THE IRON AGE BOG BODIES OF THE ARCHAEOLOGISCHES LANDESMUSEUM, SCHLOSS GOTTORF, SCHLESWIG, GERMANY

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A Thesis
Submitted to the Faculty of Graduate Studies
In Partial Fulfillment of the Requirements
for the Degree of
Doctor of Philosophy

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THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

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The Iron Age Bog Bodies of the Archaeologisches Landesmuseum,

Schloss Gottorf, Schleswig, Germany

BY

Heather Catherine Gill-Robinson

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree

of

DOCTOR OF PHILOSOPHY

HEATHER CATHERINE GILL-ROBINSON©2005

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ABSTRACT

The purpose of this research was to provide a complete anthropological assessment of the remains of seven humans from peat in northern Germany. The group of bog bodies at the Archaeologisches Landesmuseum was a unique collection since it included a well-preserved adult male (Rendswühren); two of the "flat" bodies, with completely demineralized bones (Damendorf and Windeby II); a potential adolescent female (Windeby I) and two heads with distinctive hair knots (Osterby and Dätgen). A single bog skeleton, from alkaline peat, Kühsen, was also examined. All of the bodies dated to the Scandinavian Iron Age, approximately 500 B.C. to A.D. 800, with the exception of the bog skeleton, the date of which was unknown. The remains displayed varying levels of preservation but in all cases, except the skull and mandible, extensive soft tissue remained on the bodies. With the exception of the Windeby I body, little previous research had been undertaken with the bodies in this collection. Each body was completely reassessed and reinterpreted based on evidence compiled from multiple sources including archival material; gross anatomical analysis; digital radiography; Multi-slice computed tomography (MSCT); detailed image analysis with both virtual and physical three-dimensional reconstructions and trace element and stable isotope analyses. One body was sampled for ancient DNA analysis. Several of the techniques employed were used with bog bodies for the first time. Data were compared with Iron Age skeletal remains from Denmark and Iron Age cremation burials from Schleswig-Holstein. From this research, interpretations regarding methodological issues of preservation and analysis, and how these individuals might have fit within the archaeological and cultural context of the Iron Age in northern Germany were made. The data obtained from these analyses contributed substantially to the interpretation of these seven individuals.

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I would also like to thank my supervisory committee members: Dr. Chris Meiklejohn and Dr. Martin Reed. I know that your schedules are chaotic and I thank you for your time and contributions to this thesis. My thanks also to my external examiner, Professor Bryony Coles, whose detailed comments and insight made this thesis a much better work.

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palaeoparasite analysis and the hologram creation, were generously provided at no charge.

This research would not have been possible without the generosity and kindness of many people at the Archaeologisches Landesmuseum, Schloss Gottorf in Schleswig, Germany. Every single person at the museum made me feel welcome, provided assistance, was interested in the research and tolerated my mediocre spoken German. I would especially like to thank Dr. Claus von Carnap-Bornheim, the Director of the Archaeologisches Landesmuseum, who allowed me this amazing opportunity to work with the bog bodies and made me feel as if I belonged at the museum. My thanks also to Herr Aniol for his patient assistance, remarkable insight and many hours travelling with bog bodies. Dr. Ullbricht was instrumental in providing access to the material kept in the Organic Storage Magasin and cheerfully arranged access to whatever I needed, whenever I wanted it. Herr Stavinoga and Herr Freese also helped in various ways, and I thank them. Frau Tessars found me many archive files. Finally, I owe an enormous amount of gratitude to Dr. Michael Gebühr, without whom this research would never have happened. Michael, my unofficial "doctor-father", you made sure that I had everything that I needed at the museum and made me feel less homesick while I was in Germany. I thank you so very much for your knowledge of the Iron Age in Schleswig, your enthusiasm, your sense of humour and your confidence in me – not to mention the good Chinese food!

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DEDICATION

For my assorted families in Canada and Europe: you have all been with me throughout this whole experience and only you understand how long this road has been and how significant the success of this thesis truly is.

I dedicate this thesis to Giles William Robinson – the love of my life.

My thanks are insufficient and mere words are completely inadequate.

You are my world.

TABLE OF CONTENTS

Abstract i

Acknowledgements ii

Dedication vi

Table of Contents vii

List of Figures xiv

List of Tables xvii

List of Copyrighted Materials for Which Permission as Obtained xviii

CHAPTER 1 – Introduction 1
Introduction 1
Purpose of the research 2
Research goals 3
Structure of the research 5
Chapter outline 6

CHAPTER 2 – Taphonomy: Understanding Tissue Preservation in the Archaeological Record 9
Introduction 9
An introduction to taphonomy 10
Soft tissue decomposition and preservation 11
Decomposition 11
Preservation 15
Problems with taphonomy and interpretation 19
Postmortem or antemortem 19
Recognition of taphonomy 21
Dealing with taphonomy in anthropological studies 24
Experimental archaeology 24
Anthropologie de terrain 28
Summary 29

CHAPTER 3 – Understanding our Methods: Anthropological Analysis of Preserved Human Remains 31
Introduction 31
Invasive versus non-invasive studies 31
Invasive studies 32
Dietary analysis 32
Palaeopathology 33
DNA 33
Non-invasive studies 34

Imaging 34
Radiography 34
Computed tomography (CT) 37
The role of imaging in mummy studies 39
Presence or absence of skeletal material 39
Determination of age and sex 40
Presence or absence of palaeopathological features 40
Accompanying objects 42
Other roles of imaging 42
Specific issues in bog body imaging 44
Bog Bodies 47
Introduction 47
Previous and contemporary bog body studies 50
Historical bog body studies 50
A modern bog body study 57
Re-examination of bog bodies 63
Elling Woman (1978) 63
1948 Borremose Woman (1977) 64
Huldremose Woman (1990) 65
Kayhausen Boy, Neu Versen Man,Woman from Sedelsberg 68
Grauballe Man (2000) 70
Key compilation publications 71
Summary 73

CHAPTER 4 – Setting the Stage: Iron Age Archaeology of Northern Europe **75**
Introduction 75
Definition of the Iron Age in Northern Europe 75
Life in Iron Age Northern Europe 78
Subsistence and settlement 78
Subsistence 78
Settlements 81
Clothing and textiles 82
Trade and crafts 84
Trade 84
Crafts 86
Burial practices, beliefs and votive deposits 87
Burial practices 87
Beliefs 90
Hoards and votive deposits 90
Social and political structure 96
Summary 99

CHAPTER 5 – Materials **101**
Introduction 101
Archival materials 101
Rendswühren 103

Damendorf 105
Osterby 106
Windeby I and II 108
Dätgen 109
Kühsen 110
The Bodies 110
Rendswühren 110
Damendorf 111
Osterby 113
Windeby I 114
Windeby II 116
Dätgen 117
Kühsen 119
Summary 119

CHAPTER 6 – Methods **121**
Introduction 121
Data obtained from the archives 122
Physical Analyses 124
Metric Assessment 126
Soft tissue 126
Osteometrics 127
Non-metric Assessment 128
Imaging 134
Digital X-ray 134
CT scanning 136
Three-dimensional reconstruction 138
Holography 141
Photography 142
Invasive Analyses 142
Stable isotope analysis (hair) 142
Trace element analysis (hair) 143
DNA analysis 144
Palaeoparasitology 145
Summary 145

CHAPTER 7 – Rendswühren **146**
Introduction 146
Previously published analyses 146
The 2003-2004 Research 148
Data obtained from the archives 148
Discovery and excavation 148
External examination 149
Internal examination 151
Clothing and textiles 153
Additional information 154
Results of physical and anthropological analyses 155

Visual assessment 155
Metrics 161
Sex and age determination 163
Image analysis 164
Summary 168

CHAPTER 8 – Damendorf **171**
Introduction 171
Previously published analyses 173
The 2003-2004 Research 173
Data obtained from the archives 173
Discovery and excavation of the 1900 bog body 173
Clothing and textiles 176
Additional information 176
Results of physical and anthropological analyses 177
Visual assessment 177
Metrics 179
Sex and age determination 182
Image analysis 182
Trace element analysis 183
Stable isotope analysis 186
Summary 186

CHAPTER 9 – Osterby **188**
Introduction 188
Previously published analyses 188
The 2003-2004 Research 192
Data obtained from the archives 192
Discovery and excavation 192
Examination and reconstruction 194
Clothing 198
Additional information 198
Results of physical and anthropological analyses 199
Visual assessment 199
Metrics 202
Sex and age determination 203
Image analysis 203
Trace element analysis 205
Stable isotope analysis 205
Summary 206

CHAPTER 10 – Windeby I and II **207**
Introduction 207
Previously published analyses 207
Discovery and excavation 212
Windeby I 212
Windbey II 214

Physical analyses 216
Windeby I 216
Windeby II 220
Pollen analysis 221
Windeby I 221
Windeby II 221
The 2003-2004 Research 222
Data obtained from the archives 222
Windeby I 222
Windeby II 223
Results of the physical and anthropological analyses 224
Windeby I 224
Visual assessment 224
Metrics 228
Sex and age determination 228
Palaeopathology 231
Image analysis 232
Trace element analysis 234
DNA analysis 235
Stable isotope analysis 236
Windeby II 237
Visual assessment 237
Metrics 237
Sex and age determination 237
Palaeopathology 239
Image analysis 239
Summary 239

CHAPTER 11 – Dätgen **241**
Introduction 241
Previously published analyses 241
Discovery and excavation 241
Physical examination 242
Discovery, excavation and analysis of the head 245
Additional information 245
The 2003-2004 Research 246
Data obtained from the archives 246
Discovery and excavation 246
Physical examination 248
Additional information 249
Results of the physical and anthropological analyses 252
Visual assessment 252
Age and sex determination 259
Palaeopathology 261
Image analysis 264
Trace element analysis 267
Stable isotope analysis 267

Summary 268

CHAPTER 12 – Kühsen **269**
Introduction 269
Previously published analyses 270
The 2003-2004 Research 270
Archival data 270
Results of the physical and anthropological analyses 272
Visual assessment 272
Metrics 275
Sex and age determination 275
Palaeopathology 278
Image analysis 279
Summary 279

CHAPTER 13 – Discussion **281**
Introduction 281
Taphonomic issues 281
Kühsen as alkaline-preserved skeleton vs bog body preservation 282
Taphonomy as it relates to pseudopathologies 289
Interpretations of the bodies 292
Restraints 306
Evaluating methods for studying bog bodies 307
Archives 307
Physical examination 309
Imaging 312
Invasive sampling 314
Radiocarbon dating 318
The Schloss Gottorf bog bodies in an archaeological context 327
Comparison with a Danish Iron Age skeletal collection 327
Cremation cemeteries in Schleswig-Holstein 338
Habitation and work sites near the bog body sites 345
Windeby shell middens 347
Reconstruction of the life of an individual 348
Interpretation of bog bodies 351
Summary 359

