the vessels are dated, Joncheray concluded that chronology can be broadly correlated with typology. A second case study examines several vessel types from the major catchment regions and river systems of Poland. The large data-sets resulting from the work of Waldemar Ossowski and others demonstrate the distribution of specific Polish vessel morphologies (and hence the transmittal and adoption of corresponding construction technologies and related skill-sets). A third study involves the Alpine lakes and rivers of Switzerland, where Béat Arnold in particular has documented vernacular watercraft, both ethnographic and archaeological. The Swiss examples demonstrate the significance of riverine communication routes through mountainous terrain, as well as the convergence of disparate boatbuilding and design traditions from other regions of Europe. The final case study is not confined to a particular geographic region, but rather focuses on a specific boatbuilding tradition with exceptional longevity. The Gallo-Roman boat type is known from locations across Europe, over a period spanning nearly two millennia. These vessels, which have clear logboat antecedents, were eventually developed into large sea-going ships. This case study may thus help to verify the significance of the model to other vessel types, extending beyond logboats. If such application can be shown, then the model will have greater potential impact for the field of maritime archaeology as a whole. This design tradition is therefore a particularly appropriate and significant case study for the ideas previously presented in this thesis.

The goal of the case studies is not only to determine whether boatbuilding traditions can be traced both geographically and chronologically, but specifically to identify the ways in which boatbuilding knowledge, skills and innovations were transferred across geographical regions. The case studies are therefore inclusive of many vessel types. While the specific focus of each case study was chosen based on the availability of data and research material, this is by no means an exhaustive inquiry of European watercraft design. Rather the following case studies should be viewed as a preliminary test and application of the model developed in Section 5.10.

6.1 Loire Logboats

There are three major watersheds along the Atlantic coast of France: the Seine, the Loire, and the Dordogne-Garone. Logboats have been found in all three drainages, dating to various periods. A group of 26 dugouts from the Loire region studied by Didier Joncheray (1986) is particularly relevant to the aims and ideas presented in this thesis, as the boats demonstrate both local and regional characteristics. The vessels, found mostly along the Loire River itself but also from smaller tributaries within the region, share a similar general morphology and suite of constructional features (Figure 6.1). Among the characteristics listed by Joncheray are a lack of thickness gauges, tendency towards a rounded profile at both bow and stern, and overall lengths between 4 and 6 m. Five of the 26 boats have been radiocarbon dated, with results from 2320±60 (732 – 203 cal BC) (the Oudon 1980 vessel) to 880±60 (1032 – 1256 cal AD) (the Cellier 1984 vessel) (see Figure 6.2). A subgroup of 7 logboats, all found along a 45 km stretch of the Loire between Nantes and Ancenis, displays an extremely homogeneous morphology. Vessels in this group all have flat bottoms, straight vertical walls, and both bow and stern terminate in oval or rounded points. Only a single logboat from this group (Ancenis 1985, see Figure 6.3) has been dated, with a result of 1010±60 (894 – 1161 cal AD) (Joncheray 1986:10).

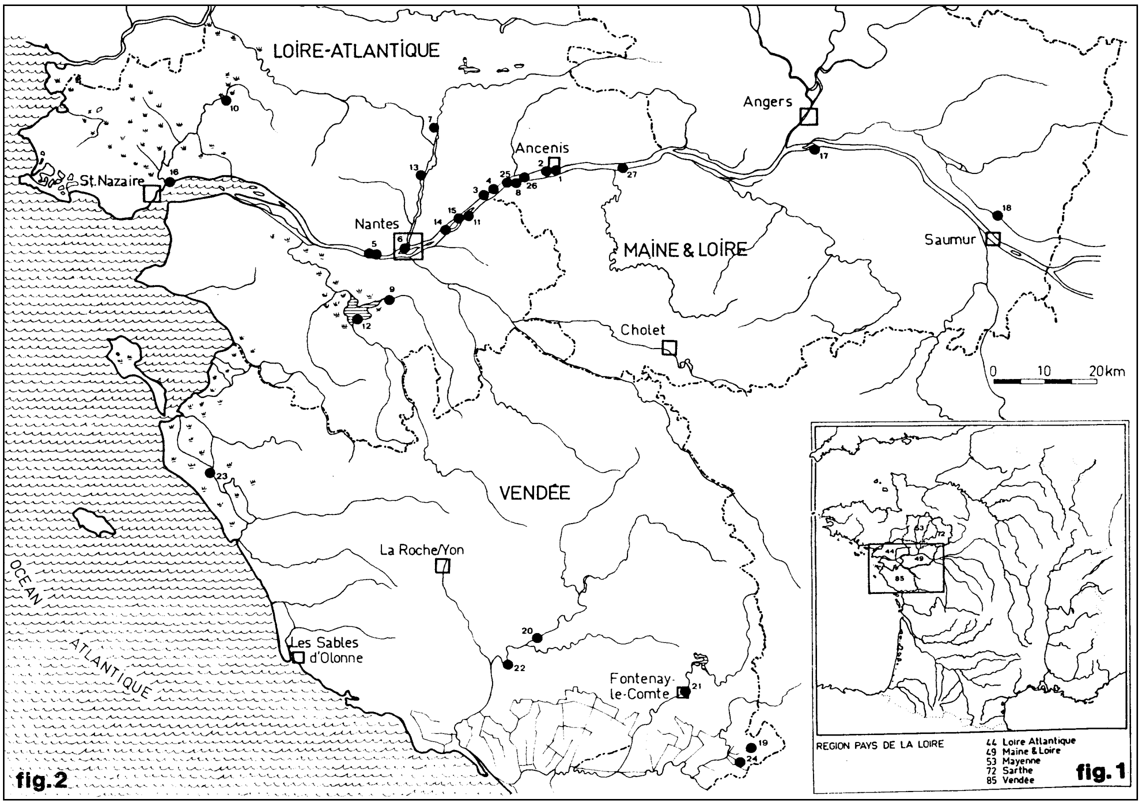


Figure 6.1 Map of Loire region logboat discovery sites (Joncheray 1986:fig. 01,02).

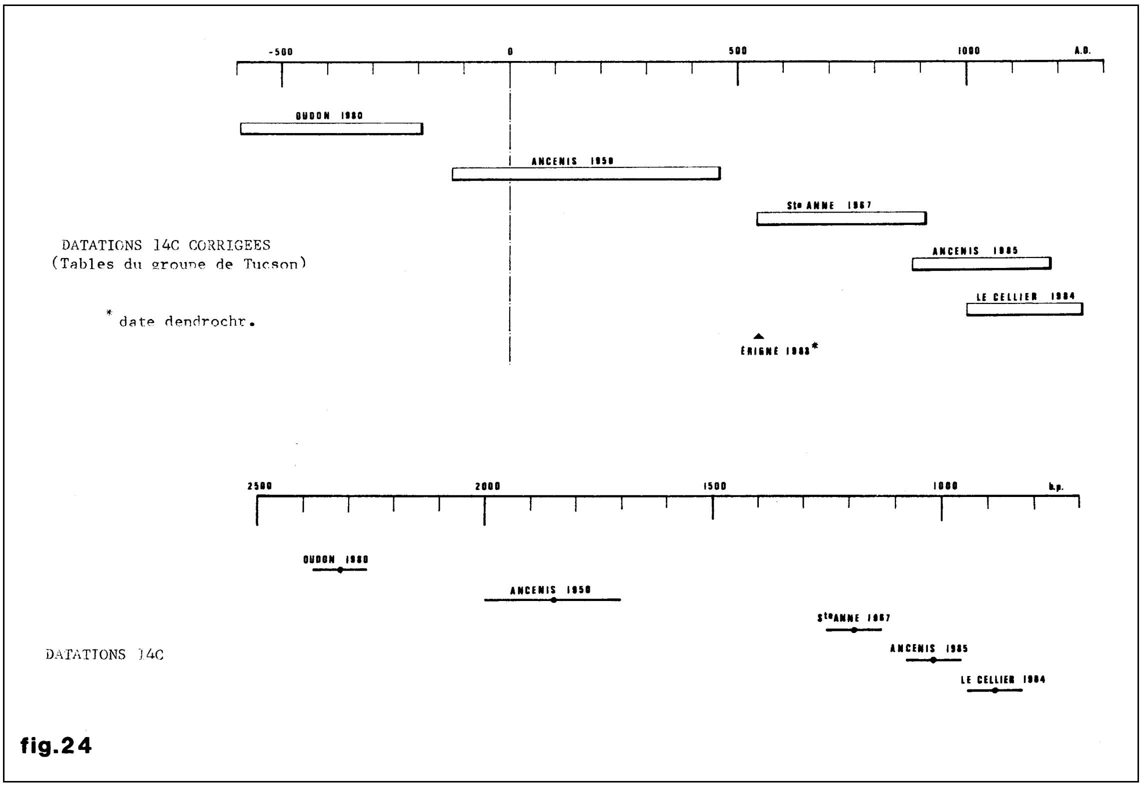


Figure 6.2 Radiocarbon dating of the Loire logboats (Joncheray 1986:fig. 24).

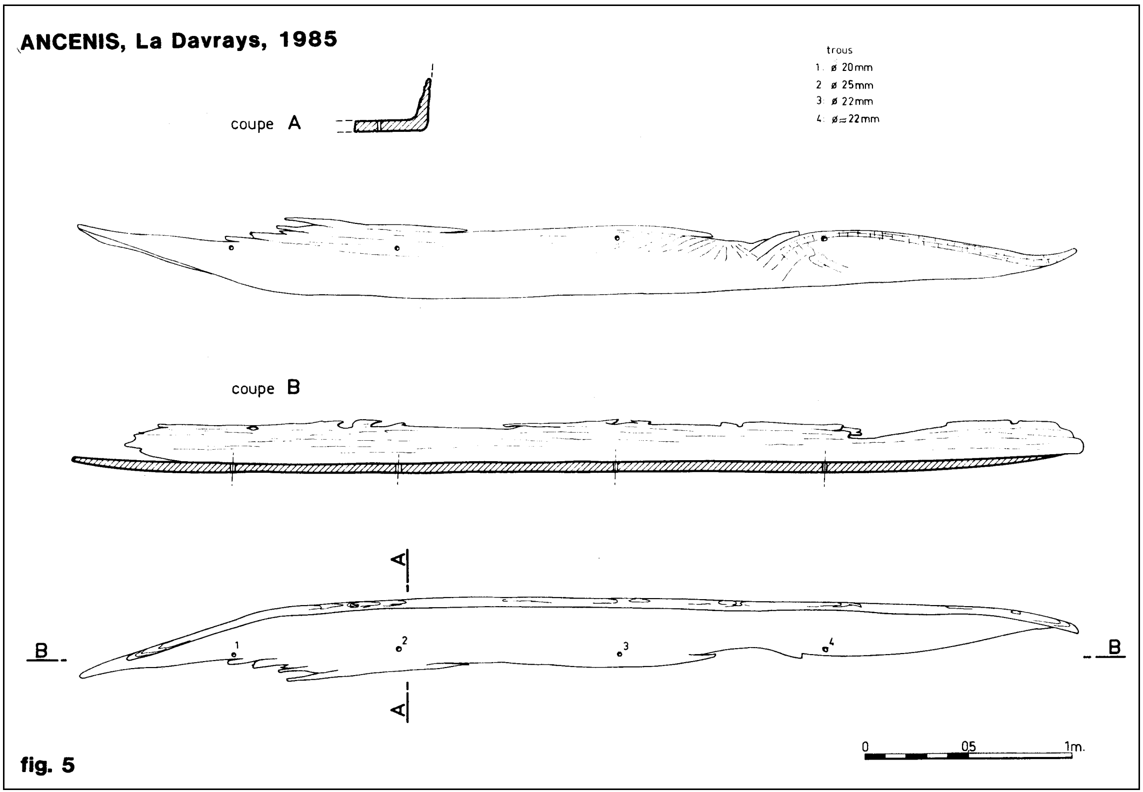


Figure 6.3 The Ancenis 1985 logboat (Joncheray 1986:fig. 05).

As a result of this study, Joncheray (1986:11-12) concluded that an approximate chronology can be established for the Loire vessels: the oldest logboats from the region have semi-circular cross-sections, followed by flat-bottomed vessels with rounded sides, and finally those with flat bottoms and straight vertical walls. This case study indicates that in some situations it may be possible, albeit difficult, to create a tentative local chronology based on vessel form and typology (see discussion in Section 5.1).

The Loire logboats can be contrasted with vessels from other regions of France, especially the well-researched Seine watershed. On the basis of the inventory of French logboats compiled by Cordier (1963; 1972), Arnold (1985b) has grouped the majority of vessels from this watershed to the "pirogues à bec" typology, regardless of dating. Vessels of this type feature flat rising ends which are semi-rectangular in plan view (Figure 6.4). This morphology is quite dissimilar to the oval and rounded points of the Loire vessels' ends. There are of course other morphologies evident in the Seine region, for example the pointed ends of the Paris-Bercy logboats, but to date no study relating vessel form with chronology has been performed.

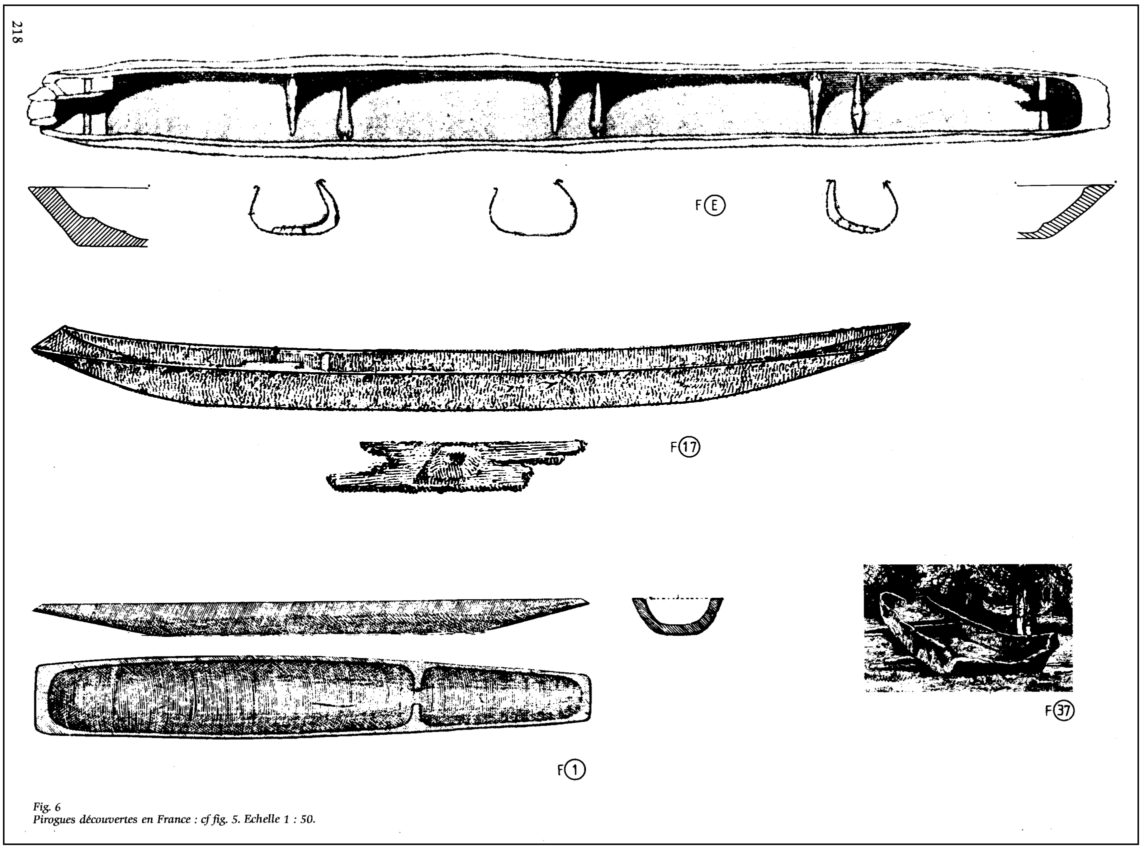


Figure 6.4 Logboats of the "pirogues a bec" typology from the Seine watershed. Top: the Port Berteau vessel; middle: the Estreboeuf vessel; bottom: the Abbeville vessel (Arnold 1985b:218).

Specific constructional features can thus be identified and traced both geographically and chronologically in the Loire catchment area. The local boatbuilding tradition is demonstrated by vessel uniformity over time. No explanation is offered by Joncheray for the geographic restriction of Ancenis-type vessels within the watershed. Given the relative homogeneity of the landscape the reason is likely to have been socio-political rather than strictly determined by geography. Vessel form may have been an element of cultural identity, differentiating a local group from neighboring peoples. This case study broadly supports the model described in Chapter 5, although further resolution of vessel morphologies and dating for logboats from nearby regions could help to refine the interpretation.

