

## 1. Project information

### Project title

Arts and crafts in Roman shipbuilding: raw materials management, construction technology, use and disposal of barges in the Lower Rhine region in the Roman period

### Summary

The proposed research programme focuses on the description and analysis of encounters between and interactive development of Roman and indigenous knowledge and construction systems relating to barges in the catchment basin of the Rhine, Meuse and Scheldt in the Middle Roman period. The research will be based on the combined use of historical, archaeological and physical data. It will attempt to establish the process of raw material procurement for and the design and construction, intended function, actual use and disposal of Roman period barges, and any changes that occurred.

## 2. Main applicant

Prof. dr. J. Bazelmans  
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De Boelelaan 1105  
1081 HV Amsterdam

Head of the Research Department of the National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist)

## 3. Other applicants

Name	Affiliation	Position	Address
Dr. E. Jansma	National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist).	Head of <i>Environmental Archaeology &amp; Conservation</i> Section, Research Dept.	Postbus 1600 3800 BP Amersfoort
	The Netherlands Centre for Dendrochronology (RING Foundation)	Scientific Director	Postbus 510 8200 AM Lelystad

## 4. Previous and future submissions

This proposal was first submitted in 2005 (PR-05-80), and did not receive funding. The two main points of criticism were: (a) the lack of an explicit relationship with NWO/GW 'de oogst van Malta' programme *A sustainable frontier? The establishment of the Roman frontier in the Rhine delta* (Radboud University Nijmegen 2004-2008) and (b) the fact that no Roman historian was included in the research team. The first worry could be laid to rest in our written reply; exchange with *A sustainable frontier?* had in fact been realized during the preliminary studies underlying our proposal. The second aspect could not be remedied in time to meet the deadline. In this new version of the proposal, Roman historian Prof. dr. F.J.A.M. Meijer (leerstoelgroep Oude Geschiedenis, UvA) has been added to the team of experts.

## 5. Institutional setting

- \* Free University (Amsterdam)
- \* National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM-establishment at Lelystad, former 'NISA')
- \* The Netherlands Centre for Dendrochronology (RING Foundation, Lelystad)

## 6. Period of funding

1-4-2007 to 31-3-2011

## 7. Members of the research team

Role	Associated roles within the separate projects	Name	Affiliation	Address	Fte
Supervisors	Sponsor, projects A and B	Prof. J. Bazelmans	National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist)	Postbus 1600 3800 BP Amersfoort	p.m.
			Archeologisch Centrum Free University (VU)	De Boelelaan 1105 1081 HV Amsterdam	
	Co-sponsor, projects A and B	Dr. E. Jansma	National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist)	Postbus 1600 3800 BP Amersfoort	0.1
			The Netherlands Centre for Dendrochronology (RING Foundation)	Postbus	
Co-sponsor, project B	Dr. J.-M.A.W. Morel	National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist)	Postbus 1600 3800 BP Amersfoort	p.m.	
Researchers	Project A	Drs. R.M. Visser		Sint Annastraat 23 1211 HN Hilversum	1.0 fte for 4 years
	Project B	Drs. Y.E. Vorst		Den Ijp 91 Den Ijp	1.0 fte for 4 years
	Project C	Dr. J.-M.A.W. Morel	National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (RACM, Amersfoort/Zeist)		0.5 fte for 2 years
Advisors	Physical data and documentation (Project A)	See below, Table 1	Diverse		p.m.
	Roman ship's building in North-western Europe (Projects B, C)	Dr. R. Bockius	Museum für Antike Schifffahrt, Römisch-Germanisches Zentralmuseum Mainz (RGZM), Germany	Ernst-Ludwig-Platz 2 D - 55116 Mainz	p.m.
		Prof. F.J.A.M. Meijer	Leerstoelgroep Oude Geschiedenis, University of Amsterdam (UvA)	P.C. Hoofthuis Spuistraat 134 1012 VB Amsterdam	p.m.
	Roman law and raw material management; Roman ship's building in the Mediterranean region (projects A, B and C)				

## 8. Structure of the proposed research

Project	Title	Type of appointment	Affiliation where research to be conducted	Supervisor(s)
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A	Roman forestry and shipbuilding: raw materials management and systems of supply, recycling and disposal	Postgraduate research assistant (AIO), 1 fte/4 years (Drs. R.M. Visser)	ROB RING VU	Prof. J. Bazelmans (cultural aspects) and Dr. E. Jansma (dendrochronology and statistical aspects)
B	Barges of the Zwammerdam type: chronology, provenance, construction, wood technology and use	Postgraduate research assistant (AIO) 1 fte/4 years (Drs. Y.E. Vorst)	ROB RING VU	Dr. J.-M.A.W. Morel (cultural and technological aspects), Dr. E. Jansma (dendrochronology and statistical aspects)
C	Roman barges from the transalpine region: synthesis	Replacement 0.5 fte/2 years (Dr. J.-M.A.W. Morel)	ROB-NISA	Prof. J. Bazelmans

## 9. Description of the proposed research

### 9.1 Problem definition, research questions and objectives

Since the Roman period, encounters between the Romans and indigenous groups in Northwestern Europe have been described in terms of the contrast between the *civilised* and the *barbarous*. Although the classical ideal of civilisation has featured less prominently in archaeology in the past few decades, it is still tempting to use the contrast between *civilised* and *uncivilised* as a framework for the analysis of the cultural changes that occurred in the region in the Roman period. This is not surprising, given the fact that the contrast is synonymous with a series of twin concepts that are useful in descriptive and analytical terms: state and tribe, urban and rural, villa and farmstead, trade and barter, money and gifts, literate and illiterate etc. However, it is by no means certain that these concepts help our understanding of the changes that were the result of encounters between very different systems of ideas, values and behaviour.