CHAPTER 14 – Conclusions **360**
Methodological and archaeological implications of the research 360
Future directions 363
Conclusion 366

References **367**

Appendices **405**
Appendix A: List of bog bodies and current locations 405
Appendix B: List of documents in the archives 407

Appendix C: List of publications mentioning or discussing the bog bodies in this research 441
Appendix D: Windeby I osteometrics 444
Appendix E: Kühsen osteometrics 447

List of Figures

Figure 1: Bog body find spots from northwestern Europe 49
Figure 2: Timeline of Iron Age chronology 77
Figure 3: The region known as "Barbaricum" 79
Figure 4: Pattterns of trade between the Roman Empire and Free Germany 85
Figure 5: Change of artifact deposition patterns during the Iron Age 89
Figure 6: Stratification and grave goods during the Early Roman Iron Age 99
Figure 7: Map of Schleswig-Holstein showing the find locations of the bog Bodies and the Kühsen skeleton 102
Figure 8: Sample of a handwritten document from the Rendswühren file, before transcription 104
Figure 9: Sample of a handwritten document from the Damendorf archive, before transcription 107
Figure 10: Rendswühren Man in display case 112
Figure 11: Damendorf Man 112
Figure 12: Osterby Man 114
Figure 13: The Windeby I body on display 116
Figure 14: Windeby II mounted for display 117
Figure 15: Dätgen Man 118
Figure 16: Rendswühren Man in "ballerina pose" 155
Figure 17: Rendswühren Man 157
Figure 18: Rendswühren Man – neck and head 157
Figure 19: Rendswühren Man – chest packing 158
Figure 20: Rendswühren Man – autopsy scar 159
Figure 21: Rendswühren Man – wiring of left foot 159
Figure 22: Rendswühren Man – cut on bottom of right foot 160
Figure 23: Rendswühren Man – cut to area below right axilla region 161
Figure 24: Rendswühren Man during the MSCT scan process 165
Figure 25: Rendswühren Man during digital radiography 165
Figure 26: Digital radiograph of the head of the Rendswühren Man 166
Figure 27: Rendswühren Man – head with sagittal cut 169
Figure 28: Rendswühren Man – interior of right side of head 169
Figure 29: Rendswühren Man – interior of right side of head, showing mouth 170
Figure 30: Rendswühren Man – possible left ear 170
Figure 31: Map of the find site of Damendorf 1900 body 175
Figure 32: Damendorf Man 178
Figure 33: Damendorf Man – skin tear on left arm 178
Figure 34: Damendorf Man – toes of left foot 180
Figure 35: Damendorf Man – feet 180
Figure 36: Damendorf Man – showing measurements A through E and O through Q 181
Figure 37: Damendorf Man – showing measurements F through K 182
Figure 38: Damendorf Man – edited images reconstructed from CT scans of the Damendorf Man 184
Figure 39: Damendorf Man – Presence of trace elements 186
Figure 40: Map of the Osterby area 189

Figure 41: The Osterby skull after reconstruction 190
Figure 42: Side view of Osterby skull before reconstruction 193
Figure 43: Top view of Osterby skull before reconstruction 193
Figure 44: Pen and ink drawing of the partially-reconstructed skull from Osterby 195
Figure 45: Pen and ink drawing of the partially-reconstructed skull from Osterby (front) 196
Figure 46: Pastel drawing of Osterby skull during reconstruction 197
Figure 47: Osterby skull 200
Figure 48: Osterby skull – left mandible attachment 201
Figure 49: Face of the Osterby Man, after image editing 204
Figure 50: Osterby Man, view inside the skull 205
Figure 51: Osterby skull – presence of trace elements 206
Figure 52: Map of the region showing the bog where Windeby I and II were found 208
Figure 53: Map of the Domlandsmoor 209
Figure 54: Sketch of Windeby I *in situ* 213
Figure 55: Sketch of Windeby I *in situ* – side view 214
Figure 56: Windeby II body *in situ* - top view 215
Figure 57: Windeby II body *in situ* - side view 215
Figure 58: Windeby I – skull X-ray showing brain 217
Figure 59: Windeby I – tibiae, showing possible Harris Lines 218
Figure 60: Windeby I head, with band across the eyes (reconstruction) 220
Figure 61: Radiograph of Windeby II neck area 223
Figure 62: Windeby I skull 226
Figure 63: Three-dimensional model of Windeby I 233
Figure 64: Model of the Windeby skull, inside view 234
Figure 65: Windeby I – presence of trace elements 235
Figure 66: Windeby II skeletal material 238
Figure 67: Location of the Dätgen bog body (1959) 242
Figure 68: Dätgen body *in situ* – partial excavation 246
Figure 69: Vertebral column of Dätgen Man 248
Figure 70: Dätgen – radiograph of thorax 250
Figure 71: Dätgen – radiograph of pelvis 251
Figure 72: Dätgen – radiograph of foot, showing extent of wiring 251
Figure 73: Dätgen Man – body resting on boards 253
Figure 74: Dätgen Man – head 254
Figure 75: Dätgen Man – upper body 256
Figure 76: Dätgen Man – thorax 257
Figure 77: Dätgen Man – pelvis and femora 258
Figure 78: Dätgen Man – wooden dowel protruding from right femur 259
Figure 79: Dätgen Man – lower limbs 260
Figure 80: Dätgen Man – pelvic region 262
Figure 81: Dätgen Man – stab wounds 263
Figure 82: Dätgen Man – heart with stab wound 264
Figure 83: Dätgen Man – reconstruction of fracture to right distal femur 265
Figure 84: X-ray of Dätgen distal femora showing original placement of bones 266

Figure 85: Dätgen Man – presence of trace elements 268
Figure 86: Kühsen cranium and mandible 273
Figure 87: Kühsen mandible 279
Figure 88: Comparison of the Kühsen and Windeby I skulls 284
Figure 89: Body diagram of Rendswühren 285
Figure 90: Body diagram of Damendorf 285
Figure 91: Body diagram of Osterby 286
Figure 92: Body diagram of Windeby I 286
Figure 93: Body diagram of Windeby II 287
Figure 94: Body diagram of Dätgen 287
Figure 95: Marano woman (Philippines) with traditional hair knot 297
Figure 96: Stable isotope data of the Schloss Gottorf bog bodies 316
Figure 97: Plot of radiocarbon dates for the Schloss Gottorf bog bodies 322
Figure 98: Plot of rejected radiocarbon dates for Windeby I and Ii 324
Figure 99: Plot of radiocarbon dates for several Danish bog bodies 327
Figure 100: Comparison of Early Roman Iron Age stature 331
Figure 101: Summary comparison of Early Roman Iron Age stature for adults 333
Figure 102: Comparison of anterior-posterior (sagittal) subtrochanteric diameter 335
Figure 103: Discriminant function analysis performed to classify the Schleswig remains (1) with Neolithic remains from Denmark (2) and Iron Age remains from Denmark 336
Figure 104: Map of Iron Age cremation cemeteries in Schleswig-Holstein 339
Figure 105: Average stature of males and females in 9 Schleswig-Holstein cremation cemeteries 342
Figure 106: Comparison of the average stature of males in 9 Iron Age cremation cemeteries, plus Windeby I, Dätgen and Rendswühren Man 343
Figure 107: Map of the Windeby area 346

List of Tables

Table 1: Summary of archival materials examined 103
Table 2: Analyses conducted on the Schloss Gottorf bodies 122
Table 3: Table of methods used for determination of sex 129
Table 4: Table of methods used for age estimation 132
Table 5: Rendswühren – paired measurements 162
Table 6: Rendswühren – non-paired measurements 162
Table 7: Damendorf – paired measurements 181
Table 8: Damendorf – non-paired measurements 181
Table 9: Osterby craniometrics 202
Table 10: Methods used for sex estimation of the Windeby I skeleton 229
Table 11: Windeby I: Age estimate by epiphyseal fusion 231
Table 12: Windeby I – preliminary stable isotope data 236
Table 13: Methods used for sex determination of the Kühsen skeleton 276
Table 14: Age estimation of the Kühsen skeleton 277
Table 15: Summary of key results from the analysis of the Schloss Gottorf bog bodies 293
Table 16: Major methods of analysis used for bog body studies 308
Table 17: Stable isotope data from the hair of Dätgen, Osterby, Damendorf and Windeby I, and the fur cape from Windeby I 315
Table 18: Calibrated radiocarbon dates 321
Table 19: Comparison of chronologies used in comparative analyses 329
Table 20: Definition of age categories 330
Table 21: Facial measurements used for comparison 337
Table 22: Iron Age cremation cemeteries in Schleswig-Holstein 340
Table 23: Age category and age range for Iron Age cremation cemetery research 341
Table 24: Average stature of males and females in each cemetery 344

LIST OF COPYRIGHTED MATERIALS FOR WHICH PERMISSION WAS OBTAINED

Copyrighted item	Source	Page in thesis
Bog body find spots from northwestern Europe	van der Sanden 1995, p. 196-197	49
Timeline of Iron Age chronology	Nørgård Jørgensen 2003, p. 200	77
The region known as "Barbaricum"	Jørgensen et al. 2003, inside front cover of volume	79
Patterns of trade between the Roman empire and Free Germany	Hedeager 1987, p. 127	85
Stratification and grave goods during the Early Roman Iron Age	Ethelberg 1995, p. 132	99
Map of the region showing the bog where Windeby I and II were found	Schlabow 1958a, p. 119	208
Map of the Domlandsmoor	Schlabow 1958c, p. 186	209
Sketch of Windeby I *in situ*	Schlabow 1958c, p. 123	213
Sketch of Windeby I *in situ* – side view	Schlabow 1958c, p. 123	214
Sketch of Windeby II *in situ* – top view	Schlabow 1958c, p. 187	215
Sketch of Windeby II *in situ* – side view	Schlabow 1958c, p. 187	215
Windeby I – skull X-ray showing brain	Hage 1958, p. 168	217
Windeby I – tibiae, showing possible Harris Lines	Hage 1958, p. 169	218
Windeby I head with band across eyes (reconstruction)	Schlabow 1958b, p.181	220
Map of Iron Age cemeteries in Schleswig-Holstein	Hingst 1983, between pages 10-11	339
Map of Windeby area showing the location of the bog bodies, shell middens, undated settlements, dated cremation urn sites and iron working sites	Harck 1973, colour map insert	346

All photographs from the research are property of the author (Heather Gill-Robinson).