6.2 Polish Case Studies

In Poland, Dr Waldemar Ossowski has obtained absolute dates for more than 100 of the nearly 300 logboats excavated from Polish rivers and lakes. The dating program has allowed Ossowski to reconstruct aspects of the typological development of Polish logboats, and to examine their cultural and historical connections (Ossowski 1999). There are two major watersheds in Poland (the Oder and the Vistula), as well as districts of numerous lowland lakes, often linked by canals and small waterways. Various parallels to the distribution of features on Czech logboats are apparent in Ossowski's research on Polish vessels. Some particular features are restricted to boats from specific river systems. For example, concave interior shaping became common on logboats from the upper Oder and its tributary the Warta in the late 16th century, but no boats with this morphology have been found on the Vistula. And in the 20th century on the Bug River (Vistula watershed), oval grooves are often found in the top edge of the bulkhead, a feature that is not found on boats from any other region or catchment area (Ossowski 1999). Geographic limitations corresponding to watershed catchment areas are thus evident as an explanation for localized uniformity of design.

Tracking the distribution of skill sets is also possible with data from the Polish research. A very interesting Polish example demonstrates the process by which specific features or vessel types were transferred from one region to another. The typical flat-bottomed Oder logboat, common within this river system, was not initially found in other catchment areas. The watershed boundaries acted as barriers to design transfer, despite the flat open terrain of the Polish Plain. In the late 18th century the Bydgoszcz canal was constructed between the towns of Bydgoszcz and Nakło, connecting the Oder with the Vistula river system. Bydgoszcz became a major inland port, and the flat-bottomed Oder vessel quickly spread through the new watershed as a result of the new connection between the two watersheds (Ossowski 2006). An advantage in construction or utilization of the introduced vessels was made apparent by demonstration and usage in the new region. In this instance it was not necessarily the original builders themselves who conveyed the innovations, but rather users who spread the Oder-type vessels into new territory. Local boat-builders, having seen or experienced the foreign craft, incorporated constructional features or techniques into their own production. This is further evidence in favor of the proposition that boat builders adopt innovations and features from craft they can see and inspect for themselves, but that without this direct contact, the transfer of skill is much less likely occur. The mechanism by which successful Polish designs were propagated in the modern era was described in Section 5.5, where the logboat being replicated was literally used as a template for constructing the new vessel. The method was unchanged from previous eras, just the tools had changed. A short summary of Polish morphologies and watersheds is shown in Table 6.1. The Polish case studies are in broad support of the model described in Chapter 5.

Design Element	**Watershed**	
	Oder	**Vistula**
Concave interior shaping	Yes	No
Oval grooves on bulkhead	No	Yes
Flat-bottomed “Oder-type”	Yes	Yes, following canal construction

Table 6.1 Comparison of Polish vessel morphology by watershed region.

6.3 Alpine Case Studies

Numerous examples of skills transfer can also be found in Europe's Alpine regions, where the headwaters of major European rivers converge and where large relatively isolated mountain lakes have preserved local inland watercraft technology. Rivers have also been extremely important routes for transport and communication through the mountainous terrain. This region demonstrates geographic constraint and channeling of skill sets and constructional features over long periods of time.

In Switzerland, the flat-bottomed lake vessel has antecedents as far back as the Neolithic (for example the lime-wood Auvernier 1973 logboat), with similar surviving boats from the Bronze Age (Auvernier 1975, Twann 1975) and the Iron Age (Bevaix 1917) (Arnold 1985a:285) (Figures 6.5, 6.6 and 6.7).

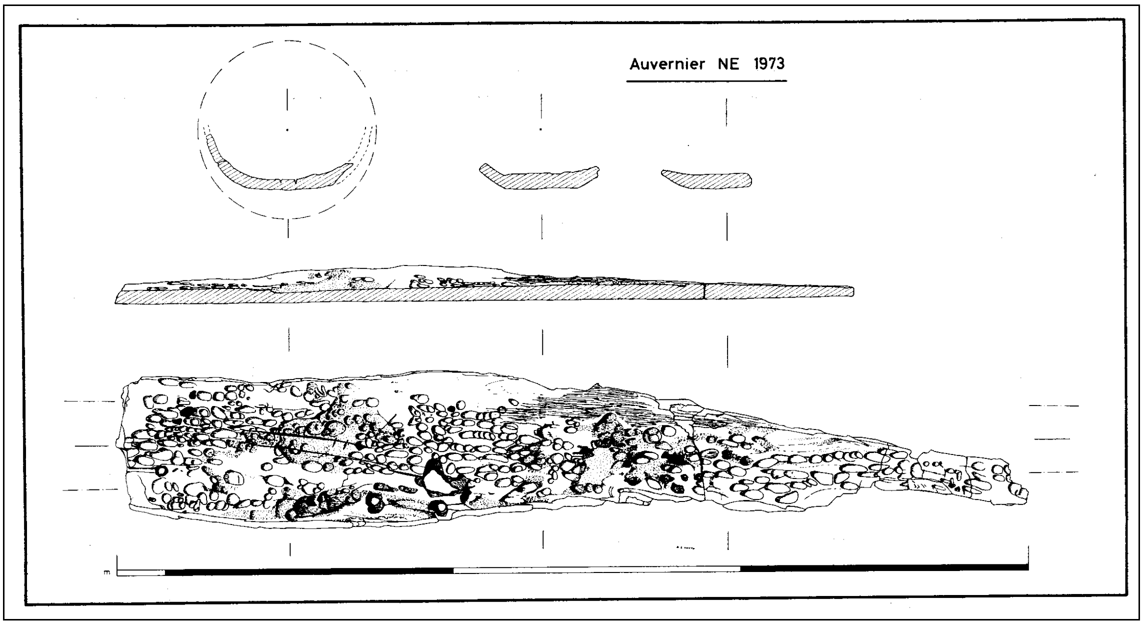


Figure 6.5 Auvernier 1973 logboat, dated by association to ca. 3680 BC (Arnold 1980:179).

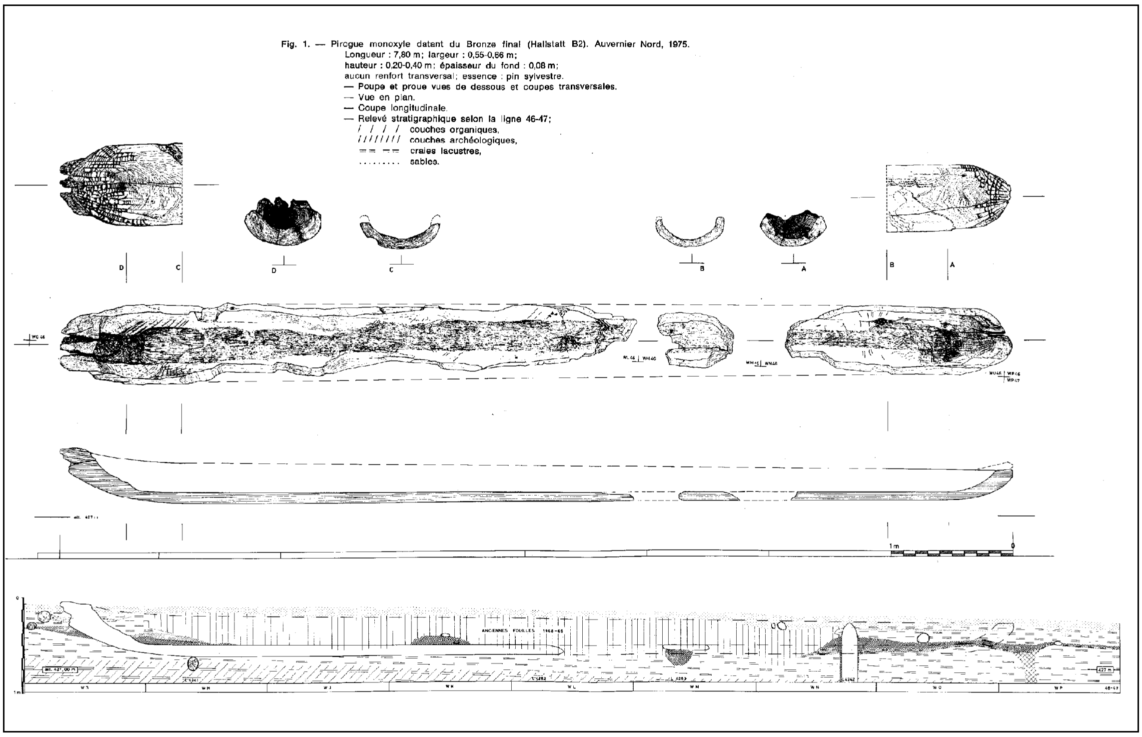


Figure 6.6 Auvernier 1975 logboat, dendro-dated to 850-880 BC (Arnold 1976:fig. 1).

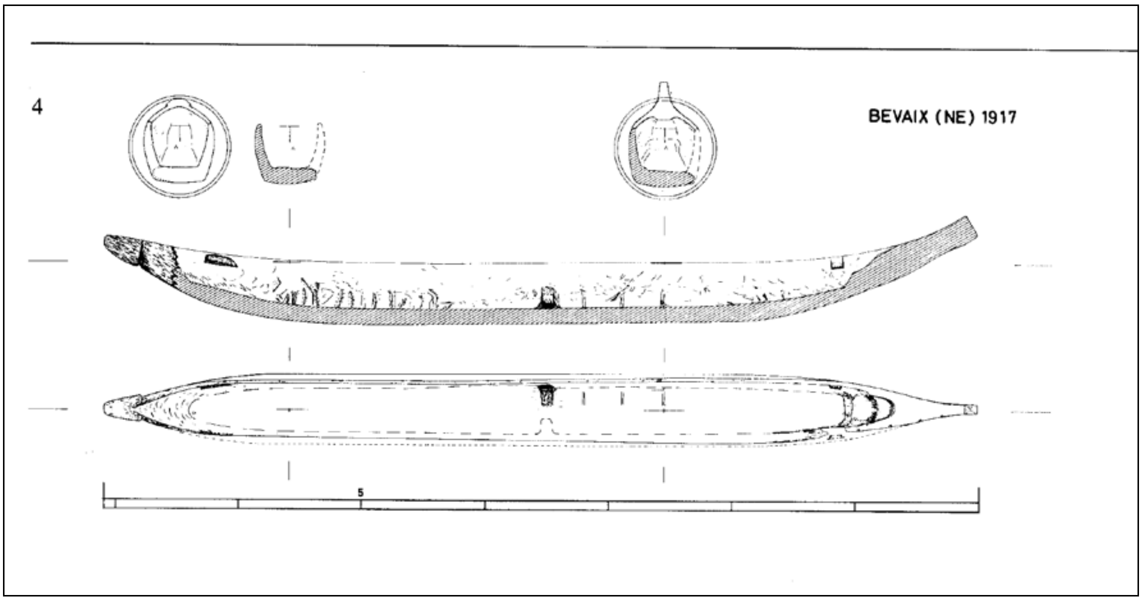


Figure 6.7 Bevaix 1917 logboat (Arnold 1980:183).

Related logboats were still in use in Central Switzerland through the 19th century, especially on the relatively inaccessible lakes of Zug and Aegeri. By the early 20th century the Alpine forests had become depleted of the large trees needed to construct dugouts. The fishermen who were the logboats' main users were forced to replace them with plank-built vessels due to the lack of suitable raw material

(Figure 6.8). The new boats, built at first by adding strakes to a smaller trunk, were constructed to resemble the original logboats as much as possible (Arnold 1985a:285).

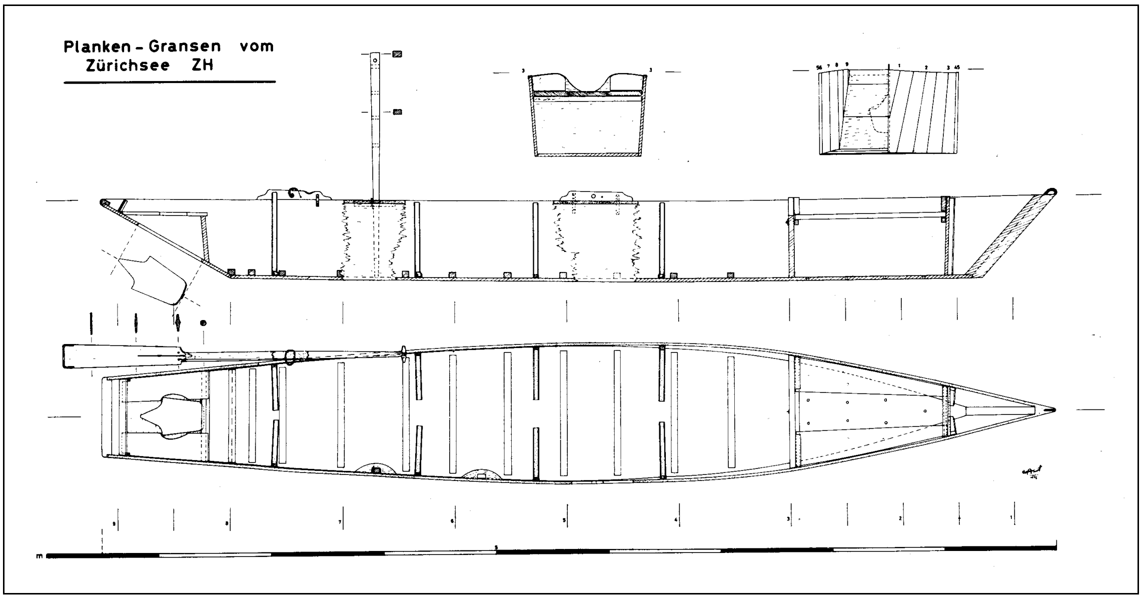


Figure 6.8 Early 20th century plank vessel ("gransen") from Lake Zurich, constructed to resemble a logboat (Arnold 1985a:290).

On other Swiss lakes, connected to wider transportation networks via major rivers, various foreign design elements were introduced. For example the indigenous vessels of Lake Geneva (linked to the Mediterranean Sea via the Rhone River) were considerably influenced by Mediterranean style war galleys built from the 13th century onward. Traditional vessels of Lake Constance (on the Rhine) are pointed both at the bow and stern. This construction does not appear on Lake Thun or Brienz where the bow is pointed but the stern ends in a flat transom, although the traditions have mixed on the lakes of the Rhone watershed.

It is Lake Neuchâtel, however, which has the greatest significance for comparison with the continental divides of the great Bohemian and Moravian watersheds. The Neuchâtel-Morat-Biel lake system lies at the head of two major European waterways, leading to distant seas: the North Sea via the Rhine, and over the low divide between Yverdon and Lausanne to the Mediterranean Sea via Lake

Geneva and the Rhone. The riverine geography of this region resulted in a convergence of disparate vessel types from both sides of the continental divide. Indigenous vessels from the Neuchâtel region show a tremendous range of features and elements, some (such as the 'neyeu', with pointed bow and stern) traceable from the Rhine, and others (for example the stemmed 'galère') with a Mediterranean heritage (Arnold 1980, Arnold 1985a). The wide variety of Neuchâtel vessel features and types is a consequence of the transmittal and mixing of watercraft designs from the North Sea to the Mediterranean. Interestingly, most of the planked Neuchâtel vessels show their logboat ancestry by their flat bottom, unlike the keeled barques and galleys of Lake Geneva, built on the Mediterranean model (Figure 6.9).

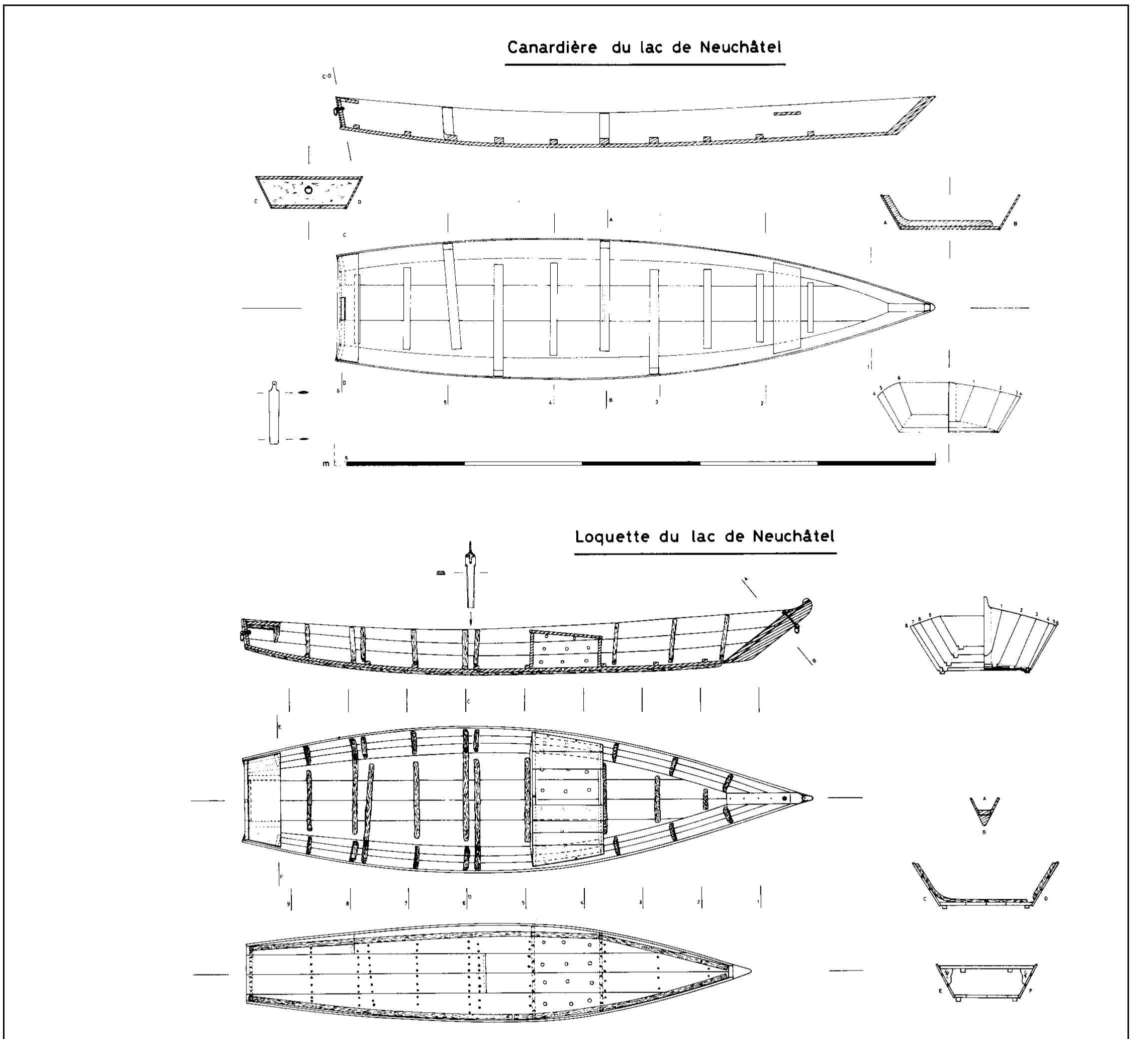


Figure 6.9 Planked flat-bottomed Neuchâtel boats (Arnold 1980:191).