This is the problem we intend to explore in the proposed research. The focus will be on a contrast which reflects the difference between *advanced* and *backward*, namely *design* and *craftsmanship*. In typological terms, there are two knowledge and construction systems. One is based on research, deliberate reflection, theorising, codification and written instruction; the other on unreflecting trial and error, learning on the job, example and imitation, unwritten rules and tradition. Shipbuilding is one interesting area where the two systems came face to face in the Roman period, generally resulting in a synthesis. There is evidence that Roman design engineers and indigenous shipbuilders worked closely together, particularly on the production of barges. This is therefore an ideal field of research for the study of the social, power-political, institutional and cultural factors at work in profound and complex processes of change.

The research area encompasses the Rhine, Maas and Scheldt river basins. Zwammerdam-type barges were used in this region and the timber for the *limes* of Germania Inferior was felled here. The research will focus on the Middle Roman period, a time to which all barges of the Zwammerdam type can be attributed. The nature of and reasons for the development of the Zwammerdam type can be studied by comparing it with other types of vessel which are known to have co-evolved with the Zwammerdam type: canoes, inland vessels in other catchment areas in Belgium, France and Switzerland and ships of the Mediterranean tradition.

To grasp the complex interplay of factors that influenced the development of barges in the Roman period, one must break this approach down into a series of related questions that can be answered on the basis of empirical data. These questions have been assigned to three projects:

#### **A - Roman forestry and shipbuilding: raw materials management and systems of supply, recycling and disposal**

There exist serious gaps in our knowledge of Roman timber supply in our region. The literature and historical and epigraphic sources present a limited and distorted picture. Ongoing research of timber supply in the Netherlands focuses on qualitative and morphological aspects of wooden remains, such as tree species and dimensions (NWO/GW programme *A sustainable frontier?*). Here, dendrochronology is mainly

used as supplier of (existing) absolute dates and determinations of the provenance of the wood (determinations which in part are antiquated, being based on regional chronologies that since their compilation were altered, refined, reinterpreted in terms of provenance or discarded as a tool for dendro-provenancing). *A sustainable frontier?* furthermore is restricted geographically to the *limes* West of Vechten, and excludes timber from indigenous settlements and the buried remains of woodlands and forests from this period in the Netherlands. Against this background, we propose to construct a general concept of timber availability and supply during the Roman period, based on archaeological data, written and epigraphical sources and on the comprehensive and integral analysis of all existing Roman and indigenous datasets of dated tree-ring series from this period (these include a certain amount of recycled ship's timber), as well as on the remains of woodlands and forests, and on comparable datasets from adjacent regions abroad. The following questions will be addressed:

1. What was the level of demand for timber from the army and from the urban and indigenous populations?
2. What was the amount of timber produced in local woodlands and forests?
3. How was the production of timber along the *limes* organised? (Sub-question: are indigenous tree-ring patterns reflecting practices of coppicing and thinning?)
4. How was the transport and supply of timber along the *limes* organised? (Sub-question: is there proof of rafting? If so, given the fact that oak is too heavy to be rafted without taking certain measures: how were the technicalities solved?)
5. Did the Romans protect forests against use by others and if so, to what extent? (Sub-question: is there dendrochronological proof that certain woodlands and forests were only used by the Romans, meaning that the timbers from these forest only shows up in Roman constructions?)
6. To what extent was timber imported into the two *Germaniae* in the Roman period?
7. How, why and over what distances was timber transported?
8. Did the indigenous population have access to imported timber and if so, to what extent?
9. In what state of dismantlement was timber (ship's and otherwise) supplied (incidentally and in consignments)?
10. What was the ratio of recycling to disposal of Roman ships?

### **B - Barges of the Zwammerdam type: chronology, provenance, construction, wood technology, use and disposal**

Recent integrated dendrochronological research on three Roman barges (De Meern 1, Woerden 7 and De Meern 4) has produced surprising results concerning their age and working life, the origins and typological development of this type of vessel, the associated timber supply (including transport) and the wood and shipbuilding technology used (see below, 9.2). It is recommended that these conclusions be tested to ascertain whether they apply to other Roman ships of this type. Questions to be addressed in this study are:

1. When were the trees from which the ships are made felled?
2. What was the geographical and ecological origin of the trees?
3. How were the different parts of the ship obtained from trees? How many trees were used for each ship?
4. Can the sequence in which each ship was built be traced?
5. What are the technical properties of the timber used?
6. Are there technical correlations between ship parts and wood type?
7. Were repairs made to the ships? If so, when? What are the implications for the working life of the ships?
8. What was the typological development of these ships; is it possible to identify traces of the interaction between indigenous and Roman shipbuilding and any changes that occurred?