CHAPTER 1
INTRODUCTION

INTRODUCTION

A bog body is a human body that has been naturally preserved in acidic peat. The body may have preserved skin, muscle, hair, nails and internal organs. Bog bodies are found in northwestern Europe, mainly Denmark, northern Germany, the Netherlands, Ireland and the United Kingdom. Most of the bog bodies on display, or otherwise held in the collections of museums, underwent limited examination at the time of excavation and analysis. A very few bodies, for example, Denmark's Grauballe Man, were thoroughly analyzed shortly after discovery. Recently, a few bodies have been re-examined and re-interpreted using new technology and fresh perspectives. This research is an example of this new approach to the study of bog bodies.

Bog bodies are, in general, very rare and precious archaeological finds. As stated recently: "...without doubt the bog corpse is the most fascinating anthropological type of source material since it can be thought of as a direct witness of prehistoric times" (Pieper 2003, 107). The current rapid destruction of wetland environments may prevent future discovery of further bog bodies as the sites are destroyed or environmentally altered. Furthermore, bog bodies are at great risk for deterioration once removed from the peat. Even with the benefit of natural or chemical preservation methods, the bodies are subject to decay over time. It is essential, therefore, that the research focus in this area moves towards a complete re-examination of all of the bog bodies, including substantial imaging and extensive documentation.

The most recent work in bog body research has focused on attempts to corroborate reports of bog bodies (Eisenbeiss 1992, 2003; van der Sanden 1993, 2003) and the compilation of radiocarbon dates from several Dutch and German bog bodies (van der Sanden 1995b, van der Plicht et al. 2004). The first major re-analysis of a bog body came in the late 1980s (Brothwell et al. 1990). Other current re-analyses have included the Grauballe Man (Asingh 2003) and five bog bodies from Germany (Pieper 2003). Denmark has recently begun a program to medically image several of the bog bodies (Lynnerup 2003, pers. comm.), but no further investigations are planned for those bodies at present. Two bog bodies discovered in Ireland in 2003 are scheduled for a full slate of analyses (Mulhall, pers. comm. 2004). All of these investigations are discussed in more detail in later chapters.

PURPOSE OF THE RESEARCH

This collection was selected for this research for several reasons. The Schloss Gottorf bog bodies are the largest single group of bog bodies on display at any single institution and all bodies had been found in the same geographic region: the state of Schleswig-Holstein in northern Germany. Furthermore, since the collection consisted of individuals in various states of preservation, ranging from the highly demineralized flat bodies of Windeby II and Damendorf to the well-preserved corpse of the Rendswühren Man, the group offered a chance to observe various forms of taphonomic change in acidic peat bogs. Human skeletal material recovered from alkaline peat in Schleswig-Holstein was also available to provide a taphonomic comparison to the bog mummies. Previous general observations of the bodies suggested that the individuals ranged from approximately 12

years to 60 years at the time of their death, and an adolescent female (Windeby I) was reported to be part of the group, so the individuals represented a wide age range and probably members of both sexes. Most importantly, this group of individuals had received very little prior analysis and only very limited publication. This group of bodies, with the exception of Windeby I, was essentially unknown to most researchers. This investigation provided the opportunity to analyze these bodies in detail and make the data well known in both the academic community and the general public.

The purpose of this research was to provide a complete anthropological assessment of the five human bog bodies, one skeleton and one human skull with mandible that are currently curated at the Archäologisches Landesmuseum at Schloss Gottorf in Schleswig, northern Germany. The group of bog bodies at the Archäologisches Landesmuseum is a unique collection since it includes a well-preserved adult male (Rendswühren); two of the "flat" bodies, with completely demineralized bones (Damendorf and Windeby II); a potential adolescent female (Windeby I) and two heads with distinctive hair knots (Osterby and Dätgen). All of the bodies date to the Scandinavian Iron Age, approximately 500 B.C. to A.D. 800 (Gebühr 2002), with the exception of the bog skeleton, the date of which is unknown. The remains display varying levels of preservation but in all cases, except the skull and mandible, extensive soft tissue remains on the bodies.

RESEARCH GOALS

There are two components to this research. The first component, description and interpretation, included a full physical and analytical assessment of each of the bodies, as well as a comprehensive review of published and unpublished documentation related to

each of the bodies, to enable accurate interpretation of these individuals. The second component, assessment of methodological analysis, involved the determination of scientific methods suitable for the analysis of peat bog bodies. With these bog bodies, as with many mummies, emphasis was placed on the implementation of non-invasive methodologies in order to protect the bodies from damage. Data gathered and techniques applied during this research may be used for guiding future studies with the remaining bog bodies at other institutions.

The specific goals of the research were:

- To provide a complete assessment of six bog bodies and one bog skeleton from Schleswig-Holstein, northern Germany;
- To place these individuals in the context of the Iron Age in Schleswig-Holstein;
- To bring together all previously reported data on these bodies, from both published and unpublished sources;
- To undertake medical imaging of all bodies, except Windeby II, for both diagnostic purposes and to provide a permanent physical record of each individual in three dimensions;
- To determine methods of analysis suitable and appropriate for the study of bog bodies;
- To address previous knowledge and perceptions surrounding these specific bog bodies and bog bodies in general;
- To contribute to the understanding of peatland taphonomy;
- To discuss these bodies in the context of conservation and display issues; and

- To present the data to both the academic community and the general public through academic conferences, publication and integration of the data in revised museum displays.

STRUCTURE OF THE RESEARCH

The research was structured to begin with background research of the relevant published literature related to bog bodies in general, taphonomy, mummy studies and the Iron Age in Schleswig-Holstein. Attempts were made to locate all of the published literature related to the bog bodies in this collection.

The second stage involved a thorough search of the archives of the Archaeologisches Landesmuseum. All of the archival material related to the bodies in this research was examined for information related to the discovery, excavation and analysis of each body. Temporally or geographically relevant artifacts and archaeological sites were also included in the search.

All five bodies, the skeleton and the skull were subjected to complete physical examination and documentation. A programme of imaging was included and three-dimensional modeling was applied, where appropriate. Depending on the state of preservation of the bodies and the data required, some invasive sampling was undertaken for specialist analysis.

CHAPTER OUTLINE

In Chapter 2, a review of taphonomy, the processes of preservation and decomposition, is presented. Bog bodies preserve solely as a result of surrounding environmental conditions. The chapter considers the biological and environmental processes that allow the soft tissue preservation of bog bodies. Bog bodies are a rare resource in physical anthropology and can provide an insight into the taphonomy of the wetland environments of northern Europe.

Chapter 3 provides an overview of bog bodies and discusses the techniques used in the analysis of mummies, including techniques that have previously been used to study bog bodies. This chapter examines the primary techniques for the analysis of mummies of all types and identifies the most appropriate methods for the examination of six of the seven bodies in this thesis. Mummy studies are a highly multidisciplinary field and the determination of techniques for the safe and effective examination of mummified remains, specifically bog bodies, is an important aspect of this research.

Chapter 4 is an overview of the Iron Age in northern Europe, with particular emphasis on the region of Schleswig-Holstein in northern Germany and southern Denmark. The group of bodies at Schloss Gottorf all date to the Iron Age, with the possible exception of the skeleton, and all were found in Schleswig-Holstein. In order to attempt to reconstruct the lives of the seven individuals, it is important to place them in the context of the Iron Age in northern Germany and southern Denmark. Data obtained from the analyses conducted during this research will provide additional insight into the lifestyle of people in Iron Age

Schleswig-Holstein. Skeletal remains from this region and time period are particularly rare so the bog bodies provide a unique opportunity to gather palaeobiological data.

Chapter 5 provides an introduction to the materials used in this research. The chapter consists of two sections: archival material and a brief summary of each of the bodies to be studied.

Chapter 6 is an overview of the methods used to gather data during this research. This chapter is divided into two sections: archival studies and physical analyses. Specific methods used during the physical analyses are identified and explained in detail.

Chapters 7 though 12 discuss the individual bog bodies in detail. Each body has a chapter devoted to it, with the exception of Windeby II. The Windeby II body is included in the same chapter as Windeby I because these bodies were found at the same site only a few weeks apart; Windeby II is never discussed as a separate find, but included in some publications about Windeby I. The bodies are presented in the order in which they were found: Chapter 7 - Rendswühren (1871), Chapter 8 - Damendorf (1900), Chapter 9 - Osterby (1949), Chapter 10 - Windeby I and II (1952), Chapter 11 -Dätgen (1959/60) and Chapter 12 - Kühsen (1960). Each chapter presents a complete overview of each body from discovery and excavation through to the present research and is divided into two sections: previously published research and the 2003-2004 research. The 2003-2004 research section is also subdivided two sections: data obtained from the archives and the results of the physical and anthropological analyses.

Chapter 13 is a discussion chapter. This chapter provides a comparative summary of the physical analyses of all seven individuals and complete interpretations of each of the individuals. In particular, interpretation will be made in relation to taphonomy and within the context of Iron Age archaeology in Schleswig-Holstein. Finally, this chapter discusses methodological and theoretical issues related to the analysis and interpretation of bog bodies.

Chapter 14 provides an overall summary of the research; identifies the archaeological and methodological implications of this research and suggests future directions for research with the Schloss Gottorf bog bodies and for other bog body research projects.

CHAPTER 2
TAPHONOMY: UNDERSTANDING TISSUE PRESERVATION IN THE ARCHAEOLOGICAL RECORD

INTRODUCTION

There are several environments that may lead to the natural preservation of soft tissue. Desiccation of human soft tissue remains will occur in hot, arid areas such as the deserts of Australia and Egypt or along the coast of Chile and Peru. Freezing and sublimation, also known as freeze-drying, will occur in cold, arid regions such as the Arctic and Antarctic and also desiccates soft tissues (Micozzi 1991). Preservation in waterlogged, anaerobic, acidic environments such as peat bogs will normally lead to soft, flexible sot tissue preservation with highly demineralized bone. Other environmental factors, including the chemical composition of the burial matrix or accompanying artifacts, may also lead to soft tissue preservation. Bog bodies are preserved naturally through the surrounding environmental conditions without any anthropogenic influence.

Following death, the body is exposed to an interactive series of biological and environmental processes that determine whether the physical remains will survive in the burial setting. These processes may also be affected by cultural influences. It is clear that the process of decomposition was interrupted at an early stage in some of the bodies found in the peat in northwestern Europe, since the bodies may have extensive well-preserved soft tissue. What is not clear, however, is exactly how immersion in an acidic peat environment reduces or halts decomposition and encourages mummification. This

chapter focuses on the physical and chemical processes that affect the preservation of the human body after death, a process broadly known as taphonomy and, more specifically, considers how these processes of preservation or destruction relate to bog bodies.