The transmission mechanisms of skill and design outlined in the model (Chapter 5) are thus clearly emphasized in this Alpine region, where transfer is enabled by rivers, but blocked by high mountain ranges. The distribution and adoption of features in this particular environment demonstrates "the vast network of influences…originating from the emigration of carpenters from other waterways" (Arnold 1985a:287). Innovations and features are directly adapted from experiential understanding. Without direct contact, the passing of skill occurs over a much longer time horizon, if at all.

6.4 Gallo-Roman Boats

Finally, the evolution and distribution of the above-mentioned Gallo-Roman boats (also called 'Romano-Celtic' boats (McGrail 1995) or 'continental' (de Weerd 1978)) is exceptionally illustrative of spread and combination of various constructional features and techniques. Many such boats have been discovered, and their construction has been described in considerable detail (i.e. Ellmers 1969; Arnold 1989; Arnold 1999; McGrail 1995; Höckmann 1983; and de Weerd 1991). Gallo-Roman vessels utilized on inland waterways have been discovered, as well as large sea-going examples (for example from the river Thames at London (Marsden 1994) and the islands of the English Channel (Rule and Monaghan 1993)). This division corresponds to the two sub-groups identified by McGrail (1995:143) and Arnold (1999:34), who points out that most (although not all) of the known Gallo-Roman riverboats have been discovered in the Rhine basin. This section will examine the Gallo-Roman boatbuilding tradition, and describe some of the vessels from which our knowledge of this building style is derived. Inland vessels will also be compared and contrasted with sea-going ships.

Some characteristic construction features of the tradition, outlined by McGrail (1995:140), are flush-laid non-edge fastened planking, asymmetric frames spanning the bottom and one side, side timbers forming an integral chine, and flat bottoms. The inland Gallo-Roman vessels probably developed from local cargo carrying craft, and were quickly adopted by the Roman military for their transport needs, e.g. cheap and relatively large cargo vessels (de Weerd 1991). In general these are flat-bottomed boats with single-log 'transition planks' (McGrail's 'side timbers') between the vessel's bottom and sides. The broad flat bottom "served as the basic entity of construction", as it determined the vessel's shape and size (Arnold 1999:35). The principles of inland Gallo-Roman boat construction are derived in essence from logboat building techniques, especially the transition planks (also called 'longitudinal angle timbers', cf. Ellmers 1969; 1996b). These scantlings are essentially the halves of a logboat split along its longitudinal axis to form a mirror-image pair of dugout shells, between which large planks have been inserted, forming the vessel's bottom. The key planks were selected to best utilize both maximum length and width of the parent log (Arnold 1999:37). Carvel strakes were added to build up the sides, with the framing inserted last. Framing typically covered the width of the bottom, but alternated in supporting the sides of the hull.

The spread of Gallo-Roman vessels and construction styles in Europe can be traced both geographically and chronologically. Ellmers (1996b) has identified four stages of development, from pre-Roman vessels, Roman period boats, and those from the Early and Late Middle Ages. The pre-Roman boats (known primarily from the example of the 4th century BC Laibach or Ljubljana vessel) use a variety of timber species, separate knees and transverse frame timbers, and very few iron fasteners (it is not known how the side strakes were joined, although lath caulking bast was sewn between strakes). The Laibach vessel was constructed using spruce side planking, oak for frames and knees, and elm for bottom planking. Very few nails were used, although they were of quite good quality. The boat's sides project outwards, putting high stress on the longitudinal timbers (Ellmers 1996b) (Figure 6.10).

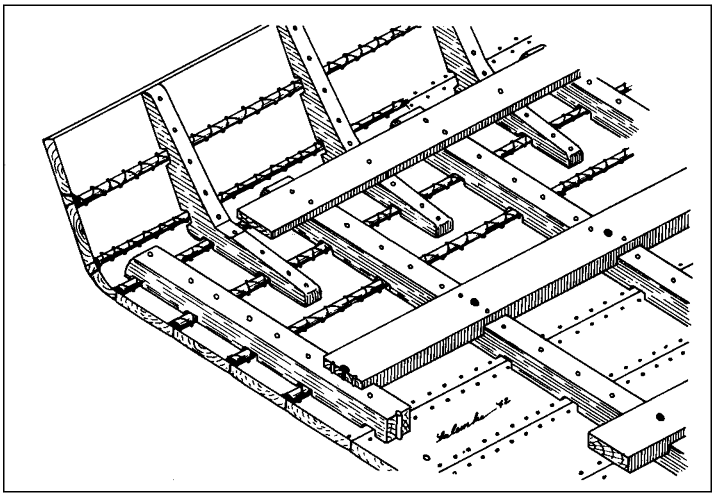


Figure 6.10 The Laibach vessel, showing internal framing and sewn plank construction (Arnold 1992:68).

Inland continental vessels constructed during the Roman period (exemplified by the 2nd century AD Bevaix and Zwammerdam boats) differ both in construction and materials from inland vessels of the pre-Roman period- oak is the main timber, and iron nails are used extensively. The frames of the Bevaix 1970 boat are paired, and each member of a pair supports an opposite wall (Figure 6.11). The vessel is 19.35m long, 2.8 m wide, and .85-.95 m high, made of oaks felled in 182 AD. The hull sides are vertical, not projecting outwards (decreasing stress on the longitudinal timbers, in comparison with the Laibach boat). The vessel was constructed exclusively of oak with extensive use of iron fasteners (Arnold 1989; Ellmers 1996b). Ellmers (1996b:67) correlates this stage not necessarily with Roman occupation, but rather with Celtic *oppida* cultures and the increasing transport needs of the late Iron Age.

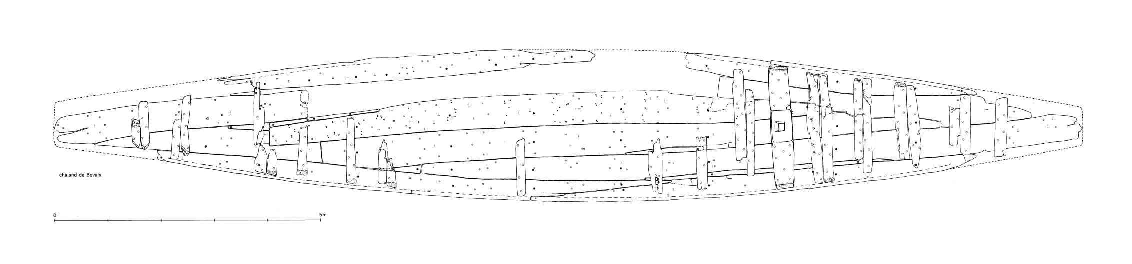


Figure 6.11 Bevaix 1970 vessel, an example of "polygonal construction" (Arnold 1992:pl.1).

A group of six river vessels excavated at the Roman auxiliary fort of Nigrum Pullum (modern Zwammerdam, Netherlands) demonstrates the progression and range of dugout-derived design and construction used for Gallo-Roman vessels. The finds consisted of three dugouts, three large barges and a steering oar. All the vessels were constructed of oak, with some subsidiary elements of silver fir (*Abies alba*). Two of the logboats (Zwammerdam 1, 6.99 m in length; and Zwammerdam 5, 5.48 m in length) were identified as fishing boats on the basis of integral perforated fish wells. The third logboat (Zwammerdam 3, 10.4 m in length) has a composite oak stem-piece and washstrakes of silver fir. Alternating paired frames fastened and supported the washstrakes, the same principle utilized for larger plank-boat construction in the Gallo-Roman tradition (de Weerd 1978) (Figure 6.12).

The larger vessels, identified as barges, were between 20 and 35 m in length. The barges exhibit a rather complex combination of pre-Roman and Mediterranean shipbuilding techniques. The longitudinally split dugout chines and plank keel demonstrate continuity with local watercraft design, while other elements (especially evidence of mortise-and-tenon fastening) were clearly adapted from Roman methods of construction. De Weerd assigns the Zwammerdam barges to the mid to late 2nd century AD, a time conflict with German tribes outside the *limes* of Lower Germany. The Roman military needed

Figure 6.12 Zwammerdam 3 vessel (de Weerd 1978:18). The paired frames and longitudinal timber are clearly visible.

local heavy transport vessels, primarily for carrying cargos of stone for fort rebuilding and construction. The vessels were constructed by south German shipbuilders in the local tradition, although considerably enlarged for the needs of the Roman army (de Weerd 1978:16). The similarity with other vessels from throughout the Rhine basin is unmistakable, leading de Weerd (1978:20) to include the Bevaix, Yverdon, Druton and Pommeroeul boats in the same category of inland heavy transport. The boats from Pommeroeul (Belgium) in particular exhibited the same longitudinally split dugout chines and alternating paired frames (De Boe 1978). Provincial Roman boat-building thus utilized local pre-Roman traditions, resulting in an innovative design based on new functional requirements and combined construction methods.

Sea-going (or estuary) boats from the Roman period are known primarily from Britain and the English Channel. The first vessel ever recognized as a Gallo-Roman boat was uncovered in 1962 during construction of a Thames riverside embankment at Blackfriars, in central London (Marsden 1972; Marsden 1994). Tree ring analysis showed that the vessel (designated as Blackfriars 1, see Figure 6.13) had been built no later than 130 AD. There was no keel, but the vessel had two thick and wide central bottom planks (allowing beaching). All surviving timbers were of oak. Large nails, up to 55 cm in length, had been driven completely through from the outside, and bent over twice so that the points were forced back into the wood. The ship was approximately 18 m long, and at least partially decked. The mast step was located quite far forward (a defining characteristic of Gallo-Roman sailing vessels). In the hold was a cargo of several tons of building stone, quarried along the River Medway, near Maidstone in Kent (Marsden 1972:121).

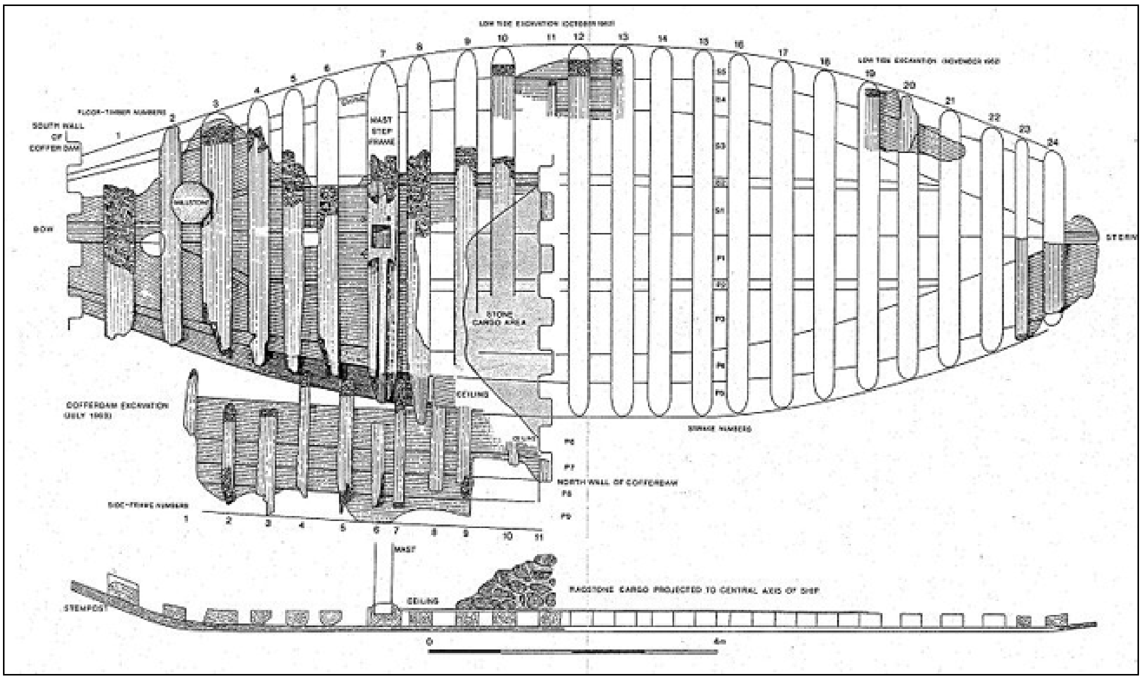


Figure 6.13 Plan of the Blackfriars 1 vessel, a sea-going Gallo-Roman ship found in the River Thames at London in 1962 (Marsden 1994).

A similar vessel was discovered at St. Peter Port, Guernsey (Channel Islands), and investigated in 1984-1986 (Rule and Monaghan 1993; Ellmers 1996b). The St. Peter Port ship, which sank around 285 AD, displayed construction techniques that were very similar to those of the Blackfriars 1 boat. The vessel was more than 25 m long, with three very thick central bottom planks. Although the stern area was better preserved, enough of the bottom hull survived to identify the mast step quite far forward. Scantlings were fastened by large iron nails driven through from the outside and clinched over on the inside.

A third vessel of this type was discovered in 1993 along the north shore of the Severn estuary in Wales. The Barland's Farm boat, as it became known, was dated to the late 3rd or early 4th century AD (Nayling *et al.* 1994). The boat's original length was ca. 11-12 m, it was approximately 3.5 m in width, and .8 m high. The vessel had four bottom (keel) planks, and all scantlings were of oak (Figure 6.14). The mast step is located approximately 1/3 of the overall length from the bow, consistent with those of Blackfriars 1 and St. Peter Port. The hull planking was not fastened together, rather each plank was attached to the frames by iron nails driven through from the outboard side and clenched over on the inside. Nayling *et al*. (1994) concluded that conceptually this is a skeleton-first construction type, as the vessel's overall shape was determined by the upward curve at the end of the floor timbers. The Barland's Farm boat, though much smaller than Blackfriars 1 and St Peter Port, has more in common with these "estuary and sea-going vessels" than with the continental riverboats from the Gallo-Roman tradition (Nayling *et al.* 1994:603).

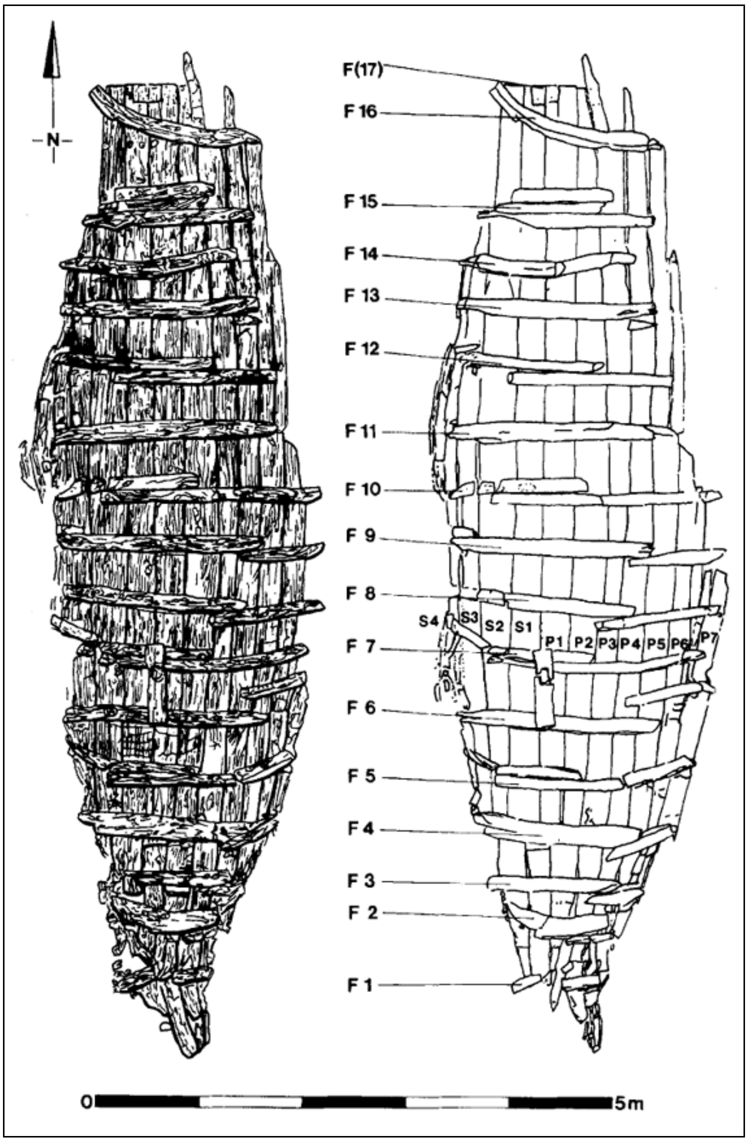


Figure 6.14 Plan of the Barland's Farm boat, a small Gallo-Roman estuarine vessel.