### **C - Roman barges from the transalpine region: synthesis**

Over the past two years the study of Roman barges in Northwest Europe has been given a boost by the excavations of the ships De Meern 1, Woerden 7 and De Meern 4. The large amount of information from

these studies has prompted the formation of new hypotheses on Northwest European shipbuilding in the Roman period; the typological development and working life of such ships; repair, installation and conversion techniques; life on board; use of timber and metal; and the rough location of shipbuilding activity. It is important that 'old' studies be reassessed in the light of these new hypotheses. Project C aims to do just that, addressing the following questions:

1. How was Roman shipbuilding organised along the *limes*? To what extent was shipbuilding activity military or civilian, or a combination of the two?
2. To what extent did this lead to demonstrable differences between ships built using different techniques?
3. To what extent were ships commissioned by military and/or civilian clients?
4. To what extent were shipbuilders local, using local techniques?
5. To what extent is the influence of local shipbuilding techniques designed for the production of dug-out canoes discernible, as opposed to the influence of 'alien' (Mediterranean) techniques?
6. Were some of the barges used only once, and others over longer periods? If so, is this reflected in a more careful choice of timber and construction method for ships intended for long-term use in comparison with those designed to be used only once?
7. Is it possible to identify trends and changes in the recycling or disposal of ships' timbers after they are no longer functional, and to what extent does this reflect changing perceptions of the availability of the material?
8. What can we discover about life on board, and does this tell us more about life on land in terms of the day-to-day use of goods such as tools, furniture and clothing?

## **9.2 Theoretical context and main concepts**

The study focuses on the combined influence of indigenous and Roman knowledge and building systems on the production of barges, set against a coherent and analytical background of timber availability and supply during the Roman period. In conceptual terms the study has a bearing on the anthropology of technique and technology, and on the sociology of Romanisation; in practical and operational terms it has a bearing on the results of scientific research into wood.

### **\* The anthropology of technique and technology**

Social scientists have only recently become interested in technique and technology (Pfaffenberger 1992). Anthropologists have clearly shown that technique and technology must be regarded as a *total social fact*: technological behaviour is social, political and symbolic/cognitive (Lemonnier 1993). In other words, it is embedded in the complex system of ideas, values and behaviour that typify a group or society, and can never be fully understood on the basis of technology and materials alone. It is the product of knowledge systems that specify how things work, what materials they are made of, how and in what order they should be made and how they should be used. Societies select from the available range of options those solutions that best suit their environment, traditions and relations with outsiders.

### **\* The Romanisation of indigenous societies**

For a full understanding of the organisational, social, temporal and spatial aspects of technique and technology and their development in the Roman period, we need to delve deeper into the phenomenon called 'Romanisation'. Until well into the 20th century, this was regarded as the one-sided transfer of elements of culture from a highly-developed to a poorly-developed culture. This viewpoint has now been abandoned. Although one cannot doubt the radical nature of the confrontation between the Roman imperial and indigenous societies, serious doubts have been cast on the analytical value of the concept of 'Romanisation'. It was not an autonomous force. The concept conceals major interregional variation and does not reflect the series of individual processes that actually occurred (Woolf 1998). The study of change processes in the Roman period now focuses on charting and analysing the institutional, power-political, social and cultural characteristics of specific situations. It has been found that local groups were in fact capable of providing a variety of responses to the challenges of the Roman presence. At the same time, the Roman state and its culture were not unaffected by intensive and varied interaction with other cultures.

## \* The dendrochronological study of Roman timber supply and ship's building

Over the past few decades, dendrochronological research has produced large datasets of dated tree-ring patterns. These datasets can be used to answer new questions relating, among others, to the provenance of timber, forest management techniques and the selection of wood for well-defined applications (Jansma 2006). Recent exploratory studies have produced promising results (Visser 2006; Vorst 2005). For the Roman period, the statistical analysis of the national dataset has provided new insights into wood provenance (the results suggest that 85% of dated Roman oak timber was felled locally, and 15% - mainly used in ships – was transported from the German Mosel region), the accessibility of woodlands for Roman and indigenous use (with one exception, the same woodlands seem to have yielded the timber for Roman and indigenous constructions), the location of these woodlands (along the *limes*, in the central Netherlands North of the *limes* and possibly adjacent regions in Germany, but also in Flanders and the south-eastern Netherlands), and the availability of oak timber (scarcity beginning in the 2<sup>nd</sup> half of the 2<sup>nd</sup> century AD). With regard to ship's building (barges), new insights were developed regarding the provenance of timber (indigenous as well as Mosel region (D)) and the sequence of building (non-formalized approach around AD 100; rational use of tree trunks and formalized ship's design after AD 160), as well as the explicit selection and application of specific types of oak timber, most likely related to the mechanical properties of the wood. The new insights into Roman shipbuilding in the Netherlands, derived through comparison of the dendrochronology and morphological details of individual barges, fit the hypothesis that 2<sup>nd</sup> century-type barges were the product of a confrontation of Roman and indigenous knowledge and building systems which started at the end of the 1<sup>st</sup> century AD. It is important that we verify and further develop these findings in a broader analytical and geographical context.