AN INTRODUCTION TO TAPHONOMY

In 1940, J.A. Efremov suggested the term "taphonomy", as a subdiscipline of palaeontology, to refer to "the laws of embedding" (1940:93). The term itself translates to "burial laws" (Gifford 1981:366) and is most commonly used to refer to the post-mortem processes of decomposition or preservation of an organism. It is now commonly accepted that "taphonomy" refers to all alterations of the organic and inorganic composition of any living organism following death. "Biostratinomy" and "perthotaxis" have also been used to refer to any changes between death and burial, whether natural or cultural, while "diagenesis" is those changes that occur after burial (Child 1995). Millard (1996) uses "taphonomy" to refer to macroscopic changes during the period from death the burial, and "diagenesis" to refer to post-burial microscopic changes.

Following death, the assemblage is affected by climatic and environmental factors on the surface, some of which prevent the bones from being buried. Environmental and cultural processes further affect the death assemblage during burial and following the discovery and excavation of the remains. Many of these processes lead to decay, the "process of degradative adjustment of materials to the conditions prevailing in their immediate environment"(Goffer 1980:239), although some will allow preservation. At the time of excavation and recovery the remains are susceptible to "those factors influencing the collecting of fossils which determine whether or not any particular fossil at the surface

will find its way into a collection" (Clark et al. 1967:155). In the case of bog bodies, this may refer the possibility of retrieving all of the parts of the body that were affected during mechanical peat digging, for example. Following recovery, "factors incident to curating and identifying a specimen which determine whether or not a fossil becomes available for [analytical] use" (Clark et al. 1967:155) affect the preservation of the body. For example, processes of conservation that make physical or chemical changes to the bog body may affect the availability of the body for study by interfering with the original body shape, chemical composition or quality of DNA.

As a result of the processes from life assemblage to death assemblage, following death and through to excavation and curation, the original assemblage available for analysis has been reduced drastically from the population which originally existed. In the case of the bog bodies, it is possible that many more bodies were in the peat than have ever been discovered. There will have been other bodies that, for whatever reason, did not preserve. When attempting to interpret the bog bodies it is important to recognize that the few individuals that we have may not have been entirely representative of the population. The bodies do, however, provide information about a specific individual at a specific point in time in a specific area. Given their unique preservation, the bog bodies provide an extraordinary glimpse at aspects of the past that are rarely observable.

SOFT TISSUE DECOMPOSITION AND PRESERVATION

Decomposition

There are two elements of decomposition: putrefaction and decay. Putrefaction is the anaerobic action of decomposition, while decay is the aerobic degradation of the remains

(Micozzi 1991). Both moisture and moderate temperatures are required for putrefaction (Aturaliya and Lukasewycz 1999). Any environment colder than 4° C will prevent putrefaction (Micozzi 1991). Temperature extremes in either direction may lead to inhibition of decomposition processes and the partial or total preservation of soft tissue.

Many materials, including human bone and soft tissue, are adversely affected by the presence of water in the burial environment. In most cases, greater levels of water increase the frequency and severity of damage to archaeological remains (Goffer 1980). An exception to this seems to be soft-tissue mammalian remains in acidic wetlands, where a greater level of water resulted in higher levels of soft-tissue preservation, although bone was severely demineralized (Gill-Robinson 1998, 2000, 2002).

In areas of repeated changes to the water table bones may be exposed to repeated wetting and desiccation. This is particularly detrimental to bog bodies. In order for preservation to occur it is necessary for the bodies to stay in a waterlogged, anaerobic environment. In periods of extreme dryness, for example during a drought or after a bog has been drained for some purpose, any human remains within the peat risk exposure to oxygen. Once oxygen reaches the body decay is inevitable unless conservation efforts are made. It is likely that at least some bog bodies were lost as a result of a change to the water table following peat drainage for agriculture or re-development.

Experimental archaeology has also demonstrated the effects of water movement in acidic peat bogs. In general, specimens migrated from a specific depth and location towards the centre of the one metre square research area. Depth also changed, although some

specimens rose in the peat while others sank further into the peat (Gill-Robinson 2000, 2002). It is likely that the constant motion of the peat caused bog bodies to move from their original deposition location. Although this movement is liable to be minimal in terms of distance, it may be reflected through differences in body position or depth from burial to excavation.

In general, decomposition rates of buried corpses are up to eight times slower, than those for human remains left on the surface (Rodriguez 1997). The slower decomposition rates for buried bodies are the result of restricted access of insects and other scavengers, the prevention of solar radiation reaching the remains and soil temperature. The deeper the body is buried, the lower the soil temperature and the slower the rate of decomposition; bodies buried below four feet in depth may remain in good condition for at least a year before more than minimal decomposition begins (Rodriguez 1997).

Where decomposition does occur, both internal and external forces are part of the process. The action of micro-organisms in the intestines begins the process of internal decomposition. Externally, soil organisms (when buried) and other decay organisms cause the breakdown of tissues. Eventually, internal and external decomposition actions meet and external organisms succeed the enteric micro-organisms (Micozzi 1991). It is possible that immediately following death, micro-organisms multiply rapidly and spread throughout the body to begin the processes of internal putrefaction (Evans 1963). Another possibility is that immediately prior to death the body tissues are rapidly colonized by bacteria and the process of putrefaction begins throughout the body at the same time (Micozzi 1991).

The phases of decay have been divided into fresh, bloat, decay and dry stages (Micozzi 1991). Following a brief fresh stage (lasting less than 48 hours), the body swells with the accumulation of putrefaction gases created by bacterial decomposition of body proteins; this is known as the bloat stage and normally lasts between two and five days in moderate temperatures. In areas of consistent cold or freeze-thaw cycling, the bloat stage may continue for several weeks. During the decay phase, bacteria continue the process of aerobic protein decay and fungi colonize the body. During the dry stage, the decomposition is virtually complete. The duration of each of these stages is dependent upon the environmental conditions around the body and varies seasonally (Micozzi 1991, 44).

During the decay stage insect activity reaches it peak. Although this thesis will not discuss the entomological contributions to decay in great detail, it is necessary to survey this area briefly. There are three categories of insects found during the decomposition process of soft tissue remains: necrophagous, omnivorous and predator/parasites. Necrophagous insects are the main consumers of the corpse. Omnivorous insects consume not only the corpse, but also the necrophagous insects that have already colonized the remains. Finally, predator and parasite insects consume only the original necrophagous insects (Micozzi 1991). Interestingly, there is no evidence for necrophagous or later stage decay insects on bog bodies. It is possible that most of the bodies had entered the wetland environment before insect activity commenced. Conversely, it is possible that other bog bodies did experience insect invasion following death and prior to immersion in the peat and that these bodies either did not preserve as well, or failed to preserve at all. There are numerous bog bodies with highly variable

levels of preservation and there is little consistency for predicting the quality of preservation of soft tissue on a body from a peat bog. It may be that bodies left on the surface until they sunk into the peat or those that were not buried for a period of time may already have been partially decomposed and exposed to insect activity before entering the peat. Although the actions of the peat may then have halted these processes of decay, it would have meant the body was already partially destroyed. When excavated it may appear that these bodies are poorly preserved but this may be less the result of the peat and more the result of the period of time immediately prior to deposition.

Preservation

In an arid environment, a lack of moisture will inhibit enzymatic decomposition. Naturally preserved mummies from Egypt and Peru are good examples of arid preservation. Recent experimental research conducted to determine the processes of arid desiccation mummification has indicated that numerous factors, including the presence of textiles, postmortem body position and the original water content of the visceral and other soft tissues are determinants in the spontaneous mummification of soft tissue in warm, arid environments (Aturaliya and Lukasewycz 1999).

In areas with low temperature and low humidity putrefaction and decomposition are inhibited by the lack of moisture, although freeze-thaw cycles can cause alternating periods of decomposition and cessation, leading to destruction of soft tissue (Hart Hansen 1998; Micozzi 1997). Bodies in cold, arid environments may preserve in one of three ways: frozen, mummified or with adipocere development. Combinations of any of these states may be found on the same body. For the immediate postmortem period the body

will be frozen. Over time desiccation will take occur and adipocere, which is discussed in more detail below, may form (Hart Hansen 1998).

Adipocere may form during postmortem change of the body fats. Adipocere is a foul-smelling waxy, greasy substance that may crumble when touched. Although it was originally believed that water was required for the formation of adipocere, long-term inhumation, even in dry soils may allow adipocere to develop (Evans 1963; Mellen et al. 1993); water in some form, precipitation or humid conditions at the time of burial, probably contributed to adipocere formation in those cases. The adipocere may form a case around the body that acts to protect the viscera from bacterial growth, enzymatic action and other external influences (Aufderheide and Aufderheide 1991).

In alkaline environments, including some types of peat, soft tissue is not preserved, but skeletal material may be. Soil pH is a particularly important factor in the survival of human remains after burial. Alkaline soils, such as those found in fen wetlands, may allow the preservation of the mineral component of bone (Healy and Housely 1992; Keeley et al. 1977; Pate and Hutton 1988). This has been seen in the fens of the United Kingdom, for example, where several Bronze Age skeletons have been excavated (Healy and Housley 1992).

In wet, anaerobic environments with acidic soils, specifically the peat bogs of northwestern Europe, soft tissue decomposition may be inhibited, but skeletal degradation is extreme. Acidic environments may preserve soft tissue but lead to extreme deterioration of osteological material (Crowther 2002; Millard 1996). In acidic soils

substantial bone demineralization, manifested as weight loss and severe bone deformation, may lead to the obliteration of skeletal markers (Noe-Nygaard 1987), preventing accurate identification and interpretation. Microbial decomposition of collagen leads to the formation of organic and carbonic acids, which causes the breakdown of bone hydroxyapatite (White and Hannus 1983).

Although preservation of soft tissue in peat bogs is generally attributed to the presence of tannic acids (Micozzi 1991), other environmental mechanisms, including an anaerobic aquatic environment, may contribute to the spontaneous preservation of these bodies. Painter (1991a), in fact, stated that the so-called tanning of bog body skin is not from vegetable tannins, as commonly believed, since the polyphenols necessary for production of vegetable tannins are absent in *Sphagnum* mosses. Painter's research indicated that sphagnan, an anionic polysaccharide that becomes soluble during the process of breakdown from dead *sphagnum* moss to peat, was responsible for the tanning of bog body skin (Painter 1991a, 1991b, 1995). Since bog bodies are immersed in a solution containing sphagnan, the bodies are involved in the process of conversion from sphagnan to humic acid. The sphagnan sequesters the calcium from the bones of bog bodies, leading to the demineralization of the bone (Painter 1991a, 1991b). Although the demineralization of bog body bone is usually attributed to the acidic environment, Painter stated that "[D]ecalcification is not evidence of acidity, and in fact it would be impaired by too much acidity" (Painter 1991a, 422).