The Blackfriars 1, St. Peter Port, and Barland's Farm vessels can be contrasted with the County Hall boat, excavated in London in 1910 (Marsden 1972). The County Hall boat was built in the Mediterranean carvel style, with the strakes attached to each other and to the keel with characteristic mortise-and-tenon joints (Figure 6.15). The keel was not fastened to the frames, as the hull was completed before the frames were attached. The vessel's shape and curvature was therefore determined by the edge-joined hull planks, and internal frames were added later for strength. These features are characteristic of the Mediterranean Roman shipbuilding tradition, as shown by numerous investigations (see Parker 1987;

Casson 1996; Steffy 1994). The County Hall boat dates to the late 3rd or early 4th century AD and is therefore contemporaneous with the 'local' boatbuilding styles described above. The two design traditions thus evidently coexisted side by side for some period in Northern Europe.

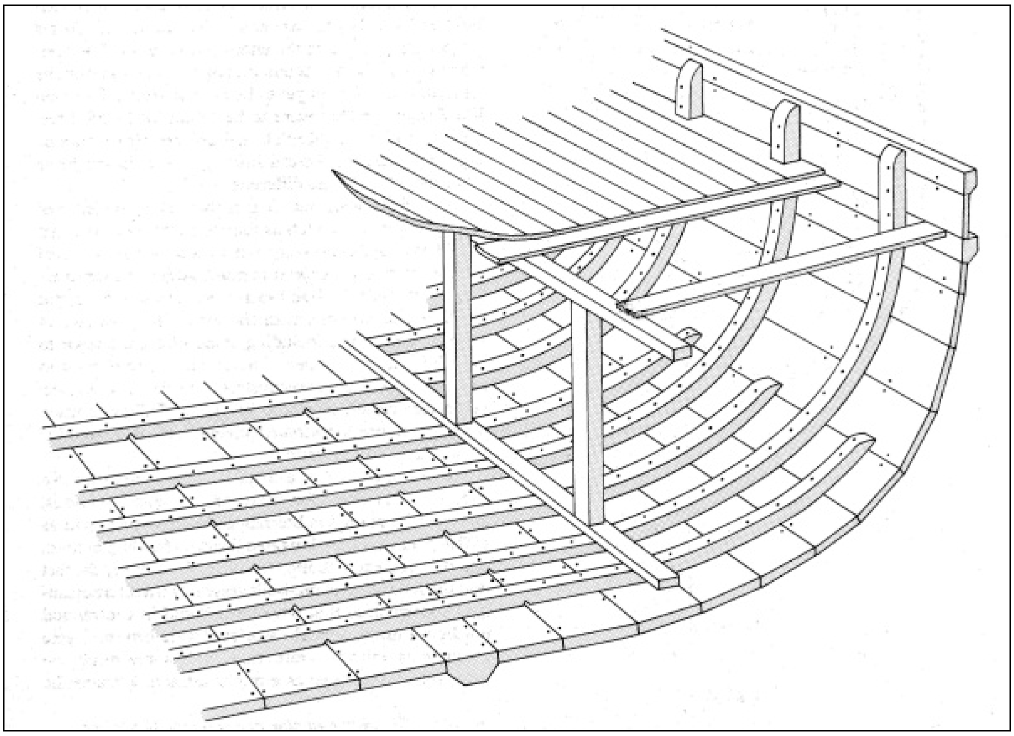


Figure 6.15 The County Hall ship, showing carvel mortise-and-tenon construction typical of Mediterranean design traditions (Marsden 1994).

Ellmers (1996b) takes the Blackfriars and St. Peter Port vessels as clear evidence that 'Celtic' (indigenous) shipbuilding continued in Britain under Roman rule. However, this construction tradition disappeared in Britain following the withdrawal of the Romans. Ellmers suggests that Anglo-Saxons then colonized Britain using their own ships, which quickly replaced the Gallo-Roman shipbuilding tradition.

Throughout inland areas of western continental Europe, the Gallo-Roman construction tradition continued through the Middle Ages (Ellmers 1996b:67). The 8th and 13th century AD Krefeld-Gellup boats, for example, retain many basic features typical of 'Celtic' boats (Figure 6.16). The 8th century vessel had mirror-image split dugout sides, and two thick floor planks fitted between the dugout shells. Narrow washstrakes were secured to the hull with wooden dowels, as was a flat transom stern. The 13th century boat features similar construction, although it was considerably larger and the longitudinal angle timbers were assembled from sawn strakes rather than dugout trunk sections. The cross timbers still alternate from one hull side to the other, but are now evenly distributed along the floor rather than being paired. Flat-bottom carvel construction continues as the basis for the 7th and 13th century AD Krefeld-Gellup boats just as it was for the 4th century BC Ljubljana vessel. The continuity of 'Celtic' pre-Roman shipbuilding heritage can thus be traced for two millennia across a large part of Central and Western Europe.

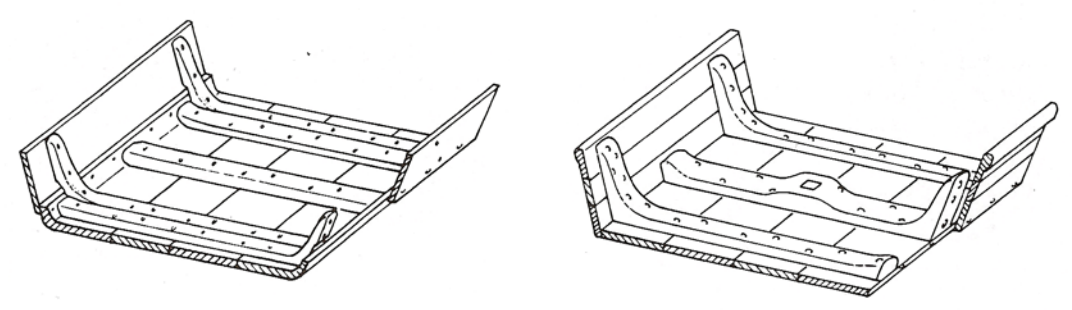


Figure 6.16 The 8th century AD (left) and 13 century AD (right) boats from Krefeld-Gellup, Germany (Ellmers 1996b:67).

6.5 Case Studies Conclusions

This chapter has tested the model presented in Chapter 5 by applying it to a selection of watercraft from various periods from regions of Europe other than the Czech Republic. The model, initially providing an explanation for the distribution of Czech logboat morphologies and construction styles, was tested against a series of case studies. Those case studies demonstrate analogous effects, suggesting that the model is widely applicable to changes in watercraft in many contexts.

This chapter has also shown, through the various examples outlined above, how specific watercraft features as well as construction traditions can be traced geographically, over long periods of time. Although trajectories of development and the spread of skill sets are influenced by many factors, chief among them are geography and socio-political conditions. At a basic level, transmission of knowledge is enabled along communication corridors such as river valleys, while it is slowed or blocked by barriers such as large mountain ranges (or simply watershed boundaries). Social, cultural, or political boundaries may also act to block or allow the movement of people and the transfer of skills and information.

The model, while broadly applicable, is not intended to be predictive in nature. It is rather a structure for inquiry, suggesting certain elements as key to the processes of the spread and transfer of knowledge and technology. The model's fundamental elements can be examined in relation to boatbuilding both archaeologically and ethnographically, providing correlation over a broad range of territories and boat types. The following chapter, which concludes the thesis, summarizes the data and analysis presented in previous chapters. The research questions posited in Chapter 1 are reconsidered in the light of data, ideas and case studies presented throughout the thesis. The original goals, especially the examination of elements of watercraft diversity and uniformity, contextualization of the inland riverine cognitive landscape, and the spread of knowledge and material culture, will be reexamined. Specific conclusions, representing a comprehensive summary of the data and analysis, will be presented.

CHAPTER SEVEN – CONCLUSION

7.1 Summary

This thesis has examined cultural change; specifically, how elements of prehistoric and early historic skill, knowledge and technology were transmitted between physical locations in Central Europe. Dugout logboats, a very distinctive class of artifact, were used as a technological proxy for knowledge in order to make the transmission visible in the archaeological record. Often overlooked as a source of information, these vessels are especially useful indicators of the spread of technology as well as certain types of trade, exchange and transport. Details of logboat construction, morphology, context and utilization can be used as tools for interpreting the behavior of their builders and operators. Changes in vessel features and shapes reflect the changing skill sets, needs and conditions encountered by the boats' users. Contextual elements, both social and environmental, are critical for interpretation of the vessels, the users, and the processes of skill and information transfer.

In the introduction, a number of research questions were posited regarding Central Europe's prehistoric inland watercraft (Section 1.4), to be answered through examination and analysis of the boats and operating environments. Vessel construction, especially elements of morphological uniformity and diversity, is particularly informative. Not only can potential or intended vessel usage be inferred from these elements, but they also demonstrate localized building traditions and skill sets. Boats as a whole are an unusual class of artifact, as they are neither wholly portable nor immutably fixed and immobile, but are restricted to a specific medium. Riverine craft are more constrained than sea-going boats in their movement, and must travel in narrow well-defined routes. The initial chapter of this thesis therefore posited that vessel features can be used to trace the transfer and adoption of skill sets along such routes and corridors.

Examinations of the boats themselves (Chapters 2 and 4) and the natural and social environments (Chapter 3) were designed to provide and explain the context within which the vessels were built and operated. The second chapter reviewed previous scientific work and investigations relating to the study of logboats in Europe, and to prehistoric and early historic watercraft in Bohemia and Moravia. Czech logboats have so far been under-reported and under-investigated, with little or no contextualization. Most of the vessels known from antiquarian sources or early literature did not long survive following discovery. A relatively small number of the known or reported Czech logboats is thus available for study, as most have not survived to the present day. The chapter provided a history of Czech logboat research and a review of available literature. The scope and context of the topic were enlarged with comparative material on logboats from neighboring countries (Austria, Slovakia, Germany, and Poland). The logboats of Germany and especially Poland have received substantial interest and study, while those of Slovakia are poorly known. Logboats from Austria are also few in number, and are known primarily from the Alpine lakes rather than from rivers such as the Danube.

Chapter Two also provided descriptions of established methodological approaches to the study of logboats and early watercraft, and the specific methodology adopted for this investigation and thesis. Previous investigations of logboat origins and the 'spread' of technologies and building traditions have generally been restricted to culture-historical or functionalist approaches. The most recent and comprehensive article (Lanting 1998) provides a high-level meta-narrative resulting in the suggestion of two core regions for the origin of the

European logboat. Lanting's approach, however, disregards morphological variation and has essentially failed to take into consideration an understanding of the people who built and operated the vessels.

The approach taken by the current thesis has been designed to elucidate behavioral aspects of the vessels' builders and operators, by focusing on practices of skill and technology transfer, especially as they apply to the artifacts in question. The goal is a more 'humanized' archaeology, in which the focus of inquiry is directed at the people who created the boats, through the traces left in the archaeological record. There is no question that a thorough understanding of vessel features and morphology is essential to the investigation, which is then taken a step further: a theoretical level at which transfer of watercraft design is used as a proxy for the adoption of knowledge and skill. Methodological elements were thus designed to maximize the information potential of Czech logboats, especially through analysis of features and morphology, and the contextualization of the vessels and their operating environments.

The third chapter consequently described the physical and human contexts within which prehistoric Central European watercraft were built and utilized. Watercraft are intimately related and tied to their operating environments. An understanding of the physical context is therefore essential for interpreting the vessels (and ultimately the behavior of the vessels' builders and operators). Comprehensive descriptions of geography, topography and hydrographic features are also especially significant, as the spread of information and skill sets in physical space is a main focus of the thesis (Sections 3.1 and 3.2). The territory's physical geography determined the routes of travel and transport, funneling the movement of people through the river valleys and across a few key passes or watershed boundaries. The crossing at the Moravian Gate between northern and southern

Europe has been extremely significant throughout prehistory, and trans-European trade and procurement routes made extensive use of this corridor. Similar important land routes connected the Elbe to the Morava and Oder, and the Vltava to the Danube. Water transport, far more efficient than overland haulage, was likely an important element in trans-continental trade and exchange.

Finally, the human context was examined, from the earliest periods of prehistory to early modern times (Sections 3.3 and 3.4). Use of the rivers was extensive throughout the region, resulting in traditions of usage spanning the last 20 or 30 millennia. The most significant riverine routes and corridors for early travel are still those used today for modern transport. Regional watersheds may be viewed as a series of interlocked transport zones, effectively inland riverine cultural landscapes, which bring together the physical and human contexts and demonstrate the significance and utility of watercraft.

Chapter 4 catalogued and described all known Czech logboats. Details were provided for each vessel, including physical measurements, construction methods, feature descriptions, discovery locations and circumstances, association and setting, etc. For the 20 accessible surviving logboats, scale plans are provided, and as well as details of conservation, curation and current location. Morphological characteristics are described in detail, especially those that may aid in identification of localized building traditions.

From the catalogue and the previous chapters, it is evident that there is considerable variation in construction, form, function, dating and utilization of pre-modern Bohemian and Moravian watercraft. Analysis of assembled information (Chapter 5) was intended to identify patterns of construction that may be used as indicators or proxies for the presence of certain skill sets or building traditions. The focus was on identifying and describing technical elements that in turn demonstrate the processes of information transfer. All aspects of watercraft construction and usage that may be relevant to this objective were also examined. The discussion as a whole was intended to elucidate further details and reveal the motivations and rationales of the boat-builders' behavior.

Dating analyses (Section 5.1) demonstrates that logboats were built and utilized in Central Europe over a tremendous span of time. Clearly these boats met the needs of their users, despite the potential for developing and building other types of vessels. A typology-based chronology is therefore not possible, and this perspective is explicitly avoided. This portion of the analysis concludes that vessel dating and chronology should be understood within the context of the local cognitive landscape.

The distribution and extent of Czech logboat sites and remains show clustering along the country's two dominant waterways. The central Bohemian basin and the lower Morava River valley are especially rich in logboat remains, reflecting both prehistoric as well as modern utilization of the local riverine landscape. The distribution of vessels along the main rivers of each watershed demonstrates their usage as transport corridors over long periods of human history (Section 5.2).

Although archaeological documentation of recovery circumstances is lacking for many vessels, there are potentially several examples of deliberate discard or placement (see Section 5.3). The Mohelnice vessel in particular, pinned bottom-up among poles and pilings, exhibits purposeful arrangement and perhaps ritualized deposition. The logboat from Čelákovice, which has a rectangular hole hewn in the floor, is also a likely example of deliberate discard. Placement of this sort may reflect formalized or ritualized boundaries or restrictions on travel.

Examination and analysis of the vessels' morphology and constructional features reflect the processes of pre-modern boat building. Successful or proven examples are replicated, resulting in persistence of design. Boats are associated with their owners and operators, and achieve personality and life histories. All these elements contribute to long term continuity of design tradition (see Section 5.5).

Reasons for building and using logboats included subsistence, trade, cargo transport, and long-distance travel (Section 5.6). Although the efficiency and utility of water travel made boats economically significant, watercraft also filled important social roles. Vessel and feature distribution indicate the region's key transport routes, and the processes by which people propagated knowledge and skill sets. Chapter 5 concluded with the articulation of a model for how watercraft designs change over time. Implications of the model are discussed in detail in Section 7.4 below.

Chapter 6 broadened the scope to include case studies from other European contexts. The ideas generated in previous chapters, especially the model elements articulated in Chapter 5, were tested against data from other periods and regions seeking to ascertain whether similar results can be identified from differing environments. Case studies of Polish, French, Swiss, and Gallo-Roman vessels were presented. The case studies broadly support the model, and demonstrate how specific watercraft features as well as construction traditions can be traced geographically, over long periods of time, in many European contexts. Rivers (and later canals) acted as transmission corridors for design innovations and can be understood as cognitive landscapes; mountain ranges (or simply watershed boundaries) acted as barriers, maintaining continuity and preserving local boat building traditions.

The work as a whole addresses the research questions, which are re-examined in the following section.

RESEARCH QUESTIONS

- Czech logboats exhibit tremendous diversity and variety in their morphology and physical characteristics. Uniformity on a local scale is the norm. However, there are significant changes over time and through space, resulting in the diversity apparent in the archaeological record. What are the parameters that determine uniformity and diversity? Can geographically (or chronologically) localized traditions of Czech logboat construction and usage be ascertained through analysis of technical and functional features?
- Can analysis of the vessels' physical and social contexts elucidate an understanding of the 'riverine transport cultural landscape'?
- Can Czech logboats be used as proxy artifacts for understanding elements of the processes by which material culture as well as knowledge and skill were dispersed and spread across Europe? What are the implications for information transmittal and exchange?
- Do the processes observed and described for Czech logboats apply to watercraft from other regions of Europe? Do these processes apply for other types of boats? Other types of material culture?