### 9.3 Research strategy and methodology

The research will be based on artefacts (ships, including disposal context) and related archaeological information, ancient literature and epigraphic sources (see Konen 2000), and physical data (tree-ring patterns). Dendrochronology provides a bridge between the actual morphology of the artefacts and knowledge derived from old and modern literature, providing 'hard' objective data on felling dates (and therefore typology), the processing of individual trees (building sequence of the artefacts), geographical provenance (and therefore supply routes), the structural integrity of the wood (technological choices) etc. The established methods and hardware of dendrochronology are considered known (see e.g. Jansma 1995 for cross-dating techniques and the determination of the provenance of timber, Holmes 1983 for the correction of measurement errors, and Cook and Kairiukstis 1990 for a wide range of statistical treatments of tree-ring data). The researchers will maintain close contact with research of Roman timber supply taking place within NWO/GW programme *A sustainable frontier?*, until its conclusion in 2008. Our input into this programme will consist of detailed dendrochronological information about timber availability and supply in a wider geographical region, bearing on Roman as well as indigenous wood use. Input from *A sustainable frontier* into our programme will consist of results for the *limes* West of Vechten that have a bearing on wood unsuited for dendrochronology (young trees, branches etc., and species that cannot be dated).

#### **A - Roman forestry and shipbuilding: raw materials management and systems of supply, recycling and disposal**

- a. A literature study, in collaboration with the applicants, into archaeological and ancient historical knowledge of the civilian and military production, transport and delivery of timber as well as the occurrence of forests and woodlands in the Netherlands.
- b. The coordinated statistical analysis of Dutch, Belgian, French and German dendrochronological datasets from the research area (see Table 1 for the international aspect; dendrochronological series from barges found in a wider geographical range in North-western Europe will be added to the dataset) This should yield clusters of timber derived from the same geographical origin and even from the same individual woodlands and forests. The resulting cluster-chronologies will serve as references for dendro-provenancing in project B.
- c. The analysis of the clusters in terms of provenance, transport, application, recycling and disposal (civilian, military, religious etc.).
- d. The dendrochronological study of the dataset in terms of forest management at the level of stand-related variations in growth associated with felling activity (coppicing, thinning).

- e. The identification of recycled ships' timbers from the datasets on archaeological (morphological) and dendrochronological grounds. The results will be used in project C.
- During this study, use will be made of the more specific knowledge and data resulting from project B. Results will be made available to projects B and C.

### **B - Barges of the Zwammerdam type: chronology, provenance, construction, wood technology and use**

- a. A literature study and a comparative anthropological/archaeological study, in collaboration with the applicants, into technological changes and Romanisation.
- b. A comparative study of all relevant shipbuilding aspects associated with barges excavated in the Netherlands (Table 2).
- c. The dendrochronological analysis of approx. 400 wood samples from these ships in terms of age, wood technology, building sequence and geographical and ecological provenance (growth site and stand type), using the dendrochronological network of cluster chronologies with known provenance created in project A .
- d. Comparison of the results with existing ideas on various shipbuilding traditions in the Roman world. The results will be interpreted in relation to the results from project A and the completed studies of De Meern 1, Woerden 7 and De Meern 4, and will serve as input into projects A and C.

### **C - Roman barges from the Netherlands and Germany: synthesis**

In project C all the data resulting from projects A and B will be synthesised with the reinterpreted results of earlier research into ships of the Zwammerdam type and the completed studies of De Meern 1, Woerden 7 and De Meern 4 (see Table 3 for details of these ships).

#### **9.4 Scientific relevance**

Our study will lead to detailed descriptions of specific cultural and historical dimensions and dynamics in the Roman period, and an assessment of existing models concerning encounters between Roman and indigenous knowledge and building systems for inland vessels, and therefore might contribute significantly to the debate on Romanisation. Based on preliminary results (Visser 2006; Vorst 2005), we expect a fundamental shift in perspective on the organisation of Roman-indigenous shipbuilding and organised transport by water in the Rhine, Meuse and Scheldt catchment areas in the Roman period. The scientifically-oriented study of past resource management of timber is new in dendrochronology in terms of scale and interdisciplinarity. We expect the resulting datasets to be useful for follow-up research on palaeo-landscape and climatology. The proposed research consists of an international, synthesising cultural and dendrochronological study of a single artefact type and of the resource management related to that artefact type. In this sense, it will have scientific relevance in both substantive (knowledge gain) and organisational terms (the building of networks and intensive data exchange). Also, the interdisciplinary nature of the proposed study could serve as an example in archaeology (knowledge gain through collaboration with exact sciences) and dendrochronology (knowledge gain through interaction with the humanities and through the building of international networks).