Bog body preservation is highly variable. Some bodies will be preserved as soft tissue corpses with highly demineralized bones, others have good soft tissue preservation in

some parts and skeletonization of other body parts, while still others are preserved as "flat bodies", mainly skin with some soft tissue and virtually no skeletal material. These variations seem to be based upon microenvironmental preservation, where minute differences in water levels (Gill-Robinson 1998, 2000, 2001, 2002) and chemical or botanical composition differentially affected the preservation of a corpse crossing several microenvironments.

Despite the acidic environment of peat bogs, the skin and muscle of bog bodies often survives structurally intact in places, while the skeletal structure is negatively affected to varying degrees throughout the same body. Bog bodies retain skin at the dermal level; no epidermal skin has been recovered either on the bodies themselves or from the surrounding peat (Brothwell and Gill-Robinson 2002), although fingerprints still remain on at least one bog body (Andersen 1956). The sterol and lipid composition of the skin and muscle in most bog bodies is the same as in living tissue (Flannery et al. 1999), unless adipocere has formed. Although most bog bodies are not found with adipocere, there are some with considerable amounts of the substance. In the case of Meenybradden Woman, a bog body from Ireland, large deposits of adipocere were found on the body (Delaney and Ó Floinn 1995). Chemical analyses of the adipocere of Meenybradden Woman through the use of high temperature capillary gas chromatography indicates that the composition of bog body adipocere is similar to that found in other environments and apparently not affected by immersion in the bog (Evershed 1992). It has been suggested that the individuals had high levels of body fat at the time of their death (Evershed 1992). In experimental research with piglets as human bog body substitutes, substantial adipocere developed on several of the disarticulated elements from a single specimen.

The adipocere also floated within the peat water at the experimental burial sites; it was not possible to identify exactly which specimen was the source of the floating adipocere (Gill-Robinson 2001, 2002).

In terms of bone composition and structure, however, bog body bones are severely demineralized and the remaining collagen fibrils, although well preserved, are supported not by bone protein, but by plant-derived molecules from the surrounding environment (Brothwell and Gill-Robinson 2002; Flannery et al. 1999). Keratinous structures are frequently preserved, even facial hair is frequently visible, although the acidic environment usually turns bog body hair red regardless of its original colour (Brothwell and Gill-Robinson 2002). In several bog bodies, portions of the intestinal tract and other internal organs have been preserved. Although brain matter is shrunken, it is well preserved in several bodies (Brothwell and Gill-Robinson 2002).

PROBLEMS WITH TAPHONOMY AND INTERPRETATION

Postmortem or antemortem

Taphonomy plays a major role in the interpretation of human remains. Differential preservation of the human remains may prevent accurate interpretation of the site since some skeletal elements or some members of a population may be under-represented in the archaeological record (Guy et al. 1997; Stojanowski et al. 2002). The differential preservation may be due to the environmental conditions of the site, the methods of burial, methods of preparation of the dead or the actual composition of the human remains themselves.

It is important in the analysis of archaeological and modern human remains to determine whether lesions and other marks attributed to palaeopathology and trauma occurred antemortem, perimortem or postmortem. Postmortem bone and soft tissue alterations in human remains may be identified as antemortem or postmortem damage. There are numerous cases of misidentified bone marks, fractures and perforations that were recorded as perimortem injury, but had taphonomic origins (Quatrehomme and İşcan 1997). Without careful analysis, or with inexperience, it is possible to misinterpret human remains (Saul and Saul 2002).

Postmortem marks made by rodent gnawing may be misinterpreted as antemortem or perimortem trauma to soft tissue and bone (Haglund 1992). Although rodent marks on most bones may be visible as parallel striae, on smaller bones, such as phalanges, or on bones that have been partially demineralized or weathered prior to rodent chewing, the parallel lines may be absent. In the case of soft tissue, it has been known that rodents, especially rats, nest in mummified and partially decomposed thoraxes (Haglund 1992).

A common problem in the interpretation of archaeological human remains is the occurrence of pseudopathologies. Evidence of trauma and palaeopathology that are identified but can be attributed to taphonomic variables are known as pseudopathologies (Wells 1967). Pseudopathologies are particularly common in the peat bog bodies of northwestern Europe. The acidic environment of peat bogs leads to severe demineralization of the skeletal material, particularly when the pressure from the overlying peat is considered, and can cause misinterpretation of fractures and other

skeletal lesions (Brothwell and Gill-Robinson 2002). Since many of the bog bodies were discovered and excavated during peat cutting processes, it is common for the skin and muscles layers to be damaged. Pieces of limbs may be unintentionally cut or severed when the peat spade is driven through the body prior to its discovery and lead to interpretation as perimortem trauma.

Whether deliberate or unintentional, soft tissue on archaeological human remains may be lost or damaged during the curatorial process between excavation and conservation. Unintentional loss of soft tissue may occur during excavation, transportation and analysis of the remains. During conservation bodies may be exposed to chemical treatments and bodies are often reconstructed for display. The effects of handling during excavation, transportation and initial examinations may inadvertently damage the body. Furthermore, conservation treatments and display preparations may cause skin tears, bone fractures or other damage, as well as having the potential to contaminate DNA.

Recognition of taphonomy

When analyzing human remains it is important to have some knowledge of the original burial environment. Awareness of the soil acidity; type and quantity of water found at the burial site; regular climatic and temperature variables; the presence of textiles, artifacts, coffins and other burial cases; grave style; and other inhumation conditions will enable a good physical anthropologist to consider the effects of these variables on the human remains. As long as the possibility of taphonomic influences is taken into account when analyzing human remains, there is greater accuracy in interpretation.

During analysis there are several techniques available to help determine the taphonomic features of human remains. Careful visual assessment of the remains will identify areas of damage or other marks that will require additional analysis for accurate interpretation. Once potential areas of interest have been identified, further analytical techniques such as light microscopy, scanning electron microscopy and mass spectrometry can be applied.

In a recent re-evaluation of 168 skeletons from the Windover Pond site in Florida the specific issue of taphonomy and preservation of the skeletal remains was addressed. In an effort to quantitatively record the level of preservation of each of the skeletons accurately a new scoring methodology, based on the observation of 80 skeletal and dental landmarks to determine skeletal completeness, was designed specifically for the project (Stojanowski et al. 2002). It is not unusual to have to construct new recording systems for taphonomic projects (Gill-Robinson 2000) and although that is of particular benefit to individual project analyses, it hinders any attempt to compare data (Hedges and Millard 1995b). Although Buikstra and Ubelaker (1994) provide forms for recording observations of taphonomy on burned and unburned bone, these forms rely upon somewhat descriptive observations and are not quantifiable for standardized observation within and between sites.

Where invasive sampling is permitted, histological examination of bone may provide insight into whether bone modifications are taphonomic or pathological. There are several qualitative markers of diagenetic change in human bone that can be observed through histology (Nielsen-Marsh and Hedges 2000). Usually transverse thin sections of bone are made and observed using standard and scanning electron microscopy (Hedges and

Millard 1995b). Hedges and Millard note that a site-specific pattern of histological change exists. In particular, "...the pattern of destruction often has a characteristic signature for bones from the same site" (Hedges and Millard 1995b: 203).

Changes in the protein content of bone are also viewed as indicators of taphonomic change. During the degradation of bone not only does the quantity of collagen decrease, but the quality of the remaining collagen also declines (Hedges and Millard 1995b). These characteristics are measured through the use of mass spectrometry to analyze nitrogen content for determining protein survival of the bone sample (Hedges and Millard 1995b).

Scanning electron microscopy (SEM) is used in the examination of bone to determine the causes and processes of taphonomic change. Taphonomic processes may be altered in pathological bone (Bell 1990) and SEM examination allows the researcher to provide a more accurate interpretation of the structure of the bone and the quality of bone preservation. SEM has also been used to image aspects of taphonomic change on mummies. For example, cut marks on the foot of the Huldremose Woman, a bog body from Denmark, were examined using scanning electron microscopy. Although it was originally believed that a peat spade caused the cut during excavation, the SEM suggested that the cut was made by a sharp edge and was likely a perimortem injury (Brothwell et al. 1990).

Although SEM is valuable in taphonomic research, allowing better analysis of three-dimensional surfaces, there are limitations. SEM may be expensive and often requires a

specially trained individual to take the images. The chamber in an SEM unit is restrictive of sample size and sensitive to sample orientation (Gilbert and Richards 2000). Innovations in digital imaging are allowing three-dimensional images to be recorded with accurate depth of field, which improves the accuracy of interpretation of cut marks and other bone modifications (Gilbert and Richards 2000).

Dealing with taphonomy in anthropological studies

Both ethnographic analogy and forensic anthropology may contribute to the understanding of taphonomy. As ethnographic analogies are used in the interpretation of early human lifestyle, forensic cases are used to interpret archaeological human remains. For example, specific marks left by weapons, known as "weapon signatures", have been identified in forensic cases; marks by bladed weapons such as machetes and knives may be compared to marks on archaeological skeletal material (Saul and Saul 2002). The position of the body at excavation, including the degree of articulation, may provide evidence of taphonomic changes. Bodies that are disarticulated and scattered may have been moved by predators or reburial customs after death, or may have been deliberately disarticulated prior to death.

Experimental archaeology

Experimental archaeology allows physical anthropologists to examine aspects of taphonomy through the simulation of the environment or activity that may have produced the taphonomic effect under study. A major problem with taphonomic studies is the long-term nature of the research (Andrews 1995). Several projects, many of them reasonably short-term in the scale of taphonomic research (three years or less in length) have been

conducted (eg. Aturaliya et al. 1995; Breuning-Madsen et al. 2001; Nicholson 1992, 1996a, 1996b, 1998).