Research questions are addressed in individual sections below.

7.2 Diversity and Uniformity

Examinations of Czech logboats have revealed patterns of localized uniformity within a tremendous overall diversity of form and morphology (Chapters 4 and 5). The occurrence (or lack) of identifiable features and constructional style indicates the use of and adherence to specific boat-building traditions. In the Czech Lands, the presence or absence of internal partitions is a particularly strong indicator of distinct constructional traditions. All known vessels from the Morava River watershed have some form of internal partitioning (especially bulkheads and transverse ridges), while nearly half of the logboats from the Elbe River basin in Bohemia were built with entirely smooth, undivided and unimpeded interior spaces. Functionalist rationales do not explain these differences, which rather result from regionalized design traditions and the skills and experience of the builders.

Clear evidence of specific constructional and boat building skill sets is also manifest at a local level. For example, all four logboats from the Mikulčice site on the Morava River display considerable similarity in form and morphology. This particular combination of features, including beveled transverse ridges, and a U-shaped hull narrowing to a V-profile at the extremities, is not seen on vessels from elsewhere in Moravia (and during the same period in Bohemia, builders were making completely different vessel types, with semi-circular hull profiles and no internal ridges). Traditions of construction are thus locally as well as regionally evident.

Some logboat types have clearly 'jumped' the geographic divide between catchment areas and are known in both major Czech watersheds. The best example of this is the single-person fishing vessel (Příkazy, Spytihněv, and Poděbrady 2), with thwarts and a bulkhead separating internal wet and dry functional spaces. As mentioned in Chapters 4 and 5, this vessel type is known from many locations in Europe, and has been extensively described by Ossowski (1999; 2000a). The ubiquity of this type of vessel from the Middle Ages onward suggests extensive travel and familiarity with pan-European boat types, or possibly even itinerant boat-builders journeying along the rivers of Europe.

The Jaroměř logboat is another example of a vessel type that 'jumped the divide', in this case from the upper Oder to the upper Elbe. The Jaroměř vessel is a *Lewin*-type logboat, known mainly from the upper Oder River system in Poland. As mentioned in Chapter 4, the upper tributaries of these large rivers come to within 5 km of each other, in the region of the modern Czech-Polish border (and just 36 km from the Jaroměř logboat discovery location). This example is particularly demonstrative of the way specific boat designs spread from one river system to another, as the constructional knowledge and skill-sets bridge the overland gaps between watersheds.

The pre-modern watercraft design climate was complex and intricate, and can be elucidated only by following numerous trajectories of evidence. Ethnographic evidence strongly suggests that boat builders and operators will adopt new features or vessel types only after they have seen and experienced those innovations first-hand. Once a new design has been proven reliable and successful, builders will incorporate it (or elements thereof) into their repertoire. This tends to propagate the long-term continuity of design tradition.

Analysis of Czech logboats' technical and functional features (Chapter 5) has demonstrated localized design traditions, as well as designs that originated in other regions and were brought to Czech rivers. These variations in design origin help to explain both the uniformity and diversity apparent in Czech logboats. Their function and utilization also account for elements of uniformity and diversity. Conclusions regarding social and cultural aspects of logboat usage are addressed in the following section.

7.3 Inland Watercraft and the Riverine Cognitive Landscape

The idea of a cohesive maritime community is readily accepted for groups or cultures living in close proximity to seas, oceans, rivers and other bodies of water. It follows that these communities develop skills and traditions (including boat-building) that are relevant and necessary to their marine environment. The development of similar skills and traditions in an inland context is not so intuitive, yet the data clearly suggest that early Europeans manufactured and used a variety of watercraft in areas surprisingly remote from the sea. Muckelroy (1978:139) clearly understood the archaeological research potential of inland watercraft: "The vessels of a given lake system or river basin are important both as vital elements in regional culture, and as indicators of relationships between the traditions of different areas. The scope for the discovery and excavation of such craft in all parts of the world is thus very great…" In the three decades since Muckelroy's seminal publication, archaeologists have undertaken many investigations of inland watercraft. Often, however, these investigations have been uncontextualized and their potential for addressing larger questions of archaeology is unrealized.

More recent inquiries focus on social aspects of inland navigation. Pål Nymoen (2008) has argued that inland watercraft, often neglected by maritime archaeologists, can shed light on themes that are as yet poorly understood. Nymoen calls for "new narratives" derived from vessels used on rivers and lakes, which will broaden our understanding of human relationships with water. Inland and even mountain communities, while not maritime in the strict sense of living next to the sea, exploited rivers and lakes, included them among the most significant of their holy and spiritual locations (Bradley 2000), and developed highly sophisticated watercraft. The results of investigations described in this thesis lead me to suggest that river valleys, or rather watersheds or catchment areas, are cognitive landscapes similar to the coastal maritime cultural regions posited by Westerdahl (1992, 2008). Patterns of transportation that cross watershed boundaries can transmit material culture (in the form of portable artifacts). Cross-catchment travel and transportation can also transmit information and knowledge between watersheds. Investigations of inland watercraft have tremendous potential for addressing questions relating to such travel, trade and communication.

Logboats and other prehistoric European watercraft were important across a wide range of human activities. The large carrying capacities of many vessels demonstrate that they were built and used not only for waterborne resource procurement, but also for use in local, regional, and long-distance trade and exchange. Boat builders and operators invested considerable time and effort to construct and use logboats, and they did so with purpose and significance.

Riverine and lacustrine landscapes are distinctive environments, and the people who lived and worked there acquired distinctive local knowledge (an understanding of currents, weather, shifting sandbars and obstructions, and the movements and habits of fish and water birds, for example) (cf. O'Sullivan 2003). Specialized skills were developed and passed from generation to generation. Boats were the vehicles that allowed land-bound humans to penetrate the watery world, and to gain an understanding of its elements. This knowledge and experience was used to create and sustain the social life of river and lakeside communities. Skills and traditions learnt and passed in this fashion included significant elements of boat construction and utilization.

Czech logboats were used for subsistence, transport, and communication as well as trade and exchange. These activities were channeled by specific combinations of river corridors and overland cross-divide connections between watersheds. The most important among these were the Moravian Gate between the Morava and Oder rivers, the overland connection from the head of the Vltava to the Danube, and the overland route from Bohemia to Moravia connecting the Elbe and Morava watersheds. These river systems in turn flow to the North Sea (the Elbe), the Baltic Sea (the Oder), and the Black Sea (the Morava). The inland riverine cognitive landscape is a result of this geographic nexus of waterborne communication routes.

In a roadless country, the waterways of a riverine landscape were of outstanding importance. The significance of the main Czech rivers as primary routes of transportation and communication was superseded only towards the end of the 19th century by railways and later paved roads. It is significant that the main railway lines, even today, are routed directly across the key watershed divides, between catchment areas of the main Bohemian and Moravian rivers. The Czech landscape thus provides a meaningful example of a *cross-cultural survival area* (as defined in Westerdahl 1992), where relict patterns of transportation remain in active use.

7.4 Spread and Adoption of Knowledge and Material Culture

The processes by which technology, intellectual innovations, skill sets and knowledge spread and transfer between groups of people are complex and multifaceted. Societies are not closed systems, and development of society or culture may be constrained or influenced by the broader social network of which it is a part (Trigger 2006:438).

Many environmental and social factors influenced the spread of human culture and communities across Europe. Creative use and adaptation of available resources and material allowed people to flourish and expand to virtually every corner of the continent. Many major innovations in early European prehistory were transmitted from Asia, gradually spreading across the extent of Europe. The list includes domesticated plants and animals, ceramics, writing and metalworking. As described by Andrew Sherratt (1997:63), "European culture cumulatively absorbed and reinterpreted many features whose origins lay in the mid-East, from agriculture to Christianity". The Near Eastern origin of key elements of European culture was recognized and gracefully articulated by V. Gordon Childe in many seminal publications (Childe 1928; 1950; 1957; and others). Technology, information, material assemblages, religion, and ideology were propagated and transmitted, imparting the basic elements of uniformity and diversity visible today. The trajectories of flow are broadly visible and understood, but the mechanics of knowledge transfer require deeper inquiry.

The processes of interregional interaction played a major role in creating culture and society (Kristiansen and Larsen 2005:5). Penetration and distribution of the ideas, customs and techniques that make up culture was necessarily routed and channeled by the continent's physical geography. To a great extent, a region's topography and natural features determine the potential courses of passage through the landscape. People naturally avoided significant obstacles, and made use of natural features that aided movement and travel. Flows of people, information and material were thus constrained into particular channels and corridors. Due to ease of access, transport routes often developed along river valleys, especially where the headwaters of one system come near the source of a second. Boats and watercraft were an integral means for spread and transmittal of culture, not only on the seas of the continental margins, but also inland on the lakes and river systems crossing and interlacing Europe's core territory.

The potential physical means by which transfer occurred are few, and all of these options were no doubt utilized in many different permutations. However, the physical restrictions of communication through the European terrain made water travel a vital necessity since early prehistoric times. Boats were essential for long distance transportation of heavy, bulky, and valuable cargos, and in some contexts were irreplaceable by any other means.

As people moved, traded and distributed material objects around Europe, they also observed technological variation and innovation, exchanged knowledge, and experienced different customs and traditions. In this way knowledge and skill sets were themselves moved and propagated. The distances involved need not have been tremendous (although on occasion they may have been); in some cases all that was required to see new or different ways of life was to move from one valley, watershed or river system to a new or neighboring one. The question thus becomes one of parameters: when and how are differences or innovations adopted in the 'home' community? The investigation described in this thesis suggests that a number of factors that apply to morphological change in logboats and other vernacular watercraft.

The surviving examples of prehistoric Central European logboats provide a glimpse at some of the mechanisms of early travel and transportation, resulting in transmission of skills and knowledge. Boat builders and craftsmen adopted technologies and building styles from examples they had seen or experienced firsthand. Skills and techniques were directly transmitted, and the design tradition was perpetuated by replication of successful examples. Specific forms were reproduced based on proven examples at hand (see Section 5.5).

Goods, skills, knowledge and customs were carried back and forth across the continent, in the process imparting the basis of European culture. Differences and similarities among vessels from different periods and regions indicate local and regional traditions, as well as trajectories of innovation and advance. Czech logboats of all periods exhibit local peculiarities as well as forms and features similar to dugouts from across Europe. The continuity of form indicates transmittal of knowledge on a continent-wide basis. Regional variations and differences, such as those noted for Bohemian and Moravian vessels (section 5.5) are evidence of localized boat-building traditions. Such persistence of design indicates the cultural continuity generated by geographic channeling of transport and communication. Boat builders on separate river systems used the knowledge and skill accumulated over generations, preserving constructional traditions. Changes in environmental or social conditions prompted innovation, enabled by personal acquaintance with new or differing types of technology.

The processes outlined above, and the results of analysis in previous chapters, have contributed to the development of a model explaining design change and innovation for all pre-modern and vernacular watercraft (see Chapter 5). Basic elements of the model include a conservatism or persistence of boat design based on proven and familiar examples. New designs may be adopted if the builder and operators can experience them first-hand, and direct personal experience is the key to the spread of different vessel types or constructional morphologies. The role of geography is significant, as the boats (and usually the people) travel in narrow well-defined corridors.

The elements contained in the model are not necessarily surprising or un-anticipated; on the contrary they are rather intuitive and make inherent sense, if one approaches the boats from the builders' and users' perspective. To my knowledge, however, this is the first time that such a model has been explicitly proposed, as well as supported with both archaeological and ethnographic evidence. The range of case studies used to test the model was necessarily limited by the constraints of the thesis, but broader application in the future to watercraft from other regions of the world may be useful in determining the model's applicability, limits, and extent.

7.5 European Watercraft Design Traditions: La Longue Durée

This thesis has shown how design traditions of Czech logboats (and other watercraft) may be identified, and how the spread and transfer of such elements is accomplished. The model developed on this basis was then applied to a number of differing situations. Similar results are obtained from examination of constructional elements found on watercraft across Europe. Chapter 6 examined shorter case studies from the Loire region of France, Poland's Oder and Vistula watersheds, rivers and lakes of alpine Switzerland, as well as a longer look at the spread and evolution of the Gallo-Roman boatbuilding tradition. The case studies considered in Chapter 6 support the model for watercraft change described in Chapter 5. This inquiry has further demonstrated some of the factors that influence the spread and transfer of watercraft features, namely the importance of river systems as geographic transit corridors as well as socio-cultural conditions. Combinations of these factors, over varying periods of time, act to promote or inhibit the adoption of technological innovations. Factors that block innovation or variation can result in local or regional uniformity, which can give way to outside influences when social, political, or geographic barriers are removed. The end result is the combination of uniformity and variation apparent in the archaeological and historical record. As a broad explanation for cultural change, this model may indeed be applicable to a wide range of material culture.

As this investigation relates to watercraft, the results may be taken a step further, and used to articulate a key concept in preliterate boat design and construction. The data and arguments presented above suggest that the single most important element of boat building throughout prehistory is the direct transfer of skill and knowledge between individuals. Experience, skill, and observed knowledge are in fact the key components of all European boat design prior to ca. 1500 AD. Even after the Renaissance, small boats and vernacular watercraft continued to be built in this fashion up until the 20th century. After ca. 400 AD, nearly all watercraft in northern Europe were clinker-built boats. By around 1500 AD, there was a marked transition to skeleton-first carvel-type construction. The typical Northern European ship around the year 1200 was clinker-built (as most had been for nearly a millennium), and featured a single mast – essentially a Viking galley. By 1520 the average English seagoing vessel was skeleton-built, carvel-planked and multi-masted (Friel 1995:11), and the same technology was in use along the entire European Atlantic seaboard. The nearly universal adoption of the carvel-type design for large boats after 1500 represented the gradual development of a specialized profession of boat builders constructing on the basis of written plans and designs. Regular written plans and mathematical ship architecture dates from the mid-18th century; building by eye was initially just as important for carvel as for clinker construction.

Boat-building has always been a specialized undertaking, although probably not on a full-time professional basis. The boat builders of prehistory, at least in northern Europe, were likely involved in the craft only part-time or seasonally (cf. McGrail 1987:159-160). This supposition is corroborated by ethnographic evidence as well. Small communities would have one or two men who could build and repair not just boats, but anything wooden, from "cradles to coffins" (McKee 1983; see also Hasslöf *et al*. 1972). Although specialized boat builders were undoubtedly present from a very early date, for example the builders of large complicated vessels such as the British Bronze Age sewn-plank boats, the learning and passing of knowledge was totally dependent on direct personal experience. From the early medieval period onward, however, there is evidence for increasing specialization of the profession in northern Europe, working from written plans and documents. Investigations of the shift to skeleton-first carvel construction have concluded that the transition was gradual, with increasing use of geometry and other design aids, finally culminating in scale drawings and models (McGrail 2003). An important ramification of the shift was that shell-first hulls were built by eye, while skeleton-first vessels construction required systematic planning; i.e. frames had to be lofted and the shape of the hull determined before planking was attached (Guilmartin 2002:90). This type of construction increasingly required documentary aids, which created a completely new way to conceive of and learn about shipbuilding.

Professional shipwrights' guilds were in existence in London by the late 14th century, although the numbers of men involved in the trade were very small. Although state participation became gradually more common, it seems that private merchants were initially more significant in initiating large scale ship building. The first royal dockyards in England (at Portsmouth) were not established until 1495 (Friel 1995:39-41). Despite new institutions such as guilds and commercial shipyards, direct experiential learning on the part of ship builder was still important. Friel (1995:43) concluded that professional shipwrights probably learned their trade through a system of apprenticeship, although with the exception of the London guild there are no formal records of such. The repetition of particular family names in guild rolls and construction accounts may indicate lineages or 'dynasties' of ship builders, where younger generations learned the craft from their older relations.

A significant motivation of the shift to carvel hulls has been attributed to the higher expense of labor-intensive northern lap-strake construction (Unger 1980). Skeleton-first construction was certainly less dependent on traditional skills than was clinker building. By the early 16th century, the lower cost of building and repairing skeleton-first hulls had reduced the application of clinker construction to small boats and locally built vernacular craft (Runyan 1991:203; also cf. Reinders and Paul 1991; Unger 1994). The shift to large carvel craft in Northern Europe is indicative of increasing state involvement in the construction of shipping and naval fleets. In fact Friel (1995:10-11) attributes the ability of European states to conduct voyages of exploration and discovery from the 15th century onwards to the development of the three-masted skeleton-built ship at this time. State participation in ship building became increasingly common. Professional shipyards became widespread, both commercial and state-sponsored. Small boats and local vernacular watercraft, however, continued to be built by the same methods and practices as they had been for thousands of years.

7.6 Conclusions

The vessels examined in this thesis are interesting on at least two levels: as direct evidence of boatbuilding technology and know-how, and as proxy artifacts for the transfer and adoption of skill sets and knowledge. Placing Czech logboats within their proper geographic and historical context, as well as examining them through a broader theoretical framework, has allowed a more complete understanding of their cultural and social significance.