#### **9.5 Research history**

##### **9.5.1 Projects A and B**

In the early days of Dutch dendrochronology, the main aim was to develop calendars that could be used for dating wood from Dutch contexts. Until well into the 1990s, therefore, the focus was on collecting independently dated measurement series of oak, the building blocks for such calendars. A large dendrochronological archive has now been compiled, relating mainly to the Roman period and later. This allows the development of calendars, while also allowing issues that go beyond the scope of dating to be resolved. Currently, the dendrochronological focus in the Netherlands is shifting to synthesising research, whereby large consignments of wood are analysed for correlation, wood management and provenance (Jansma 2006; Visser 2006; Vorst 2005).

##### **9.5.2 Project C**

The first and most important study of Roman river cargo vessels in Northwestern Europe, generally referred to as *pramen* or *rijnaken* (Rhine barges), was directed at ship remains from Zwammerdam, a name which is now synonymous with this type of vessel.<sup>1</sup> Since the early 1970s 15 vessels of the Zwammerdam type have been excavated (Table 3), no fewer than 12 of them in the Netherlands, and three in Germany. This underlines the Netherlands' key role in the study of this type of vessel. Most of these ships have been excavated and studied by non-ship archaeologists, during a time at which dendrochronology was still in its early stages, and only cursory results have been published, if at all.

In the past two years the study of Roman ships in Northwest Europe has been boosted by the excavations of De Meern 1, De Meern 4 and Woerden 7, where for the first time digital measuring techniques were used. The researchers also opted for extensive supplementary documentation. De Meern 1 has also been salvaged in its entirety and in context, while major sections of Woerden 7 have been preserved, after exhaustive sampling for dendrochronological dating and determination of provenance. De Meern 4 has been partially investigated and is preserved *in situ*.

The large quantity of data from these three excavations, including extensive dendrochronological information, has allowed new insights regarding Northwest European shipbuilding in the Roman period; the working life of the ships; repair, installation and conversion techniques; life on board; the use of wood and metals; the rough location of shipbuilding activity etc. The results have also allowed 'old' studies to be reanalysed to extract additional information.

## 9.6 Nature, volume and availability of source material

### ***Project A - Roman forestry and shipbuilding: raw materials management and supply systems***

The international dendrochronological network used in project A will consist of the measurement series of some 3400 timbers from Roman and indigenous sites in Belgium, France, Germany and the Netherlands (Table 1). The rights to the series are held by different parties, but access has been agreed for the purposes of this study.

### ***Project B - Barges of the Zwammerdam type: chronology, provenance, construction, wood technology and use***

There are six barges available for typological and dendrochronological research (Table 2). Three of these belong to RACM-Lelystad (former 'NISA'); data on two others are available at RACM-Lelystad. 400 wood samples will be taken from the available barges (nrs. 2, 4 and 6) for dendrochronological research.

### ***Project C - Roman barges from the Netherlands and Germany: synthesis***

This project will involve the barges listed in Table 3. In so far as the ships are not in the possession of RACM-Lelystad, agreements have been reached with institutes abroad, primarily the RGZM in Mainz, concerning additional research.

## 9.7 Innovativeness and originality

The proposed research consists of a combination of the study of (a) actual Roman artefacts and related archaeological information, (b) ancient literature and epigraphic sources about phenomena related to the production of these artefacts and (c) synthesising cultural dendrochronology. This multidisciplinary approach has been successfully tested in two MA studies, producing new and unexpected results (Visser 2006; Vorst 2005, see also above, 9.2).

## 9.8 Cohesion between the separate projects, added value of programmatic organization

As indicated above (Section 9.3), the projects are strongly interrelated, since they concern successive stages in a process: forestry, forest management, timber transport, timber processing and the building, use, recycling and disposal of barges. Each project is dependent on input from the other projects; the projects cannot stand alone and can be realized only as part of the proposed broader programme.

## 9.9 Programmatic context

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<sup>1</sup> And *pramen* of the *Rheinischer Bauart* (Rhine type) (R. Bockius, 2000)

The proposed research will be integrated into a collaborative project between RACM-Lelystad and the nearby Batavia Werf, which involves the construction of a facility for the study of the Zwammerdam barges in the care of RACM.

### 9.10 Social, cultural and technical relevance

#### *\* Roman forest management, shipbuilding and inland navigation*

Shipping is a key element of Dutch cultural identity. It is not therefore surprising that the excavations of ships at Zwammerdam, De Meern and Woerden drew a great deal of public interest and input. Compared to current standards, the Roman barges excavated in the Netherlands during the 70's were poorly investigated. The present research programme is designed to enhance our knowledge of the construction and use of Roman barges and tell the story of these ships in the context of international forest management and timber transport by the Romans and the development of the *limes* of Germania Inferior.

#### *\* Dendrochronology and the cultural heritage*

The proposed study will make data internationally accessible and help form research networks, it will prompt the international 'recycling' of 'dead' data and it will help close the nationally acknowledged gaps in the knowledge. Furthermore, it will result in the training of two young interdisciplinary oriented dendro-archaeologists (current number trained at PhD-level in the Netherlands: one).