One of the longest running taphonomic projects still in progress is Overton Down Experimental Earthworks in Wiltshire, southern England. A second site, Morden Bog near Wareham was begun in 1963 (Fowler and Swanton 1996). Planning for the Overton Down project began in 1958 with the first material buried at the site in 1960 (Jewell 1963). The project was designed to expose several materials commonly found on archaeological sites, such as bone and textiles, to standard burial conditions in chalk and turf environments in order to study the effects of taphonomy in a controlled setting (Jewell 1963). An earthwork was constructed, materials buried, and the site monitored through several methods, including sectioning of the bank and ditch at intervals of 1, 2, 4, 8, 16, 32, 64 and 128 years (Fowler and Swanton 1996, 1). The materials used for burial were: textiles (cotton, garbardine and linen); leather; charred and uncharred oak and hazel billets; cooked and uncooked animal bones (sheep); pieces of human femur from individuals with blood group A, B and AB (samples from five individuals in total); cremated human bone; flints and fired clay (Jewell 1963). Samples of metals and glass were added at the Wareham site (Fowler and Swanton 1996). Environmental factors, including soil composition and weather, monitored and the effects of burial were studied upon excavation (eg. Andrews 1995; Armour-Chelu and Andrews 1996; Bell 1996; Fowler 1996a, 1996b; Hedges et al. 1996; Nielsen-Marsh and Hedges 2000). It should be noted that neither the turf environment at Overton Down, nor the Morden Bog site are environmentally comparable to the peat sites from which the bog bodies of the Archaeologisches Landesmuseum were excavated. This is reflected in the differences in

preservation between the material from the experimental sites and that from the bog body sites. For example, by 1992 none of textile samples had preserved in the turf environment of the Overton site (Janaway 1996), unlike the well-preserved textiles found with some bog bodies, including the body from Damendorf that is part of this research. At the Morden Bog site there was no evidence of either the cremated human bone or the cooked or uncooked animal bone (Hillson 1996).

Laboratory experiments in taphonomy are also being conducted to study the effects of burial, patterns of bone breakage, abrasion and predatory scavenging on animal remains. Micozzi (1997) undertook experimental fieldwork with animal subjects to study the taphonomic effects of freezing and thawing on human remains. Although this work was conducted using surface-exposed animals, rather than buried remains, the general data pertaining to freeze-thaw patterns of soft tissue preservation and decomposition are still valid. Recently dead remains that had not been exposed to extreme cold decomposed through putrefaction, that is, internal structures decomposed before external structures. Bodies that were frozen at the time of death and then thawed decomposed through the actions of decay, that is, external structures decomposed before internal structures (Micozzi 1997).

Bodies from Bronze Age Denmark, approximately 3,300 years ago, have been well preserved in oak coffins within earth barrows. New experimental evidence using pigs buried in replicated Bronze Age oak coffins has demonstrated that the coffins would have been covered with a temporary cover of soil or sod while the mound was being constructed. The bodies would have had to remain in anoxic environments for the

preservation between the material from the experimental sites and that from the bog body sites. For example, by 1992 none of textile samples had preserved in the turf environment of the Overton site (Janaway 1996), unlike the well-preserved textiles found with some bog bodies, including the body from Damendorf that is part of this research. At the Morden Bog site there was no evidence of either the cremated human bone or the cooked or uncooked animal bone (Hillson 1996).

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preservation of soft tissue to occur and the only way this would have been possible was if an interim covering of the coffin was used prior to the final interment of the oak coffin in the burial mound (Breuning-Madsen et al. 2003).

The first experimental research using animals in peat in an effort to understand the processes of preservation and decomposition were conducted by Ellermann and reported in 1917. Ellermann conducted a series of experiments using rodents and, eventually, human skin placed in peat mixtures in his laboratory. Through this research Ellermann determined that, in acidic peat, bones would demineralize and the skin become leathery. In a neutral peat mixture there was more likely to be preserved skeletal material, but little or no "tanning" of the skin (Ellermann 1917). Although this research was conducted in a laboratory rather in the field, it can be viewed as the first experimental attempt to understand the taphonomic factors affecting bog bodies.

To study bog body taphonomy, burials of human substitutes in peat have been undertaken (Gill-Robinson 1996, 1998, 2000, 2001, 2002; Janaway et al. 2003). Recent research by Janaway et al. (2003) has used pigs buried in acidic upland peat in the United Kingdom to determine taphonomy for forensic and archaeological applications. While upland peat is mainly saturated, it can experience variable water levels, including dry periods (Janaway et al. 2003), unlike the raised peat bogs (lowland) where most bog bodies have been found. The work in the upland peat demonstrated that although soft tissue preservation did not reach the level seen in some archaeological bodies from lowland peat, decomposition was still reduced. Soft tissue preserved longer than would be expected in a dry soil burial of comparable depth and time duration (Janaway et al. 2003).

One research project has specifically addressed the taphonomy of lowland raised bog peat as it relates to archaeological human remains through the burial of piglets as human analogues (Gill-Robinson 1996, 1998, 2000, 2001, 2002). Piglets were chosen as human analogues for several reasons, including their physiological similarity to humans. Although it would have been preferable to use adult pigs, the relatively short duration of the project led to the decision to use the smaller piglets. Twelve piglets were obtained from a local pig farmer and buried at three different peat sites in the United Kingdom for periods ranging from six months to three years (Gill-Robinson 2000, 2002). The research was able to determine that higher levels of water at the bog site led to better soft tissue preservation, but that numerous other factors, including microenvironmental variations, contributed to selective preservation of bog bodies (Gill-Robinson 2000, 2002).

Anthropologie de terrain

Recent research has suggested that it may be possible to interpret both taphonomic and cultural factors affecting preservation in burials for a more complete burial analysis , Nilsson 1998; Nilsson Stutz 2003a, 2003b). Originally developed in France by Henri Duday, *anthropologie de terrain* "focuses explicitly and in detail on the physical aspects of death, in order to provide a taphonomic theoretical basis for inferences about the past mortuary practices" (Nilsson Stutz 2003a). Observation and detailed documentation of the body during excavation are meshed with data about the burial environment, to interpret taphonomic processes, and knowledge of cultural practices to form a holistic view of the burial of the individual, in an attempt to "...reconstruct the burial...at the moment of deposition" (Nilsson 1998, 6). These methods have been successfully applied

to Mesolithic burials at the Skateholm II site in Sweden (Nilsson 1998; Nilsson Stutz 2003a, 2003b).

Although this may seem an ideal approach for the interpretation of bog bodies, the knowledge of cultural burial practices is crucial. In the case of the bog bodies, it is unclear how many individuals represent a culturally-defined burial practice; some bodies were not deliberately placed in the peat. Furthermore, for those bodies that were intentionally buried or otherwise deposited in the peat, the meaning of this practice is not understood. There is no consistency to the bog bodies in terms of body orientation, depth of burial, presence of artifacts or any other aspect of deposition, so interpretation of bog bodies through *anthropologie de terrain*, when lacking the cultural background, would be limited.

SUMMARY

The various natural and anthropogenic factors that influence the preservation or destruction of a body after death may prevent the accurate interpretation of human remains. Although taphonomic research has become more widespread, it is crucial that taphonomic factors be taken into consideration in the interpretation of all archaeological materials, especially human remains and bog bodies in particular. Since the full extent of the influence of taphonomic factors in the preservation of human soft tissue remains is still not known, further multidisciplinary taphonomic studies of the processes of preservation in peat bogs would contribute additional valuable information to the interpretation of the physical remains of bog bodies. Unfortunately, for many bog bodies the environmental data from the excavation site is not available. In terms of this research,

and similar future projects, knowledge of the burial environment, where possible, would provide valuable information to assist with interpretation of the extent and type of preservation of the body.

CHAPTER 3

UNDERSTANDING OUR METHODS: ANTHROPOLOGICAL ANALYSIS OF PRESERVED HUMAN REMAINS

INTRODUCTION

In order to analyze and interpret human remains with preserved soft tissue, often referred to as "mummies", methods and perspectives different from those used in skeletal analyses must be adopted. While some techniques used in skeletal analysis are appropriate for mummy studies, adaptations are necessary. For example, standard osteometric points are well known for the measurement and analysis of skeletons. Mummies do not have easily identifiable or consistent landmarks and it is difficult to standardize measurement points for replication or comparison.

This chapter is an overview of methods used in the analysis of human remains with preserved soft tissue. This chapter also provides a brief overview of bog bodies. Finally, an account of the development of the techniques used in the study of bog bodies and the results of many of these analyses will be presented.

INVASIVE VERSUS NON-INVASIVE STUDIES

The current trend in the anthropological study of preserved tissues is the use of non-invasive techniques. Although there are still some invasive autopsies of mummies undertaken (Zimmerman et al. 2000), this is a practice that was more common in the past (Amy et al. 1986; El-Najjar et al. 1980; Post and Daniels 1969; Sandison 1955; Speck and Wheeland 1984). There are few well-preserved bodies available for analysis and, as a result of their rarity, there is reluctance to destroy one of these bodies through a full

autopsy. Since many of the preserved bodies are under the stewardship of museums or other heritage institutions, invasive sampling of skin or other soft tissues is often not permitted, due to protection policies. This has led to an increased use of medical imaging techniques to identify palaeopathology, trauma and methods of mummification, and to study other aspects of mummies. Since imaging is such an important aspect of current mummy studies projects, including the re-examination of bog bodies, it is discussed in more detail later in this chapter. Where invasive investigations are permitted, they are usually limited to small samples of bone, skin or other soft tissue or hair for specific analyses including dietary analysis and DNA sampling.

Invasive studies

Dietary analysis

There are two primary methods for the analysis of diet in mummies: physical analysis of preserved gut contents and chemical analyses of tissues. The exceptional preservation of the gut contents of many mummies has allowed in-depth analysis of meals consumed just prior to death. Detailed analyses of the intestinal contents included identification of grain species and a consideration of potential methods of preparation of final meals. Helbaek undertook analyses of the gut contents of Tollund Man (1951, 1958) and Grauballe Man (1959) of Denmark. Holden examined the contents from the Lindow Man (1986; Sales et al. 1991) and Huldremose Woman (1999), as well as the Tyrolean Iceman (2002) and South American mummies (1994).

The second approach is the use of stable isotope analysis and trace element analysis. Bone collagen and other destructive samples from mummies have been used for assessing

diet through stable isotope analysis (Dickson et al. 2000; White and Armelagos 1997; White and Schwarz 1994; White et al. 1999) and trace element analysis (Aufderheide and Allison 1995; Aufderheide et al. 1995). Even when completely destructive sampling of mummies is not permitted it may be possible to determine past diet through stable isotope (Macko et al. 1999; Tieszen et al. 1995) and trace element (Brothwell and Grime 2003; Casallas et al 2003; Hansen et al. 1989; Hansen and Asmund 2003) analyses of hair samples, which although destructive is less invasive. Mummies with hair often shed numerous hair fibres over time. Only a few hairs are required for analyses and these tests may be conducted with hairs that have fallen out or that can be sampled from the scalp while leaving little evidence of their extraction, therefore not affecting museum display.

Palaeopathology

The presence of soft tissue provides additional information in the analyses of archaeological human remains. Palaeopathologies such as goiter (Ciranni et al. 1999); tumours (Strouhal 1976); frostbite (Post and Donner 1972); tuberculosis (Allison et al. 1973, 1981); Chagas' disease (Rothammer et al. 1985); anthracosis and other respiratory ailments (Brothwell et al. 1969; Pabst and Hofer 1998) have been identified from mummies. Evidence of parasitic infestations (Araujo et al. 2000; Aspock et al. 2000; Ferreira et al. 1983; Horne 1979, 1985) and traumatic injuries may be visible in mummies, even when no skeletal evidence remains.