As with many archaeological inquiries, however, the questions answered are invariably outnumbered by those raised during the course of research. Many topics await further investigation. Questions raised by this thesis include the following: Why have virtually no vessels been discovered on large tributaries of the two main Czech Rivers? Why in particular are no logboats known from the longest Czech River, the Vltava? When were planked vessels introduced on Czech rivers, and why have no planked vessels been found in an archaeological context south of the Oder River watershed? When and under what circumstances did wheeled transport overtake waterborne communication as the main mechanism of trade and cargo?

The model described in Chapter 5 explains broad processes of change in pre-modern and vernacular European watercraft. It is unlikely that the parameters and elements of change identified for these vessels are solely restricted to Europe. The model is likely relevant to watercraft from other regions of the world, and investigations focusing on different geographical areas would help to substantiate and improve the models' basic premises. The major boatbuilding traditions of the world can thus be contextualized and directly related to the people who built and operated the vessels. Research in those parts of the world where vernacular watercraft are still greatly hand-built would likely be of great significance in refining elements of the model, which can then be related back to prehistory and early modern periods.

Further work should be also undertaken to identify and explore elements of maritime culture specific to inland waterways (rivers, lakes, springs, bogs, etc.), similar to recent investigations focusing on coastal and sea-based societies (cf. Van de Noort 2004; Van de Noort 2006; Westerdahl 2005). It seems likely that inland

European riverine transport landscapes exist in segments or zones along the continent's longest rivers. Boundaries or transition areas may show significant patterns of boat building and usage. Following a particular river, say the Elbe or the Danube, from the headwaters to the respective sea would likely uncover striking and meaningful patterns of continuity and variation. The connections and reciprocal influences between inland and coastal maritime cultures are another promising avenue of future research.

As articulated by Barry Cunliffe (2001:1), "The European landscape is an intricate patchwork of environments, each with its own range of resources, closely interlocked in such a way that, however isolated the communities were, networks of interaction and exchange were inevitable." The peopling of this varied landscape, exploitation and distribution of its resources, and development of culture and society, all depended to a certain extent on the physical environments available for human habitation and communication. Social and political dynamics also acted to promote or restrict cultural change. Interaction and exchange took place on many different levels – local, regional, interregional and long-distance – in different directions and over a vast time scale. The process was dynamic, multi-directional and active. The logboats (and other watercraft, see Section 5.8) of Central Europe were a means of interaction and exchange. The vessels were developed, crafted and adopted by creative and dynamic bearers of tradition, goods and culture. The vessels remain as evidence of their activities and a record of their actions.

The purpose of archaeology as a field of study is to communicate the content and character of the past, and to trace the process of humanization (Clark 1979). Elements of variety and uniformity, diversity and homogeny, are apparent in every period of human culture, in every region of the world. This juxtaposition of material culture, created and used by human beings, reflects human activities. Explaining elements of previous human behavior helps satisfy our desire to know about the past. Describing the processes of cultural change brings helps us to understand of our own past and current identities. The logboats of Bohemia and Moravia can aid this understanding as testimony to the behavior and actions of past cultures and human traditions.

BIBLIOGRAPHY

Adney, Edward T. and Howard I. Chappelle
2007 *Bark Canoes and Skin Boats of North America*. (Originally published in 1964 by the Smithsonian Institution, Washington). Skyhorse Publishing, New York.

Alford, Michael B.
1992 Origins of Carolina Split-Dugout Canoes. *International Journal of Nautical Archaeology* 21(3):191-203.

Anderson, Søren H.
1987 Mesolithic dug-outs and paddles from Tybrind Vig, Denmark. *Acta Archaeologica* 57:87-106.

Andreska, Jiří
1975 Archeologické nálezy rybařského nařadi v Mikulčicich. *Archeologické rozhledy* 27:132-138.

Angerer, Franz
1927 Über den Mondseer Einbaum. In *Die Funde Aus Den Prähistorischen Pfahlbauten im Mondsee*, pp. 99-104. Anthropologische Gesellschaft in Wien, Vienna.

Arnold, Béat
1976 La pirogue d'Auvernier Nord, 1975 (Bronze final). Contribution à la technologie des pirogues monoxyles préhistoriques. *Cahiers d'archéologie subaquatique* 5:75-84.
1980 Navigation sur le lac de Neuchâtel: une esquisse à travers le temps. *Helvetia Archaeologica*, 11(43/44):178-195.
1982 The architectural woodwork of the Late Bronze Age village Auvernier-Nord. In *Woodworking Techniques before A.D. 1500*, Seán McGrail, editor, pp. 111-128. British Archaeological Reports (S-129), Oxford.
1983 Les dernières pirogues monoxyles de Suisse centrale. *Helvetia archaeologica* 55-56:271-286.
1985a From Logboat to Plankboat – Some Traditional Craft of Switzerland. In *Postmedieval boat and ship archaeology. Papers based on those presented to an International symposium on boat and ship archaeology in Stockholm in 1982*, Carl Olof Cedarlund, editor, pp. 285-297. British Archaeological Reports (International Series, 256), Oxford.
1985b La pirogue de Chalain-Marigny et quelques considérations sur les monoxyles découverts en France. In *Néolithique, Chalain-Clairvaux, fouilles anciennes*, pp. 211-222. Lons-le-Saunier, Musée d'archéologie (Présentation des collections du Musée de Lons-le-Saunier, 1). Lons-le-Saunier.
1989 Architecture navale en Helvétie à l'époque romain: les barques de Bevaix et d'Yverdon. *Helvetia Archeologica* 20:2-28.
1992 *Batellerie gallo-romaine sur le lac de Neuchâtel*, volume 2. Editions du Ruau (Archéologie neuchâteloise, 13). Saint-Blaise.
1993 Logboats of the 6th Millenium BC. In *A Spirit of Inquiry: Essays for Ted Wright*, pp. 5-8. University of Exeter, Exeter.

1996 *Pirogues monoxyles d'Europe centrale: construction, typologie, évolution*. 2 volumes. Neuchâtel Cantonal Museum of Archaeology, Neuchâtel, Switzerland.
1998 Les pirogues néolithiques de Paris-Bercy. *Archeonautica* 14:73-78.
1999 Some remarks on Romano-Celtic boat construction and Bronze Age wood technology. *The International Journal of Nautical Archaeology* 28(1):34-44.
2000 Carpenters, Logboats and Bronze Age Villages on Lake Neuchâtel. In *Down the River to the Sea* (Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 201-206. Polish Maritime Museum, Gdańsk.
2002 Logboats from Europe and the CD-ROM, or a solution to the endless search for documents (2000 edition). *International Journal of Nautical Archaeology* 31(1):129-132.
2006 Archéologie expérimentale: la pirogue néolithique expansée Paris-Bercy 6 et les arts du feu. *Archéologie neuchâteloise* 34:65-77. Neuchâtel Cantonal Museum of Archaeology, Neuchâtel, Switzerland.

Arnold, Bettina and D. Blair Gibson (editors)
1995 *Celtic chiefdom, Celtic state*. Cambridge University Press, Cambridge.

Arnold, Jeanne E.
1995 Transportation Innovation and Social Complexity among Maritime Hunter-Gatherer Societies. *American Anthropologist* New Series 97(4):733-747.

Audouze, Francoise and Olivier Büchsenschütz
1992 *Towns, Villages and Countryside of Celtic Europe*. Indiana University Press, Indianapolis.

Axamit, Jan
1915 Příspěvky k studiu naší keramiky nordické. *Památky archeologické* 27(1915):77-86.

Barford, P. M.
2001 *The Early Slavs: Culture and Society in Early Medieval Eastern Europe*. Cornell University Press, Ithaca.

Bass, George (editor)
1972 *A History of Seafaring based on Underwater Archaeology*. Thames and Hudson, London.

Bath-Bílková, B.
1973 K problému původu hřiven. *Památky archeologické* 64:24-41.

Bauer, S.
1992 Wasserfahrzeuge aus Bayerns Vorzeit. *Das archäologische Jahr in Bayern 1991*, 80-82.

Beaudoin, François
1970 *Les Bateaux de L'Adour*. Musée Basque, Bayonne.

Bednařík, Karel
1957 Nález pravěké lodi u Přerova nad Labem. *Vlastivědný sborník Českobrodska* (1):151-152.

Beer, Hubert
1988 Unterwasserarchäologische Untersuchung bronzezeitlicher Siedlungsreste und eines Einbaumes in der Flachwasserzone der Roseninsel. *Das archäologische Jahr in Bayern 1987*, 58-60.
1990 Unterwasserarchäologische Ausgrabung und Bergung eines prähistorischen Einbaums aus der Flachwasserzone der Roseninsel. *Das archäologische Jahr in Bayern 1989*, 84-87.
1991 Zur Bergung eines prähistorischen Einbaums aus der Flachwasserzone der Roseninsel. *Vom Einbaum zum Dampfschiff, Jahrbuch des Fördervereins südbayerisches Schiffahrtsmuseum Starnberg* 8:112-119.

Boczar, M.
1966 The craft in use at the Rivergate of the Dunajec. *The Mariner's Mirror* 52-53:211-222.

Bonino, Marco
1981 Rafts and Dugouts in Central Italy. *The Mariner's Mirror* 67(2):125-148.
1983 Le imbarcazioni monossili in Italia. *Bollettino del Museo civico di Padova* 72:51-77.

Bouzek, Jan
1990 The Shifts of the Amber Route. In *Amber in Archaeology*, Curt W. Beck and Jan Bouzek, editors, pp. 141-146. Czech Academy of Sciences, Institute of Archaeology, Prague.
2003 The Central European Amber Route During the La Tène and Early Imperial Times. In *Amber in Archaeology, Proceedings of the Fourth International Conference on Amber in Archaeology, Talsi, 2001*, Curt W. Beck, Ilze B. Loze, and Joan M. Todd, editors, pp. 156-163. Institute of the History of Latvia, Riga.

Bouzek, Jan, D. Koutecky, and K. Simon
1989 Tin and Prehistoric Mining in the Erzgebirge (Ore Mountains): some new evidence. *Oxford Journal of Archaeology* 8(2):203-212.

Bradley, Richard
2000 *An Archaeology of Natural Places*. Routledge, London and New York.
2005 *Ritual and Domestic Life in Prehistoric Europe*. Routledge, London and New York.

Braudel, Fernand
1972 *The Mediterranean and the Mediterranean World in the Age of Philip II*, Volume 1. Harper and Row, New York.

Břeň, Jiří
1976 Earliest Settlements with Urban Character in Central Europe. In *Oppida in Barbarian Europe*, Barry Cunliffe and Trevor Rowley, editors, pp. 81-94. BAR Supplementary Series 11, Oxford.

Bronk Ramsey, Christopher
1995 Radiocarbon calibration and analysis of stratigraphy: The OxCal program. *Radiocarbon* 37(2):425-430.
2001 Development of the radiocarbon calibration program OxCal. *Radiocarbon* 43(2A):355-363.

Broodbank, Cyprian
1989 The Longboat and Society in the Cyclades in the Keros-Syros Culture. *American Journal of Archaeology* 93(3):319-337.

Brun, Patrice
1995 From chiefdom to state organization in Celtic Europe. In *Celtic chiefdom, Celtic state*, Bettina Arnold and D. Blair Gibson, editors, pp. 13-25. Cambridge University Press, Cambridge.

Burmeister, Stefan
2004 *Rad und Wagen: Der Ursprung einer Innovation Wagen in Vorderen Orient und Europa*. Verlag Philipp von Zabern, Mainz.

Casson, Lionel
1991 *The Ancient Mariners*. Princeton University Press, Princeton, New Jersey.
1996 Sailing Ships of the Ancient Mediterranean. In *The Earliest Ships: the Evolution of Boats into Ships*, Robert Gardiner and Arne Emil Christensen, editors, pp. 39-51. Conway Maritime Press, London.

Cederlund, Carl Olof
2000 The Structure of Inland Transportation in Early Swedish Iron Production; Types of Vessels in the Same; Its Relation to General Transport and Communication Routes. In *Down the River to the Sea* (Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 245-250. Polish Maritime Museum, Gdańsk.

Childe, V. Gordon
1928 *The Most Ancient East: The Oriental Prelude to European Prehistory*. Kegan Paul, London.
1929 *The Danube in Prehistory*. Clarendon Press, Oxford.
1950 *Prehistoric Migrations in Europe*. Harvard University Press, Cambridge.
1957 *The Dawn of European Civilization*. (6th edition). Vintage Books, New York.
1958 *The Prehistory of European Society*. Penguin Books, Harmondsworth.

Christensen, Arne Emil
1996 Proto-Viking, Viking and Norse Craft. In *The Earliest Ships: the Evolution of Boats into Ships*, Robert Gardiner and Arne Emil Christensen, editors, pp. 72-88. Conway Maritime Press, London.
2000 Some Archaic Details of Norwegian Fresh-water Boats. In *Down the River to the Sea* (Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 163-168. Polish Maritime Museum, Gdańsk.

Christensen, Charlie
1990 Stone Age Dug-Out Boats in Denmark: Occurrence, Age, Form, and Reconstruction. In *Experimentation and Reconstruction in Environmental Archaeology*, David E. Robinson, editor, pp. 119-142. Oxbow Books, Oxford.

Čižmář, Miloš
2002a *Keltské oppidum Staré Hradisko*. Vlastivědné muzeum v Olomoucí, Olomouc.
2002b Laténský depot ze Ptení- K poznání kontaktů našeho území s jihem. *Památky archeologické* 43:194-225.

Čižmářová, Jana
2001 *Keltové na Moravě.* Moravian Museum, Brno.
2004 *Encyklopedie Keltů na Moravě a ve Slezsku*. Libri, Prague.

Čižmářová, Jana, Vladimír Ondruš, Milan Salaš, and Jaroslav Tejral
1996 *Moravia in Prehistoric Times*. Moravian Museum, Brno.

Clark, J.G.D. (Grahame)
1952 *Prehistoric Europe: The Economic Basis*. Methuen & Company, London.
1965 Traffic in stone axe and adze blades. *Economic History Review* 2(18):1-28.
1979 Archaeology and Human Diversity. *Annual Review of Anthropology* 8:1-20.

Coles, Bryony and John Coles
1989 *People of the Wetlands: Bogs, Bodies and Lake-Dwellers*. Thames and Hudson, New York.

Cordier, Gérard
1963 Quelques mots sur les pirogues monoxyles de France. *Bulletin de la Société préhistorique française* 60(5-6):306-315.
1972 Pirogues monoxyles de France (Premier supplément). *Bulletin de la Société préhistorique française* 69:206-211.

Crumlin-Pedersen, Ole (editor)
1999 *Aspects of Maritime Scandinavia AD 200-1200*. National Museum of Denmark, Copenhagen.

Crumlin-Pedersen, Ole and Birgitte Munch Thye (editors)
1995 *The Ship as Symbol in Prehistoric and Medieval Scandinavia*. National Museum of Denmark, Copenhagen.

Crumlin-Pedersen, Ole and Athena Trakadas (editors)
2003 *Hjortspring: A Pre-Roman Iron-Age Warship in Context*. Viking Ship Museum, Roskilde.

Cumberpatch, Christopher G.
1995 Production and Society in the Later Iron Age of Bohemia and Moravia. In *Different Iron Ages: Studies on the Iron Age in Temperate Europe*, J.D. Hill and C.G. Cumberpatch, editors, pp. 67-94. BAR International Series 602, Oxford.

Cunliffe, Barry
2001 *Facing the Ocean: The Atlantic and its Peoples 8000 BC – AD 1500*. Oxford University Press, Oxford.

Curtin, Philip
1984 *Cross-cultural trade in World History*. Cambridge University Press, Cambridge.

Cynkałowski, A.
1961 *Materiały do pradziejów Wołynia i Polesia Wołyńskiego*. Polskie Towarzystwo Archeologiczne, Warsaw.

Davis, Jack L.
1992 Review of Aegean Prehistory I: The Islands of the Aegean. *American Journal of Archaeology* 96(4):699-756.

De Boe, Guy
1978 Roman boats from a small river harbour at Pommeroeul, Belgium. In *Roman Shipping and Trade, Britain and the Rhine Provinces*, Joan Du Plat Taylor and Henry Cleere, editors, pp. 22-30. Council for British Archaeology, Report No. 24.

De Navarro, J. M.
1925 Prehistoric Routes Between Northern Europe and Italy Defined by the Amber Trade. *The Geographical Journal* 66(6):481-503.

Dolukhanov, Pavel
1996 The Pleistocene-Holocene Transition on the East European Plain. In *Humans at the End of the Ice Age: The Archaeology of the Pleistocene-Holocene Transition*, L. Straus, B.V. Eriksen, J. Erlandson and D. Yesner, editors, pp. 159-170. Plenum Press, New York.

Drda, Petr and Alena Rybová
1994 Bohemia in the Iron Age: A Recent View. In *25 Years of Archaeological Research in Bohemia*, Jan Fridrich, editor, pp. 82-92. Czech Academy of Sciences, Institute of Archaeology, Prague.
1998 *Keltové a Čechy*. Academia, Prague.

Du Gardin, Colette
1993 The Circulation of Amber in Prehistoric Europe. In *Trade and Exchange in Prehistoric Europe*, Chris Scarre and Frances Healy, editors, pp. 131-134. Oxbow Books, Oxford.

Durham, Bill
1960 *Indian Canoes of the Northwest Coast*. Copper Canoe Press, Seattle.

Earle, Timothy and Jonathan Ericson (editors)
1977 *Exchange Systems in Prehistory*. Academic Press, New York.