### 10. Programme of work

Projects A and B will start in April 2007; project C will start two years later. The researchers and supervisors will meet bi-weekly from the start of the programme. Both postgraduate research students will share working spaces for at least 50% of the time at RACM-Lelystad and RING (both situated in Lelystad), where at least one supervisor per project also has a working space. During the project four national and international workshops will be organised to facilitate the exchange of data and ideas and to present the results of the project. The proposed researchers are Drs. R.M. Visser (intended postgraduate research assistant for project A), Drs. Y.E. Vorst (intended postgraduate research assistant for project B), Dr. J.-M.A.W. Morel (intended supervisor of project B and post-doc project C) and Dr. E. Jansma (intended supervisor of projects A and B).

Date	Project A R.M. Visser	Project B Y.E. Vorst	Project C Dr. J.-M.A.W. Morel	Technical support
Before actual start of research prog				Preparation for reassembly of Zwammerdam 2, 4 and 6 at RACM-Lelystad
April-June 2007	<ul style="list-style-type: none"> <li>○ Assembling dendrochronological dataset (table 2), including working visits to dendrochronological laboratories in Cologne, Liège, Göttingen, Hamburg, Trier and Besançon (one week each).</li> <li>○ Literature study</li> </ul>	<ul style="list-style-type: none"> <li>○ Preparation for physical study of Zwammerdam 2, 4 and 6</li> <li>○ Working visit to London and Lampeter for advice on sampling strategies and information on wood conversion</li> <li>○ Literature study on Roman ships and shipbuilding</li> </ul>		Reassembly of Zwammerdam 2, 4 and 6
July 2007	Holiday	Holiday		Holiday
August-December 2007	<ul style="list-style-type: none"> <li>○ Data conversion</li> <li>○ Gathering of information on the contexts that yielded the dendrochronological dataset.</li> <li>○ Training programme at national research</li> </ul>	<ul style="list-style-type: none"> <li>○ Recording conversion methods and traces of woodworking on the barges</li> <li>○ Literature study</li> <li>○ Designing a sampling strategy</li> <li>○ Dendrochronological</li> </ul>		Reassembly of Zwammerdam 2, 4 and 6

	school ARCHON	sampling (start) <ul style="list-style-type: none"> <li>○ Training programme at national research school ARCHON</li> </ul>		
January-June 2008	<ul style="list-style-type: none"> <li>○ Cultural analysis of the contexts that yielded the dendrochronological dataset</li> <li>○ Identification of ship's finds and exchange with project B</li> <li>○ Exchange of data with project B</li> <li>○ Writing of chapters on problem definition, research questions and objectives and on methodology</li> </ul>	<ul style="list-style-type: none"> <li>○ Dendrochronological analysis of the first ship</li> <li>○ Literature study on the subject of dendrochronological and dendroprovenancing</li> <li>○ Analysis of the use of timber in the ships</li> <li>○ Sampling of the second ship</li> <li>○ Exchange of data with project A</li> <li>○ Writing of chapters on problem definition, research questions and objectives and on the development of ships in the Roman period</li> </ul>		<ul style="list-style-type: none"> <li>○ Reassembly of Zwammerdam 2, 4 and 6</li> <li>○ Help with dendrochronological sampling</li> </ul>
July 2008	Holiday	Holiday		Holiday
August-December 2008	<ul style="list-style-type: none"> <li>○ Statistical analysis and dendrochronological analysis of dendro-dataset</li> </ul>	<ul style="list-style-type: none"> <li>○ Dendrochronological analysis of the second ship</li> <li>○ Analysis of the use of timber in the second ship</li> <li>○ Writing the chapter(s) on methodology</li> <li>○ Sampling the third ship</li> </ul>		<ul style="list-style-type: none"> <li>○ Reassembly of Zwammerdam 2, 4 and 6</li> <li>○ Help with dendrochronological sampling</li> </ul>
January-June 2009	<ul style="list-style-type: none"> <li>○ Identifying linkage with original cultural and physical datasets, problem solving</li> <li>○ Epigraphic, archaeological and historical studies</li> <li>○ Exchange of data with projects B and C</li> </ul>	<ul style="list-style-type: none"> <li>○ Dendrochronological analysis of the third ship and preserved parts of others</li> <li>○ Analysis of the use of timber in the third ship</li> <li>○ Additional literature study on Roman ships and shipbuilding</li> <li>○ Visit to Mainz</li> <li>○ Exchange of data with projects A and C</li> </ul>	<ul style="list-style-type: none"> <li>○ Assembling old excavation data and analytical data on barges in Table 3</li> <li>○ Exchange of data with projects A and B</li> </ul>	<ul style="list-style-type: none"> <li>○ Reassembly of Zwammerdam 2, 4 and 6</li> <li>○ Help with dendrochronological sampling</li> </ul>
July 2009	Holiday	Holiday	Holiday	None
August-December 2009	<ul style="list-style-type: none"> <li>○ Epigraphic, archaeological and historical studies</li> </ul>	<ul style="list-style-type: none"> <li>○ Dendrochronological analysis of all ships of Zwammerdam type including those already analysed</li> <li>○ Analysis of the use of timber in the ships</li> <li>○ Typological analysis</li> </ul>	Integration of old data with data resulting from current research programme	None
January-June 2010	Synthesis of results	Synthesis of results	Synthesis of results	None
July 2009	Holiday	Holiday	Holiday	None
August 2010-March	Writing of thesis	Writing of thesis	Writing of synthesis (monograph and three articles, the latter in	None

2011			collaboration with Bazelmans and Jansma	
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### 11. Word count

3992 words (< 800 per project).