DNA

Other recent research has included the development of techniques for DNA analysis of mummies. The presence of well-preserved soft tissue has allowed the successful

extraction of DNA for sexing, determination of palaeopathological conditions and potential familial or kinship affiliation (Monsalve 2002; Monsalve et al. 2002, 2003; Rollo et al. 2000; Simonsen et al. 2003; Spigelman et al 2003; Ubaldi et al. 1998). Until recently it has been possible to extract DNA from intestinal bacteria of bog bodies, but not the bodies themselves (Fricker et al. 1997). Researchers at the Paleo-DNA laboratory at Lakehead University have, only recently, successfully extracted mitochondrial DNA from two Dutch bog bodies (Matheson et al. n.d..).

Non-invasive studies

Imaging

A range of techniques adopted from medical imaging in clinical settings has greatly enhanced the opportunities to examine mummies in a non-invasive manner. The first use of X-rays in the study of mummies was recorded only a few months after the discovery of the Roentgen rays in 1895 (Fiori and Nunzi 1995; Isherwood 1995; Rühli et al. 2004). Since then mummies are routinely X-rayed as part of anthropological analyses (eg. Appleboom and Struyven 1999; Brothwell et al. 1990; Eiken 1989; Gardner et al. 2004; Gostner and Vigl 2002; Hunt and Hopper 1996; Krebs and Ratjen 1956; Moodie 1931; Notman and Beattie 1996; Sigmund and Minas 2002; Whitehouse 1980). Radiological investigation can provide data related to the age and sex of the individual, the presence of artifacts, palaeopathology and trauma and methods of mummification (Rühli et al. 2004).

Radiography

Radiography provides a relatively inexpensive and widely available means of non-invasive and non-destructive examination of mummified human remains (Spoor et al.

2000). Many European museums face budgetary crises and in order for radiographic assessments of a bog body to take place the method of examination must be cost effective. Furthermore, although there are several unconserved bog bodies in museum storage most of the bog bodies are currently on display and are primary attractions for the museum. Only non-invasive studies of the bodies are permitted since the bodies must not be damaged further so they can be on display. Radiography allows the body to be imaged fairly quickly and inexpensively, usually with little or no damage.

There are some potential limitations to the examination of mummies with radiography. For example, except in unusual circumstances, the mummy to be examined must be moved to the location of the X-ray unit, risking damage to the body during transportation (Aufderheide 2003). There are portable X-ray units available for circumstances where the body cannot be moved (Conlogue et al. 1989, 1997; Gostner and Vigl 2002; Notman et al. 1987), but access to portable units may be limited or cost-prohibitive. In recent and past radiographic studies of bog bodies specially constructed bases and travel crates have been constructed to move the body safely (Asingh 2003; Krebs and Ratjen 1956). This is a costly and time-consuming procedure that requires the body to be moved to the imaging base and there is a risk of damage any time the bog bodies are moved. Many bog bodies are mounted on bases that have metallic clips or frames and cannot be separated from the bases; the metal content of the base may also affect the imaging.

Also, the soft tissues of most preserved human remains are substantially desiccated, which may cause problems with the identification and interpretation of specific body structures (Aufderheide 2003). In particular, since plain radiography has low contrast

resolution (Rühli et al. 2004; Spoor et al. 2000) it has a limited ability to distinguish between subtle changes in density. Distortion of images in plain radiography is common because the X-rays project as a conical beam and the intensity of the beam may vary where the surface being imaged is uneven (Spoor et al. 2000); the use of specialized filters may be necessary to solve problem of X-ray dispersion from variable densities of the individual structures of the mummies. Only a skilled radiological technician will be able to reduce or avoid these complications of plain film radiography imaging (Hunt and Hopper 1996; Rühli et al. 2004). Complications arise in imaging bog bodies since the majority of bodies have severely demineralized bones. The differences in density between the desiccated skin and demineralized bone can be very small and interpretation of the radiographs is difficult, particularly where multiple layers of skin may overlap on top of bony structures. Furthermore, standard radiographs are two-dimensional images of three-dimensional structures and may require specialized training for accurate interpretation (Hunt and Hopper 1996; Spoor et al. 2000).

Finally, mummies may be shrouded in clothing or textiles, or may have been positioned in such a way that body parts, packing or artifacts may overlap (Aufderheide 2003; Hunt and Hopper 1996; Moodie 1931). This may prevent the radiologist and physical anthropologist from being able to view specific structures that have been obscured by overlapping objects. Although bog bodies are seldom found with artifacts, textiles or other objects, the severely distorted bodies often have overlapping body parts that complicate the interpretation.

Computed Tomography (CT)

Through computed tomography internal body structures can be imaged in a higher degree of detail than permitted with standard radiography. With CT scanning "...an arm rotates the X-ray source around the body in a plane tangential to the long axis of the body" (Aufderheide 2003: 377) and slices of the object or body are captured. The energy is detected and captured electronically, rather than on photographic film as in standard radiography, although hard copies can be produced from electronic images (Notman 1998). The body, or body part, can be electronically reconstructed through image cross-sections, ranging from less than one to ten mm in thickness, which can then be both enhanced and manipulated electronically (Aufderheide 2003). As the scan is done some areas may be identified for further examination. These areas can be enlarged, enhanced or viewed on different planes for clarification of the image for accurate interpretation (Notman 1986). The data from CT is stored electronically and can manipulated around different planes to present the image in three-dimensional views. With the addition of specialized computer software the CT images can be transformed into accurate three-dimensional models of the morphological structures of the body, including the potential for facial reconstruction based on CT data (eg. Attardi et al. 2000; Cesarani et al. 2003; Jansen et al. 2002; Lewin et al 1990; Ousley and McKeown 2001; Robson Brown 1999; Ruhli et al 2002; zur Nedden et al 1994).

Spiral, or helical, CT was first used in 1989. With this method the X-ray source and detectors rotate around the specimen allowing the measurements to be "taken in a spiral trajectory, rather than individual slices at fixed ... positions" (Spoor et al. 2000:63). This method has recently been applied in mummy studies (Attardi et al. 2000; Ciranni et al.

1999; Jansen et al 2002) and specifically to bog bodies in 2003 (Lynnerup, pers. comm.). The newest generation of CT, known as Multislice-CT (MSCT), has been used to examine cranial lesions in archaeological skeletal material (Rühli et al. 2002) and was used in early 2003 for the imaging of several Danish bog bodies (Lynnerup, pers. comm.).

There are numerous advantages to the use of computed tomography in mummy studies. First and foremost, computed tomography can provide detailed visualization of the internal structures of the body without invasive examination of the remains (Aufderheide 2003; Notman 1986). When plain radiology has been used on a mummy with unsatisfactory results, CT scanning may be used to provide a more clearly defined image of internal structures. CT may also provide opportunities for visualization that could not be obtained through plain film radiography, for example, in the case of superimposition of overlapping wrapping or objects (Hunt and Hopper 1996; Spoor et al. 2000). CT produces cross-sectional images providing information without interference from other nearby or overlapping body structures. Furthermore, since the density of the object is measured from multiple directions during the duration of the scan issues of parallax distortion are avoided (Spoor et al. 2000).

As with radiography, there are some potential limitations to the use of computed tomography in mummy studies. The mummy must be taken to the location of the CT machine and the risk of damage during transportation exists. Furthermore, CT machines are designed for living human patients and some mummified bodies may not fit within the restrictive chamber of the CT unit, particularly if the body is wrapped, contained within a coffin or has been physically altered through the mummification process (Aufderheide

2003). Since many bog bodies cannot be removed from their bases or are severely contorted, fitting the body in the CT chamber may be impossible.

Secondly, in order for the highly detailed image to be recorded it may take several hours for the entire body to be scanned (Aufderheide 2003). Capturing a perfect image may be a time-consuming process of adjustment and fine tuning to ensure that the density and complexity of the various structures of the mummy are accurately and clearly represented. Furthermore, desiccated soft tissues may lead to indistinct images of some internal structures that may affect the interpretation of the images. In most cases a radiologist is required to scan and accurately interpret the images (Aufderheide 2003). In this research, radiologists were consulted about the best approach to imaging the bog bodies and conducted the scans. When necessary, a radiologist was consulted to provide assistance with interpretation. All mummy study projects should be collaborative and include experts from a range of fields, including radiologists.

THE ROLE OF IMAGING IN MUMMY STUDIES

Presence or absence of skeletal material

Radiographic analyses will determine the presence or absence of any skeletal material within any coffin, wrapping or textile bundle. In the case of some of the so-called "flat" bog bodies that are often less than three cm in depth, it is unknown if any of the skeletal material still exists but is completely demineralized, or if the skeletal material has disappeared completely. This can be successfully addressed through radiographic analysis.

Determination of age and sex

It is well known that the identification of age at death of mummies may be difficult (Brothwell 2003). This is particularly true for bog bodies, where severe demineralization of skeletal material, to the point of virtual absence in some cases, severely hinders the interpretation of age. Radiographic analyses can assist in the determination of age and sex of the individual. Most physical anthropologists are unfamiliar with the analysis and interpretation of soft tissues but are very familiar with skeletal markers. Although the images produced by CT and plain film radiography are representative of the osteological material beneath the soft tissue, the images are not the same as visualizing the bone itself. It is important for physical anthropologists working with mummies to confer with radiologists, who are experienced with imaging interpretation, when examining radiographs and CT images. Subtle osteological changes that could be identified by physical examination of the bones, such as osteophytic activity indicative of advancing age or changes to the pubic symphyses and auricular surfaces, may not be immediately visible in some images (Hunt and Hopper 1996) and could lead to misinterpretation of the age of the individual. Imaging can also provide assistance in identifying epiphyseal lines in the long bones that may no longer be visible on the surface of the bone but can still be seen radiographically, potentially leading to a more accurate age assessment than may have been possible by physical examination alone (Hunt and Hopper 1996).

Presence or absence of palaeopathological features

With skeletal material evidence of trauma and palaeopathology, for example healed fractures, may be immediately visible. With mummified human remains some diseases

affecting soft tissue may be visible, but any skeletal evidence for disease will be hidden. Diseases such as ear infections, mastoiditis (Moodie 1931) and pleural effusion (Ascenzi et al 1998) may be visible with imaging. Numerous diseases leave few traces on skeletal material and the soft tissue present on mummies allows investigators to examine bodies for soft tissue evidence of trauma or pathology that may not normally be preserved in the archaeological record. Radiology may assist in the identification of soft tissue disease. For example, arteriosclerosis was identified in a pre-dynastic Egyptian female mummy from the appearance of sclerosed arteries in the area of the scapulae, ribs and one forearm (Moodie 1931). Other soft tissue diseases identified with plain radiography and CT scanning include benign tumours, cysts, abscesses and skin lesions. Diseases in skeletal material include advanced osteosarcoma and degenerative diseases (Pahl 1986). Osteoarthritis is one of the most common skeletal changes identified through imaging of mummies (Baggieri et al. 2001; Connolly 1986; Hunt and Hopper 1996; Moodie 1931). Both plain radiography and CT have been used to identify palaeopathological and traumatic injuries in various mummies.