Edmonds, Mark
1993 Towards a context for production and exchange: The polished stone axe in earlier Neolithic Britain. In *Trade and Exchange in Prehistoric Europe*, Chris Scarre and Frances Healy, editors, pp. 69-86. Oxbow Books, Oxford.

Eijskoot, Y. and T. De Ridder
2004 *Vlak verslag 20. De Vergulde Hand 7.073. Basisverslag*. Dienst Welzijn, Vlaardingen.

Ellmers, Detlev
1969 Keltischer Schiffbau. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 16:73-122.
1996a The Beginnings of Boatbuilding in Central Europe. In *The Earliest Ships: the Evolution of Boats into Ships*, Robert Gardiner and Arne Emil Christensen, editors, pp. 11-23. Conway Maritime Press, London.
1996b Celtic Plank Boats and Ships, 500 BC – AD 1000. In *The Earliest Ships: the Evolution of Boats into Ships*, Robert Gardiner and Arne Emil Christensen, editors, pp. 52-71. Conway Maritime Press, London.

Erich, Robert W. and Emilie Pleslová-Štiková
1968 *Homolka: An Eneolithic Site in Bohemia*. American School of Prehistoric Research, Peabody Museum, Harvard University. Bulletin No. 24.

Filip, J.
1956 *Keltové ve střední Evropě*. Academia, Prague.

Fox, Cyril
1926 A 'Dug-out' Canoe from South Wales: With Notes on the Chronology, Typology, and Distribution of Monoxylous Craft in England and Wales. *The Antiquaries Journal* 7(2):121-151.

Fridrich, Jan (editor)
1994 *25 Years of Archaeological Research in Bohemia*. Památky archeologické – Supplementum 1, 1994. Czech Academy of Sciences, Institute of Archaeology, Prague.

Friel, Ian
1995 *The Good Ship*. Johns Hopkins University Press, Baltimore.

Fry, Malcolm F.
2000 *Coití: Logboats from Northern Ireland*. Northern Ireland Archaeological Monographs 4, Environment and Heritage Service, Antrim, Northern Ireland.

Galuška, Luděk
1991 *Great Moravia*. Moravian Museum, Brno.

Gardener, Robert and Arne Emil Christensen (editors)
1996 *The Earliest Ships: The Evolution of Boats into Ships*. Conway Maritime Press, London.

Gibbins, David and Jonathan Adams
2001 Shipwrecks and Maritime Archaeology. *World Archaeology* 32(3):279-291.

Gilmore, Janet C.
1986 The *World of the Oregon Fishboat: A Study in Maritime Folklife*. UMI Research Press, Ann Arbor.

Greenhill, Basil and John Morrison
1995 *The Archaeology of Boats and Ships*. Conway Maritime Press, London.

Guilmartin, John F.
2002 *Galleons and Galleys*. Cassell & Co., London.

Hammond, Norman
1981 Classic Maya canoes. *International Journal of Nautical Archaeology* 10(3):173-185.

Hanák, K.
1930 Nález staroslovanského člunu v řece Moravě. *Sborník velehradský* 1(1930):19-20.

Harbottle, Garman
1982 Chemical Characterization in Archaeology. In *Contexts for Prehistoric Exchange*, Jonathan Ericson and Timothy K. Earle, editors, pp. 13-51. Academic Press, New York.

Harding, Anthony F.
1984 *The Mycenaeans and Europe*. Academic Press, London.
2000 *European Societies in the Bronze Age*. Cambridge University Press, Cambridge.

Harding, Anthony, Radka Šumberová, Christopher Knüsel, and Alan Outram
2007 Velim*: Violence and Death in Bronze Age Bohemia*. Czech Academy of Sciences, Institute of Archaeology, Prague.

Hasslöf, Olaf
1958 Carvel construction technique. Nature and Origin. *Folk-Liv* 58:49-60.

Hasslöf, Olaf, Henning Henningsen, and Arne-Emil Christensen
1972 *Ships and Shipyards, Sailors and Fishermen*. Copenhagen University Press, Copenhagen.

Havlena, Václav, Josef Jaroš, and Jiří Pešek
1967 *Sedimentary Formations of the Bohemian Massif*. Geological Survey of Czechoslovakia, Prague.

Hell, M.
1913 Ein Baumtrogfund in Untersberger Moor bei Salzburg. *Sitzungsbericht der Anthropologischen Gesellschaft Wien* 43(1912-13):47-49.

Hellich, Jan
1931 *Průvodce sbírkami*. Hellichova Musea Poděbradska, Poděbrady.

Hellmich, Max
1912 Einbäume in Schlesien. *Schlesiens Vorzeit in Bild und Schrift. Zeitschrift des schlesischen Altertumsvereins* 6:17-32.

Helms, Mary
1988 *Ulysses' Sail*. Princeton University Press, Princeton, New Jersey.

Hirte, Christian
1987 *Zur Archäologie monoxyler Wasserfahrzeuge im nördlichen Mitteleuropa. Eine Studie zur Repräsentativität der Quellen in chorologischer, chronologischer und konzeptioneller Hinsicht*. Unpublished thesis, University of Kiel.

Höckmann, Olaf
1983 'Keltische' oder 'römisch'? Bemerkungen zur Typgenese der spätrömischen Ruderschiffe von Mainz. *Jahrbuch des Romisch-Germanischen Zentralmuseums Mainz* 30:403-434.

Holm, Bill
1994 Canoes of the Northwest Coast. In *Anthropology of the North Pacific Rim*, William W. Fitzhugh and Valérie Chaussonnet, editors, pp. 259-264. Smithsonian Institution Press, Washington.

Hons, Josef
1975 *Dějiny dopravy na území ČSSR*. Alfa, Bratislava.

Hornell, James
1940 The Genetic Relation of the Bark Canoe to Dug-Outs and Plank-Built Boats. *Man* 40:114-119.
1946 *Water Transport: Origins and Early Evolution*. Cambridge University Press, Cambridge.

Hrala, Jiří
1969 Monoxyl z Labětína. *Archeologické rozhledy* 21:812-816.

Hrubý, Vilém
1965 Staroslovanské čluny na našem území. *Z dávných věků* 2(1):119-136.

Hubert, Miroslav
2006 *Stará plavba na dolní Vltavě*. Mare-Czech, Prague.
2008 *Lodě a plavba na střední Vltavě*. Mare-Czech, Prague.

Ingold, Timothy
1986 *The Appropriation of Nature: Essays on Human Ecology and Social Relations*. Manchester University Press, Manchester.
2000 *The Perception of the Environment: Essays on livelihood, dwelling, and skill*. Routledge, London.

Jakubec, Ivan
2002 K nejstarší historii a "předhistorii" dunajsko-oderského průplavu. *Vodní cesty a plavba* 4:23-45.

Jelínková, Dagmar
1989 K chronologii sidlištních nálezů s keramikou pražského typu na Moravě. In *Pravěké a slovanské osídlení Moravy*, Vladimír Nekuda, editor, pp. 251-281. Czechoslovak Academy of Sciences, Institute of Archaeology, Brno.

Jochim, Michael
2002 The Lower and Middle Paleolithic. In *European Prehistory: A Survey*, Sarunas Milisauskas, editor, pp. 15-54. Kluwer Academic/Plenum Publishers, New York.

Johnstone, Paul
1980 *The Sea-craft of Prehistory*. Harvard University Press, Cambridge Massachusetts.

Joncheray, Didier
1986 *Les embarcations monoxyles dans la région Pays de la Loire*. Assocation d'Etudes préhistoriques et historiques des Pays de la Loire, 9. Nantes, France.

Justová, Jarmila
1965 Nový nález monoxylu v Poděbradech. *Vlastivědný zpravodaj Polabí* 1965/5-6:85-90.
1969 Nový monoxyl z Poděbrad*. Archeologické rozhledy* 21:811.

Kaul, Flemming
1998 *Ships on Bronzes: A Study in Bronze Age Religion and Iconography* (2 volumes). National Museum of Denmark, Copenhagen.

Keller, Ferdinand
1865 Die Keltischen Pfahlbauten. *Mitteilung der Antiquarischen Gesellschaft in Zürich* 12(3):94-96.
1878 *Lake Dwellings of Switzerland and other parts of Europe*. Longmans, Green and Company, London.

Klanica, Zdeněk
1968 Výsledky čtrnácté sezony výzkumu v Mikulčicích. *Přehled výzkumů AÚ ČSAV v Brně 1967*:61-85.

Kohoutek, František
1978 *Československé Řeky*. Olympia, Prague.

Kossina, Gustav
1911 *Die Herkunft der Germanen*. Kabitzsch, Leipzig.

Kristiansen, Kristian and Thomas B. Larsson
2005 *The Rise of Bronze Age Society*. Cambridge University Press, Cambridge.

Kučerová, Irena and Jaroslav Peška
2004 Monoxyl z Mohelnice. In *Sborník přednášek z odborného semináře pro technologii ochrany pamatek (STOP) 2004*, 32-38.

Kukla, Jiří
1969 *The Periglacial Zone, Loess and Paleosoils of Czechoslovakia*. Czechoslovak Academy of Sciences, Brno.

Kunze, Walter
1968 Der Mondseer Einbaum. *Jahrbuch des Oberösterreicheschen Musealvereines* 113(1):173-202.

Květ, Radan
2002 *Základy nauky o starých stezkách*. Moravské Zemské Muzeum, Brno.

Lanting, Jan N.
1998 Dates for Origin and Diffusion of the European Logboat. *Palaeohistoria* 39/40:627-650.

Lewis, David, and Werner Forman
1982 *The Maori: Heirs of Tane*. Orbis Publishing, London.

Litwin, Jerzy
1995 *Polskie szkutnictwo ludowe XX wieku*. Polish Maritime Museum, Gdańsk.

Macháček, Jiří, Nela Doláková, Petr Dresler, Pavel Havlíček, Šárka Hladilová, Antonín Přichystal, Alena Roszková, and Libuše Smolíková
2007 Raně středověké centrum na Pohansku u Břeclavi a jeho přírodní prostředí, *Archeologické rozhledy* 59(2):278-314.

Mainberger, Martin
2009 An Early Bronze Age Logboat from Degersee, Southern Germany. *International Journal of Nautical Archaeology* 38(1):3-12.

Malinowski, Bronislaw
1961 *Argonauts of the Western Pacific*. (Originally published in 1922). E.P. Dutton, New York.

Marsden, Peter
1972 Ships of the Roman Period and after in Britain. In *A History of Seafaring based on Underwater Archaeology*, George Bass, editor, pp. 113-132. Thames and Hudson, London.
1989 A late Saxon logboat from Clapton, London Borough of Hackney. *International Journal of Nautical Archaeology* 18(2):89-111.
1994 *Ships of the Port of London: First to Eleventh Centuries AD*. English Heritage, London.

McCay, Bonnie J.
1978 Systems Ecology, People Ecology, and the Anthropology of Fishing Communities. *Human Ecology* 6(4):397-422.

McCusick, Marshall B.
1960 *Aboriginal canoes in the West Indies*. Publications in Anthropology No. 63. Yale University Press, New Haven.

McGrail, Seán
1978 *Logboats of England and Wales*. British Archaeological Reports 51, Oxford.
1987 *Ancient Boats in N.W. Europe; The Archaeology of Water Transport to AD 1500*. Longman, London.
1995 Romano-Celtic boats and ships: characteristic features. *International Journal of Nautical Archaeology* 24(2):139-145.
2003 How Were Vessels Designed before the Late-Medieval Period? In *Boats, Ships and Shipyards. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000*, Carlo Beltrame, editor, pp. 124-131. Oxbow Books, Oxford.

McKee, Eric
1983 *Working Boats of Britain*. Conway Maritime Press, London.

Milisauskas, Sarunas
1978 *European Prehistory*. Academic Press, New York.

Mithen, Stephen J.
1994 The Mesolithic Age. In *The Oxford Illustrated History of Prehistoric Europe*, Barry Cunliffe, editor, pp. 79-135. Oxford University Press, Oxford.

Mitzka, W.
1933 *Deutsche Bauern- und Fischerboote*. Wörter und Sachen, beiheft 6. Heidleberg.

Montelius, Oskar
1903 *Die typologische Methode: Die älteren Kulturperioden im Orient und in Europa.* Selbstverlag, Stockholm.

Mordant, Claude and Daniel Mordant
1992 Noyen-sur-Seine: A Mesolithic Waterside Settlement. In *The Wetland Revolution in Prehistory*, Bryony Coles, editor, pp. 55-64. The Prehistoric Society & Wetland Archaeological Research Project, Exeter.

Moscheles, Julie
1924 Natural Regions of Czechoslovakia. *Geographical Review* 14(4):561-575.

Moucha, Václav
1994 The Early Bronze Age in Bohemia. In *25 Years of Archeological Research in Bohemia*, Jan Fridrich, editor, pp. 55-64. Czech Academy of Sciences, Institute of Archaeology, Prague.

Mowat, Robert J.C.
1996 *The Logboats of Scotland*. Oxbow Monographs 68, Oxbow Books, Oxford.

Mrázek, Ivan
1996 *Drahé kameny v Pravěku Moravy a Slezska*. Moravské Zemské Muzeum, Brno.

Muckelroy, Keith
1978 *Maritime Archaeology*. Cambridge University Press, Cambridge.

Munro, Robert
1882 *Ancient Scottish Lake-Dwellings or Crannogs*. David Douglas, Edinburgh.

Nayling, Nigel, David Maynard, and Seán McGrail
1994 Barland's Farm, Magor, Gwent: a Romano-Celtic boat. *Antiquity* 68:596-603.

Nechvátal, Bořivoj
1969 Nález monoxylu v Jizeře na Skorkově. *Archeologické rozhledy* 21:812-813.

Nekvasil, J.
1982 *Pohřebiště lužické kultury v Moravičanech*. Fontes Archaeologiae Moravicae 14/1-2. Archaeological Institute of the Czech Academy of Sciences, Brno.

Neuninger, H. and Pittioni, R.
1963 Frühmetallzeitlicher Kupferhandel im Voralpenland. *Archeologia Austriaca* Beiheft 6:1-39.

Neustupný, Evžen and Jiří Neustupný
1961 *Czechoslovakia Before the Slavs*. Frederick A. Praeger, New York.

Niblett, Rosalind
2001 A Neolithic dugout from a multi-period site near St Albans, Herts, England. *International Journal of Nautical Archaeology* 30(2):155-195.

Niederle, Lubor
1923 Nalez člunu v Kolině. *Obzor praehistorický* II(1):32-34.

Novotný, Bohuslav
1950 Nález člunu v Labi u Poděbrad. *Archeologické rozhledy* 47:231-234.
1951 Nejstarši plavidla na Českých vodách. *Národopisný věstník Československý* 32:253-292.

Nymoen, Pål
2008 Boats for Rivers and Mountains: Sources for New Narratives about River Travel? *The International Journal of Nautical Archaeology* 37(1):3-16.

O'Sullivan, Aidan
2003 Place, Memory and Identity among Estuarine Fishing Communities: Interpreting the Archaeology of Early Medieval Fish Weirs. *World Archaeology* 35(3):449-468.

Okorokov, Alexander
1995 Archaeological finds of ancient dugouts in Russia and the Ukraine. *The International Journal of Nautical Archaeology* 24(1):33-45.

Olsen, Olaf and Ole Crumlin-Pedersen
1978 *Five Viking Ships from Roskilde Fjord*. National Museum of Denmark, Copenhagen.

Oliva, Martin
2007 K otázce regionálních projevů a territoriality v mladém paleolitu Moravy. *Archeologické rozhledy* LIX(2):203-218.

Ossowski, Waldemar
1999 *Studia nad Łodziami Jednopiennymi z Obszaru Polski*. Polish Maritime Museum, Gdańsk.
2000a Some Results of the Study of Logboats in Poland. In *Down the River to the Sea* (Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 59-66. Polish Maritime Museum, Gdańsk.
2000b Medieval Boats and Inland Water Transport in Poland. In *Schutz des kulturerbes unter Wasser* (Proceedings of the IKUWA '99 Conference), pp. 279-287. Lübstorf.
2003 Expanded Logboats between the Baltic and the Black Sea. In *Boats, Ships, and Shipyards* (Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000), Carlo Beltrame, editor, pp. 177-182. Oxbow Books, Oxford.
2006 Are the skills of boat builders reflected by classification of small water craft from Poland? Paper delivered at Theoretical Archaeology Group (TAG) Annual Conference, December, 2006, University of Exeter.

Paret, Oscar
1930 Die Einbäume im Federseeried und im übrigen Europa. *Prähistorisches Zeitschrift* 21:76-116.

Parker, A.J.
1987 *Ancient Shipwrecks of the Mediterranean*. Oxbow Books, Oxford.

Pazdur, Anna, Marek Krąpiec, Adam Michczyński, and Waldemar Ossowski
2001 Radiocarbon and Dendrochronological Dating of Logboats from Poland. *Radiocarbon* 43(2A):403-415.

Pflederer, Tobias
2002 Ein Einbaum der Latènzeit aus dem Starnberger See. *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 9:17-19.

Philipsen, P.S.
1983 *En Analyse af Danske Stammebåde*. National Museum of Denmark, Copenhagen.

Piggott, Stuart
1983 *The Earliest Wheeled Transport, From the Atlantic Coast to the Caspian Sea*. Cornell University Press, Ithaca, New York.