### 12. Planned deliverables

Two dissertations (projects A and B), a monograph (project C) and three major papers in resp. the yearbook of the *Römisch-Germanisches Zentralmuseum* in Mainz, *Journal of Roman Studies* and *Journal of Archaeological Science*.

### 13. Brief curriculum vitae of main applicant

Jos Bazelmans (born Veldhoven, 19 May 1963) studied cultural anthropology at the University of Leiden and later at the University of Amsterdam, receiving a *cum laude* for both his *kandidaats* and his *doctoraal* examinations. In 1996 he once more received a *cum laude* for his PhD thesis, an anthropological analysis of the exchange of gifts as described in the Old English poem Beowulf (Bazelmans 1999). Between 1995 and 2000 Bazelmans taught at the Faculty of Pre- and Protohistory of the University of Leiden, while at the same time conducting research at the University of Amsterdam and the University of Groningen. In 2000 he became a senior researcher at the National Service for Archaeological Heritage Management (ROB) in Amersfoort. In late 2001 he was promoted to the position of head of the Research Department of the ROB. Since 1 November 2003 Jos Bazelmans has been professor of archaeological heritage management at the Free University of Amsterdam. Since 20 May he is member of the board of directors of the newly found National Service for the Management of the Archaeological, Cultural Landscape and Built Heritage Management (Amersfoort/Zeist).

### 14. Summary for non-specialists

The rivers Rhine, Meuse and Scheldt saw a great deal of traffic in the Middle Roman period (AD70-270). Large, fairly simple barges were used to transport building materials and food. The vessels were sailed, punted or rowed over long distances. This project will study to what extent the way the barges were built (in terms of shape, size, materials and the order in which they were constructed) was a result of interaction between indigenous and Roman knowledge.

This question became all the more urgent recently as a result of the study of the ships De Meern 1, De Meern 4 and Woerden 7. It had been believed that Roman barges were built in Germany to be used just once – as container ships – and in a strictly military context. It now seems likely that they were partly built in the Netherlands, used for long periods, often several decades, and that they were the product of collaboration between military and civilian partners. The De Meern 4 barge also makes it clear that the builders experimented deliberately at a very early stage with a combination of transalpine and Mediterranean construction techniques. Finally, the study has shown that, in certain periods, large amounts of timber – including for shipbuilding – were floated over large distances from the Rhine and Mosel area in Germany to the Netherlands.

This study will therefore focus on the question of how design, craftsmanship and trial and error combined to produce a type of ship that was deemed capable of performing existing tasks on a new scale, or of performing new tasks. In addressing this question, the researchers will also look at the procurement of building wood in general and wood for building ships in particular. The research will make innovative use of archaeological, historical and dendrochronological data. Whereas, in the past, the study of growth patterns in wood mainly served to answer questions as to dating, this research will show that it is also suitable for determining the origin of wood and how it was processed and used, as well as the order in which ships were built. For this purpose, we will use the many dated tree-ring series that have been produced in the Netherlands, as well as those produced within the wider research network of the catchment basins of the rivers Rhine, Meuse and Scheldt.

### 15. Research budget

\* Postgraduate research assistant salary, Project A, 1 fte for 4 years

€172.371

* Postgraduate research assistant salary, Project B, 1 fte for 4 years	€172.371
* Replacement post-doc salary, Project C, 0.5 fte for 2 years	€ 25.000
* Costs of travel abroad, Project A: 6 working visits for dendrochronological network	€ 10.500
* Costs of travel abroad, Project B: 3 working visits for study of Roman barges abroad	€ 6.000
* Grand total	€386.242

**Working visits, Project A, for the collection of dendrochronological data**

<b>Location</b>	<b>Duration</b>	<b>Costs</b>
Mainz 2007	2 weeks	€ 1500
Besançon 2007	2 weeks	€ 1500
Cologne 2007	2 weeks	€ 1500
Göttingen 2007	2 weeks	€ 1500
Hamburg 2008	2 weeks	€ 1500
Liege 2008	2 weeks	€ 1500
Trier 2008	2 weeks	€ 1500
Mainz 2009	2 weeks	€ 1500
		€ 10,500

**Working visits, Project B, for the collection of various data**

<b>Location</b>	<b>Duration</b>	<b>Costs</b>
Mainz 2007	2 weeks	€ 1500
Lampeter 2007	2 weeks	€ 1500
London 2007	2 weeks	€ 1500
Mainz 2009	2 weeks	€ 1500