Pitt-Rivers, A.L.F.
1875 On the evolution of culture. *Proceedings of the Royal Institute* 7:496-520.

Pitts, Lynn F.
1989 Relations between Rome and the German 'Kings' on the Middle Danube in the First to Fourth Centuries A.D. *The Journal of Roman Studies* 79:45-58.

Podborský, Vladimír
2004 *Dějiny pravěku a rané doby dějinné*. Masaryk University, Brno.

Poláček, Lumír
2000 Holzfunde aus Mikulčice. In *Studien zum Burgwall von Mikulčice*, volume 4. Czech Academy of Sciences, Institute of Archeology, Brno.

Polišenský, Josef
1991 *History of Czechoslovakia in Outline*. Bohemia International, Prague.

Poulík, Josef
1975 *Mikulčice: Sídlo a pevnost knížat velkomoravských*. Academia, Prague.

Price, T. Douglas (editor)
2000 *Europe's First Farmers*. Cambridge University Press, Cambridge.

Pryor, Francis
2004 Some thoughts on boats as Bronze Age artifacts. In *The Dover Boat in Context*, Peter Clark, editor, pp. 31-34. Oxbow Books, Oxford.

Randsborg, Klavs
1995 *Hjortspring: Warfare and Sacrifice in Early Europe*. Aarhus University Press, Aarhus.

Rausing, Gad
1984 *Prehistoric Boats and Ships of Northwestern Europe*. CWK Gleerup, Malmö.

Reinders, Reinder and K. Paul (Editors)
1991 *Carvel Construction Techniques. Skeleton-First, Shell First. Fifth International Symposium on Boat and Ship Archaeology, Amsterdam 1988*. British Archaeological Reports, Oxford.

Reitmeier, Thomas and Kurt Nicolussi
2002 Ein hochmittelalterlicher Einbaum aus dem Obersee, Gemeinde St. Jakob, Defereggen (Osttirol) und die fischereiwirtschaftliche Nutzung alpiner Hochgebirgsseen in Tirol. *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 9:12-16.

Renfrew, Colin
1969 Trade and Culture Process in European Prehistory. *Current Anthropology* 10(2/3):151-169.
1975 Trade as Action at a Distance. In *Ancient Civilization and Trade*, Jeremy Sabloff and C.C. Lamberg-Karlovsky, editors, pp. 3-59. University of New Mexico Press, Albuquerque.
1979 *Problems in European Prehistory*. Cambridge University Press, Cambridge.
1983 Geography, Archaeology, and Environment. *The Geographical Journal* 149(3):316-323.
1987 *Archaeology and Language: The Puzzle of Indo-European Origins*. Cambridge University Press, Cambridge.
1993 Trade Beyond the Material. In *Trade and Exchange in Prehistoric Europe*, Chris Scarre and Frances Healy, editors, pp. 5-16. Oxbow Books, Oxford.

Renfrew, Colin and Arnold Aspinall
1990 Aegean Obsidian and Franchthi Cave. In *Les industries du Mésolithique et du Néolithique initial*, Catherine Perlès, editor, pp. 257-270. Indiana University Press, Bloomington.

Riché, Pierre
1993 *The Carolingians*. University of Pennsylvania Press, Philadelphia.

Roach, Alastair
2008 Model Boats in the Context of Maritime History and Archaeology. *The International Journal of Nautical Archaeology* 37(2):313-334.

Roberts, Kenneth G. and Philip Shackleton
1983 *The Canoe: A History of the Craft from Panama to the Arctic*. International Marine Publishing Company, Camden, Maine.

Roberts, Owain
2004 Round the headland or over the horizon? An examination of evidence for British prehistoric efforts to construct a seaworthy boat. In *The Dover Boat in Context*, Peter Clark, editor, pp. 35-50. Oxbow Books, Oxford.

Rogers, Jason S.
2009 Documenting Dugout Logboats from Bohemia and Moravia, Czech Republic. In *Between the Seas: Eleventh International Symposium on Boat and Ship Archaeology,* Ronald Bockius, editor, pp. 115-122. Tagungen RGZM No. 4. Römisch-Germanisches Zentralmuseum, Mainz, Germany.

Rule, Margaret and J. Monoghan
1993 *A Gallo-Roman Trading Vessel from Guernsey*. Guernsey Museum Monograph No. 5, St Peter Port.

Runyan, Timothy
1991 The Relationship of Northern and Southern Seafaring Traditions in Late Medieval Europe. In *Medieval Ships and the Birth of Technological Societies, Volume II: The Mediterranean Area and European Integration*, Christiane Villain-Gandossi, Salvino Busottil, and Paul Adam, editors, pp. 197-209. Foundation for International Studies, University of Malta, Valletta.
Rybníček, Michal
2006 *Závěrečná zpráva: Příkazy - Hynkov (okr. Olomouc) - monoxyl člunu*. Report prepared by Mendelova Agricultural and Forestry University, Dendrochronology Laboratory, Brno.

Sabloff, Jeremy and C.C. Lamberg-Karlovsky (editors)
1975 *Ancient Civilization and Trade.* University of New Mexico Press, Albuquerque.

Salemke, G.
1972 Der Einbaum vom Mondsee, Österreich. *Das Logbuch* 8:4-8.

Sasinek, F.
1886 Slovanské koráby. *Časopis Vlastineckého spolku musejního v Olomouci*, č. 11.

Scarre, Chris and Frances Healy (editors)
1993 *Trade and Exchange in Prehistoric Europe*. Oxbow Books, Oxford.

Schenker, Alexander M.
1995 *The Dawn of Slavic: An Introduction to Slavic Philology*. Yale University Press, New Haven.

Schild, Romuald
1996 The North European Plain and Eastern Sub-Balticum between 12,700 and 8,000 BP. In *Humans at the End of the Ice Age: The Archaeology of the Pleistocene-Holocene Transition*, L Straus, B.V. Eriksen, J. Erlandson and D. Yesner, editors, pp. 129-158. Plenum Press, New York.

Šenk, Jaromír
1994 Semínský koráb. Unpublished MS on file at Východočeské muzeum, Pardubice.

Sherratt, Andrew
1976 Resources, Technology, and Trade: An Essay on Early European Metallurgy. In *Problems in Social and Economic Archaeology*, I. Longworth, G. Sieveking and K. Wilson, editors, pp. 557-581.
1981 Plough and pastoralism: aspects of the Secondary Products Revolution. In *Pattern of the Past: Studies in Honour of David Clark*, Ian Hodder, G. Isaac and N. Hammond, editors, pp. 261-305. Cambridge University Press, Cambridge.
1994 The Emergence of Élites: Earlier Bronze Age Europe, 2500-1300 BC. In *The Oxford Illustrated History of Prehistoric Europe*, Barry Cunliffe, editor, pp. 244-276. Oxford University Press, Oxford.
1997 *Economy and Society in Prehistoric Europe*. Princeton University Press, Princeton.

Šibrava, Vladimír
1967 *Quaternary of the Bohemian Massif and the Carpathian Foredeep*. Geological Survey of Czechslovakia, Prague.

Šilhová, Alena, and Jaroslav Špaček
2004 Monoxyl z Čelakovic a jeho konzervace. In *Sborník přednášek z odborného semináře pro technologii ochrany pamatek (STOP) 2004*, 29-31.
Sklenář, Karel
1993 *Archeologické památky*. Optys, Opava.

Smith, M.E.
1977 *Those Who Live from the Sea: A Study in Maritime Anthropology*. West Publishing Company, St. Paul.

Soffer, Olga
1993 Upper Paleolithic Adaptations in Central and Eastern Europe and Man-Mammoth Interactions. In *From Kostenki to Clovis, Upper Paleolithic – Paleo-Indian Adaptations*, Olga Soffer and N.D. Praslov, editors, pp. 31-49.

Špaček, Jaroslav
2003 Archeologické výzkumy Městského muzea v Čelákovicích v roce 2002. *Středočeský vlastivědný sborník* 21, Středočeský Muzeum v Roztokách u Prahy.
2004 Z dávné minulosti Čelákovic a jejich okolí. In *100 let Městského muzea v Čelákovicích*, Jaroslav Špaček, editor, pp. 145-199. Městské muzeum v Čelákovicích, Čelákovice.

Stradal, Christian and Cyril Dworsky
2002 Zwei Einbaumfunde aus dem Klopeiner See/Kärnten. *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 9:10-12.

Steffy, J. Richard
1998 *Wooden Ship Building and the Interpretation of Shipwrecks*. Texas A&M University Press, College Station.

Sulgostowska, Zofia
2006 Mesolithic mobility and contacts on areas of the Baltic Sea watershed, the Sudety, and Carpathian Mountains. *Journal of Anthropological Archaeology* 25:193-203.

Svoboda, Jiří
1994 The Pavlov Site, Czech Republic: Lithic Evidence from the Upper Paleolithic. *Journal of Field Archaeology* 21(1):69-81.

Svoboda, Jiří (Editor)
1991 *Dolní Věstonice II: Western Slope*. Études et Recherches Archéologiques de l'Université de Liège, No. 54, Liège.

Svoboda, Jiří, Vojen Ložek, Helena Svobodová, and Petr Škrdla
1994 Předmosti after 110 years. *Journal of Field Archaeology* 21(4):457-472.

Svoboda, Jiří, Vojen Ložek, and Emanuel Vlček
1996 *Hunters between East and West: The Paleolithic of Moravia*. Plenum Press, New York.

Svobodová, Helena
1985 Antické importy z keltských oppid v Čechách a na Moravě. *Archeologické rozhledy* 37:653-668.

Switsur, Roy
1989 Early English Boats. *Radiocarbon* 31(3):1010-1018.

Tchernia, A., Patrice Pomey, and A. Hesnard
1978 L'Epave romaine de la Madrague de Giens. *Gallia* 34 (supplement).

Teigelake, Ulrike
2003 Tracing Ship Traffic Without Ships – Alternative Methods of Finding Evidence for Pre- and Early Historical Inland Water Transport. In *Boats, Ships and Shipyards. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000*, Carlo Beltrame, editor, pp. 154-159. Oxbow Books, Oxford.

Thorpe, Lewis (editor and translator)
1986 *Two Lives of Charlemagne*. Penguin Books, New York.

Throckmorton, Peter
1970 *Shipwrecks and Archaeology: The Unharvested Sea*. Little, Brown and Company, Boston.

Tichý, Radomír
1999 *Monoxylon II: Plavba po 8000 letech*. JB Production, Nachod, Czech Republic.

Třeštík, Dušan
1973 "Trh Moravanů" – Ústřední trh Staré Moravy. *Československý časopis historický* 21:869-892.

Trigger, Bruce
2006 *A History of Archaeological Thought*, 2nd Edition. Cambridge University Press, Cambridge.

Tringham, Ruth
1971 *Hunters, Fishers, and Farmers of Eastern Europe, 6,000 – 3,000 B.C*. Hutchinson, London.

Trňáčková, Zora
1963 Zpravy Vlastivědný ústavu v Olomouci, č. 110. Report on file at the Archive of the Czech Academy of Sciences, Institute of Archaeology, Brno.

Troels-Smith, J.
1946 Stammebaade fra Aamosen. *Nationalmuseets Arbejdsmark* 1946:15-23.

Unger, Richard W.
1980 *The Ship in the Medieval Economy, 600 – 1600*. Croom Helm, London.

Unger, Richard W. (Editor)
1994 *Cogs, Caravels and Galleons: The Sailing Ship 1000 – 1650*. Conway Maritime Press, London.

Vácha, Petr and Jiří Stegbauer
2006 *Poděbrady, město mého srdce*. Ostrov, Prague.
Van de Moortel, Aleydis
2000 *The Archaeological Study of the Utrecht Ship*. National Museum of Denmark, Copenhagen.

Van de Noort, Robert
2004 An ancient seascape: the social context of seafaring in the early Bronze Age. *World Archaeology* 35(3):404-415.
2006 Argonauts of the North Sea – a Social Maritime Archaeology for the 2nd Millennium BC. *Proceedings of the Prehistoric Society* 72:267-287.
(In Press) After the Argonauts: crossing the divide in the first millennium BC. In *Atlantic Europe in the First Millennium BC: Crossing the Divide*, T.H. Moore and Xose-Lois Armada, editors, Oxford University Press, Oxford.

Van de Noort, Robert, R. Middleton, A. Foxon, and Alex Bayliss
1999 The ‘Kilnsea-boat’, and some implications for the discovery of England’s oldest plank boat. *Antiquity* 73:131-135.

Van de Noort, Robert, and Aiden O’Sullivan
2006 *Rethinking Wetland Archaeology*. Duckworth, London.

Vandiver, Pamela B., Olga Soffer, Bohuslav Klima, and Jiří Svoboda
1989 The Origins of Ceramic Technology at Dolní Věstonice, Czechoslovakia. *Science* 246(4933):1002-1008.

Vandkilde, Helle
2007 *Culture and Change in Central European Prehistory*. Aarhus University Press, Aarhus.

Vogemonte, Lothar [Lothario à Vogeso Monte]
1700 *Dissertatio de Utilitate, Possibilitate, et Modo conjunctionis Danubii cum Odera, Vistula, & Albi Fluviis, per Canalem Navigabilem*. Christopher Lercher, Vienna.

Waters, Michael R.
1992 *Principles of Geoarchaeology*. University of Arizona Press, Tuscon.

de Weerd, Maarten
1978 Ships of the Roman Period at Zwammerdam/Nigrum Pullum, Germania Inferior. In *Roman Shipping and Trade, Britain and the Rhine Provinces*, Joan Du Plat Taylor and Henry Cleere, editors, pp. 15-21. Council for British Archaeology, Report No. 24.
1991 Gallo-Roman plank boats; Shell first building procedures between sewn and cog. In *Carvel Construction Techniques*, Reinder Reinders and K. Paul, editors, pp. 28-31. British Archaeological Reports, Oxford.

Wells, Peter S.
1984 *Farms, Villages, and Cities: Commerce and Urban Origins in Late Prehistoric Europe.* Cornell University Press, Ithaca and London.
2001 *Beyond Celts, Germans, and Scythians: Archaeology and Identity in Iron Age Europe*. Duckworth, London.

Werner, W.
1973 Einbäume auf österreichischen Seen. *Das Logbuch* II/1973:43-50.

Weski, Timm
2005 Unfinished and Paired Logboats from Bavaria, Germany. *International Journal of Nautical Archaeology* 34(2):269-281.

Westerdahl, Christer
1992 The maritime cultural landscape. *The International Journal of Nautical Archaeology* 21(1):5-14.
2000 From Land to Sea, From Sea to Land. On Transport Zones, Borders, and Human Space. In *Down the River to the Sea* (Proceedings of the Eighth International

Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 11-20. Polish Maritime Museum, Gdańsk.
2005 Seal on Land, Elk at Sea: Notes on and Applications of the Ritual Landscape at the Seaboard. *The International Journal of Nautical Archaeology* 34(1):2-23.
2008 Boats Apart. Building and Equipping an Iron-Age and Early-Medieval Ship in Northern Europe. *The International Journal of Nautical Archaeology* 37(1):17-31.

Westerdahl, Christer (editor)
2006 *The Significance of Portages. Proceedings of the First International Conference on the Significance of Portages, October 2004*. BAR International Series 1499. Archaeopress, Oxford.

Wheeler, Ryan J., James J. Miller, Ray McGee, Donna Ruhl, Brenda Swann, and Melissa Memory
2003 Archaic Period Canoes from Newnans Lake, Florida. *American Antiquity* 68(3):533-551.

Whittle, Alasdair
1994 The First Farmers. In *The Oxford Illustrated History of Prehistoric Europe*, Barry Cunliffe, editor, pp. 136-166. Oxford University Press, Oxford.

Wilson, David M.
1966 A Medieval Boat from Kentmere, Westmorland. *Medieval Archaeology* 10:81-88.

Wright, Edward V., Robert E.M. Hedges, Alex Bayliss and Robert Van de Noort
2001 New AMS radiocarbon dates for the North Ferriby boats – a contribution to dating prehistoric seafaring in northwestern Europe. *Antiquity* 75:726-734.

Zápotocký, Milan
1969 K vyznamu Labe jako spojovací a dopravní cesty. *Památky Archeologické* 60:277-366.

Zbierski, Andrzej
2000 The Beginnings of Gdańsk and Polish Shipping. In *Down the River to the Sea* (Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997), Jerzy Litwin, editor, pp. 1-6. Polish Maritime Museum, Gdańsk.

Zimmerly, David W.
2000 *Qayaq: Kayaks of Alaska and Siberia*. University of Alaska Press, Fairbanks.

Zvelebil, Marek
2006 Mobility, contact, and exchange in the Baltic Sea Basin 6000-2000 BC. *Journal of Anthropological Archaeology* 25:178-192.

Zvelebil, Marek and Kamil V. Zvelebil
1988 Agricultural transition and Indo-European dispersals. *Antiquity* 62:574-583.

Internet sites:

Atlas Florae Europaeae
2007 http://www.fmnh.helsinki.fi/english/botany/afe/index.htm

MŽP - Ministerstvo Životního Prostředi (Ministry of Environment of the Czech Republic)
2007 www.env.cz

Povodí Labe (International Commission for the Protection of the Elbe River)
2007 www.ikse-mkol.org