## Tables

**Table 1 – Dendrochronological network used in Project A**

**Table 2 – Roman barges analysed dendrochronologically in Project B**

**Table 3 – Roman barges from northwestern Europe analysed in project C**

**Table 1 – Dendrochronological network used in Project A**

Country	Region	Author(s)	Affiliation	Dendrochronological data from Roman sites	Participation confirmation
Netherlands	General	Hanraets, Jansma & Vernimmen	ROB/RING	800 (Roman and indigenous)	Yes
Belgium	Flanders	Hanraets, Jansma & Vernimmen	ROB/RING	100	Yes
	Wallonia	Dr. P. Hoffsummer (director)	Dept. of Archaeometry University of Liege Belgium	Approx. 100 series dating from AD 200 onwards	Yes
Germany	Cologne, Xanten, Mainz	Dr. B. Schmidt	Labor für Dendrochronologie Institut für Ur- und Frühgeschichte University of Cologne, Germany	1000 series from Roman contexts	Yes
	Northern Germany	Dr. H.-H. Leuschner	Institut für Palynologie Labor für Dendrochronologie und Dendroklimatologie University of Göttingen Germany	100 series from indigenous settlements	Yes
	General	Sigrid Wröbel	Institute for Wood Biology University of Hamburg Germany	500 series (estimate)	Yes
	Central Europe	Dr. M. Neyses	Rheinisches Landesmuseum Trier Germany	400 series (estimate)	Yes
France	General	Dr. G. Lambert	Laboratoire de Chrono- Ecologie Section de Dendrochronologie Faculty of Sciences University of Franche-Comté	400 series (estimate)	Yes

**Table 2 – Roman barges analysed dendrochronologically in Project B**

Name	Type	Manager	Availability	Nr. of samples
Zwammerdam 2	Zwammerdam	ROB	Complete structure	125
Zwammerdam 4	Zwammerdam	ROB	Complete structure	125
Zwammerdam 6	Zwammerdam	ROB	Complete structure	125
De Meern 1	Zwammerdam	ROB	Cross-section and selected parts	20 (analysed)
De Meern 4	Zwammerdam	Municipality of Utrecht	Cross-section	14 (analysed)
De Woerden 7	Zwammerdam	destroyed	Complete structure	100 (analysed)
Parts of the ships from Woerden	Zwammerdam	Province of Zuid-Holland	Parts	20

**Table 3 – Roman barges from Northwestern Europe analysed in project C**

Table of Roman ships from Northwestern Europe					
Ship number	Navis no.	Praam-type (Zwammerdam type)	Related to Zwammerdam type	Canoes	'Mediterranean' ships (Oberstimm type)
<b>Netherlands</b>					
De Meern 1	85	Woerden 1 sub-type			
De Meern 2	86			fragment	
De Meern 3	98			fragment	
De Meern 4	--	Zwammerdam			
Druuten 1	16	Zwammerdam			
Kapel Avezaath 1	12	Zwammerdam			
Kerk Avezaath 1	10				
Kerk Avezaath 2	11	Zwammerdam?			
Vechten 1	83				Oberstimm
Woerden 1	13	Woerden 1 sub-type			
Woerden 2/6 <sup>2</sup>	14/97	Woerden 1 sub-type			
Woerden 3	15			fragment	
Woerden 4	95	Zwammerdam?			
Woerden 5	96			creel	
Woerden 7	--	Zwammerdam (6)			
Woerden 8	--				fragment
Zwammerdam 1	75			creel	
Zwammerdam 2	76	Zwammerdam			
Zwammerdam 2a	77				fragment
Zwammerdam 3	78				
Zwammerdam 4	79	Zwammerdam			
Zwammerdam 5	80				
Zwammerdam 6	81	Zwammerdam			
Zwammerdam 7	82	Scull			
<b>Netherlands, total</b>	<b>23</b>	<b>12</b>		<b>8</b>	<b>3</b>
<b>Germany</b>					
Mainz 1	31		Mainz A		
Mainz 2	32		Mainz A		
Mainz 3	33		Mainz B		
Mainz 4	34		Mainz A		
Mainz 5	35		Mainz A		
Mainz 6 (Kappelhofgasse)	36	Zwammerdam			
Oberstimm 1	37				Oberstimm
Oberstimm 2	38				Oberstimm
Xanten-Lüttingen	123	Zwammerdam			
Xanten-Wardt	124	Zwammerdam			
<b>Germany, total</b>	<b>10</b>	<b>3</b>	<b>5</b>		<b>2</b>
<b>Belgium</b>					
Pommeroeul 1	18		Pommeroeul 1		
Pommeroeul 2	19				
<b>Belgium, total</b>	<b>2</b>		<b>1</b>	<b>1</b>	
<b>Switzerland</b>					
Bevaix	39				
Yverdon 1	40				
<b>Switzerland, total</b>	<b>2</b>		<b>2</b>		
<b>Northwestern Europe, total</b>	<b>37</b>	<b>15</b>	<b>8</b>	<b>9</b>	<b>5</b>

<sup>2</sup> It was subsequently found that Woerden 6 was in fact the stern of the partial ship Woerden 2, which had been investigated earlier.

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