Transverse lines on long bones, known as Harris Lines, are only visible through radiographic analysis and may indicate periods of physical stress and arrested growth through nutritional deficiency or illness (Vyhnanek and Stloukal 1991). The presence of these lines, which are actually areas of lamellar bone, are not conclusive evidence of growth arrest, nor are their absence indicators of a lack of illness or physical stress. Some Egyptian mummies have been reported as having visible growth arrest lines on radiographic survey, but caution must be applied in interpreting some of these marks since the application of resins to the body may have permeated the bone and simulated

the transverse lines (Whitehouse 1980). The presence of these lines may, in the case of some mummies, be pseudopathological.

Accompanying objects

The role of radiography in the location of accompanying objects is more applicable to wrapped mummies such as those from South America or Egypt (Moodie 1931) than to the study of bog bodies. Aside from standard artifacts such as objects of personal ornamentation, other things that may accompany a mummified body include bandages or other forms of wrapping, packages of organs removed during embalming and artificial body parts (Cockburn et al. 1998; Harris et al. 1998; Rühli and Böni 2000). Bog bodies are only rarely found with artifacts, except clothing and other textiles, and most are usually immediately visible without the need for imaging.

Other roles of imaging

The collection of physical image data through CT scanning may allow a three-dimensional reconstruction of both the skeleton and soft tissue of a mummy when numerous consecutive two-dimensional slices are layered to form a three-dimensional image (Notman 1998). It may be possible, where facilities exist, to produce three-dimensional models of skulls through the use of stereolithography. The standard process is that the CT slices taken of a mummy are transferred to a computer workstation with specialized software for the separation of bone from soft tissue and overlying obstructions, such as wrappings. The slices are used to reconstruct a three-dimensional view of the skull. A three-dimensional object can then be "printed" from the computer

model through the process of rapid prototyping. There are several methods for rapid prototyping, including resin-based (stereolithography) and plaster-based (jet-binder). In stereolithography, the computer guides two laser beams, which cross at specific coordinates to polymerize and solidify the resin. Each scan slice is polymerized one slice at a time in a perfect stack with precision as accurate as 0.1 mm. The accuracy of the CT data determines the accuracy of the resulting model (Hjalgrim et al. 1995; Recheis et al. 1999). In the jet-binder method, which was used during this research, a layer of plaster is laid down in the shape of the model, followed by a layer of binder. This process is then repeated until the full three-dimensional physical model is created.

In cases of wrapped mummies radiological analysis will help determine if there is more than one body within the wrappings (Hunt and Hopper 1996), as sometimes seen in pre-Columbian mummy bundles (Moodie 1931); whether soil exists within the body cavities; whether the remains are human or animal (where skeletal material exists); whether soft tissue is present and whether the body is still articulated (Aufderheide 2003). Bog bodies, for example, are often excavated as complete peat blocks, from which the body can be removed slowly and carefully. In the case of the Lindow body from the United Kingdom a 50 cm thick block of compact wet peat was excavated and X-rayed. Although the images were indistinct, it was apparent that within the peat lay a partial body. Outlines of a head, thorax and arms were visible, although there was no evidence of a pelvis or lower limbs (Connolly 1986). Radiographs were able to provide a valuable starting point for the removal of the wet peat in order to avoid any further damage to the body during the delicate process of excavation from the peat block.

For those who are proponents of the autopsy of mummies radiographs often serve to highlight features that may require further investigation during invasive investigation (Aufderheide 2003). Although autopsies have been performed on some bog bodies in the past (e.g. Handelmann 1871a) permission would no longer be granted for these invasive procedures and radiography does not serve this purpose with these mummies. It may, however, serve to identify parts of the body that had been examined or reconstructed prior to display.

Finally, as with any type of archaeological human remains, mummies may be subject to repatriation or issues associated with long-term conservation. Digital imaging through CT allows the storage of images for archival and museum display purposes when bodies have been repatriated or cannot be placed on display for ethical or practical reasons (Kiple et al. 2001; Notman 1998). A full set of digital images reduces the need for further physical examination of the remains; the body can be repatriated, placed on display, or otherwise protected from damage from handling. It has been suggested that libraries of CT images should be created to make information from archaeological human remains available for study on a global basis while protecting the original bodies (Kiple et al. 2001; Hunt and Hopper 1996; Notman 1998). Above all else, CT and other digital images of the body provide complete documentation that can be archived to provide a permanent record of the human remains in case of decay or destruction.

Specific issues in bog body imaging

There are particular challenges with imaging of bog bodies, whether plain film radiography or CT scanning is used. One of the primary challenges is the degree of

fragility of most of the bodies. Although many of the bodies are well preserved, they are usually highly desiccated and exceptionally light in weight. Skin fragments may fall off when the body is touched and there is a high risk of breakage if the body is not fully supported when being moved. Any accidental folding or pulling may cause limbs or other fragile areas of the body to detach. As a result, any effort to image these bodies requires substantial planning and extreme caution.

Another challenge with bog body imaging is the degree of demineralization of the bones of all bog bodies. Adjustments can be made in both radiography and CT scanning to account for the reduced bone density, but this requires a skilled radiological technician. Imaging of bog bodies is seldom a straightforward process and numerous attempts may be required to produce a good image, since every bog body presents a different degree of demineralization, as well as variation between different skeletal elements of the body.

One area of particular concern for the area of interpretation of radiographs and CT scans is the problem of pseudopathologies in bog bodies. The extreme degree of demineralization and distortion of the many bog bodies may lead to misinterpretation of some evidence of trauma and pathology. Numerous instances of pseudopathological fractures and skin lesions have been recorded in bog bodies (Asingh 2003; Brothwell et al. 1990, Lynnerup pers.comm.). Although this is not unique to bog bodies, the acidic bog environment does perhaps lead to a higher level of psuedopathologies in bog bodies than in other types of mummies.

Until very recently, only a few bog bodies had undergone imaging. Although plain film radiography was used in several cases (Brothwell et al. 1990; Connolly 1986; Delaney and Ó Floinn 1995; Hage 1958; Krebs and Ratjen 1956; Langfeldt and Raahede 1980), only a few bog bodies had been CT scanned (Delaney and Ó Floinn 1995; Denton et al. 2003; Reznek et al 1986; van der Sanden 1996). The most comprehensively studied set of bog body remains are those from the Lindow bodies. Examinations included both plain film radiography and CT scanning; this project was the first time that a bog body had been CT scanned. These bodies are fairly recent discoveries (two decades ago) but the majority of bog bodies were excavated more than 50 years ago and imaging technology and interpretation for archaeological human remains was limited.

In 1992 and 1993 the Yde girl, from the Netherlands, was CT scanned twice. The second scan provided digital images that enabled three-dimensional facial reconstruction. The CT images, 1.5 mm slices, were manipulated to allow for the shrinkage and deformation that occurred in the bog before being formed as a plastic model and then cast in wax. The model was then sculpted out of clay on the wax skull and completed with a wig and glass eyes to provide an idea of what Yde girl may have looked like in life (van der Sanden 1996).

In January 2003 a program to image all of the Danish bog bodies was begun. To date six bodies have been CT scanned using spiral CT or MSCT and at least two more bodies may be imaged in the future. Although Grauballe Man was also imaged with conventional radiography, it was felt that these images were not as useful as those obtained from CT imaging and that conventional radiography would not be used with other Danish bog

bodies during their imaging (Lynnerup, pers. comm.). Dr. Niels Lynnerup at the Panum Institute in Copenhagen is currently processing the images from the 2003 CT scans and the results will be published in the near future. There are no further extensive investigations, like those of the Grauballe Man, planned with the Danish bodies at this time.

In September 2004, concerns were raised at the Fifth World Congress on Mummy Studies in Turin, about the use of radiology for the study of all types of mummies. As discussed above, it has become routine to X-ray or CT scan all mummies at an early stage in the analyses. The use of radiology, particularly repeated imaging of the same body, may interfere with the quality of DNA samples. Exposure to the radiation, however small, may affect the already-degraded DNA found in most mummies. It may be sensible to limit the exposure of mummies to radiation to protect any remaining DNA, if these studies are anticipated. Alternatively, it may necessary to take small samples for future DNA analyses prior to any imaging.

BOG BODIES

Introduction

The well-preserved human remains recovered from the peat of northwestern Europe are commonly known as bog bodies. Although a few bodies are exceptionally well preserved, other bog bodies may have only partial soft tissue preservation. As discussed in the previous chapter, where the peat is alkaline bodies are preserved as skeletons with no soft tissue. In areas of acidic peat the soft tissue may be exceptionally well preserved but bone is severely demineralized. In some of these bodies the bones may be so

demineralized that the bodies have become flattened corpses only a few centimetres thick (Glob 1969, van der Sanden 1996). All bog bodies are spontaneous mummies and have had no anthropogenic contribution to their preservation. Figure 1 shows a map of bog body find spots. The numbers on the map refer to van der Sanden's 1996 catalogue of bodies (van der Sanden 1996).

Estimates of the number of bog bodies recovered are highly variable and range from "hundreds" (Coles and Coles 1989, 177) up to about 2,000 (Aufderheide 2003; Brothwell and Gill-Robinson 2002; Chamberlain and Parker Pearson 2001), with several estimates between 1,000 and 1,400 (eg. Brothwell 1996; Fischer 1998; Menon 1997; Parker Pearson 1999). It is likely, however, that the numbers are vastly over-estimated. This is due, in part, to the research of Dr. Alfred Dieck. Dieck's main catalogue of the bog bodies (1965) listed several bodies that could not be verified. In a later publication Dieck (1986) estimated 1,850 bog bodies or body parts. Recent research, however, has suggested that many of the bodies listed in Dieck's publications were, in fact, created by Dieck and never existed (Eisenbeiss 1992, 1994, 2003; van der Sanden 1993, 2003). It is impossible to determine how many bog bodies have ever been discovered, particularly in light of paper bodies and those bodies that were never reported. It may be possible, however, to determine how many bodies are still in existence in museum storerooms and displays. An informal estimate of the bog bodies still in existence is somewhere around 45, although there may be more bodies that have not been formally represented in catalogues or reports (see Appendix A).

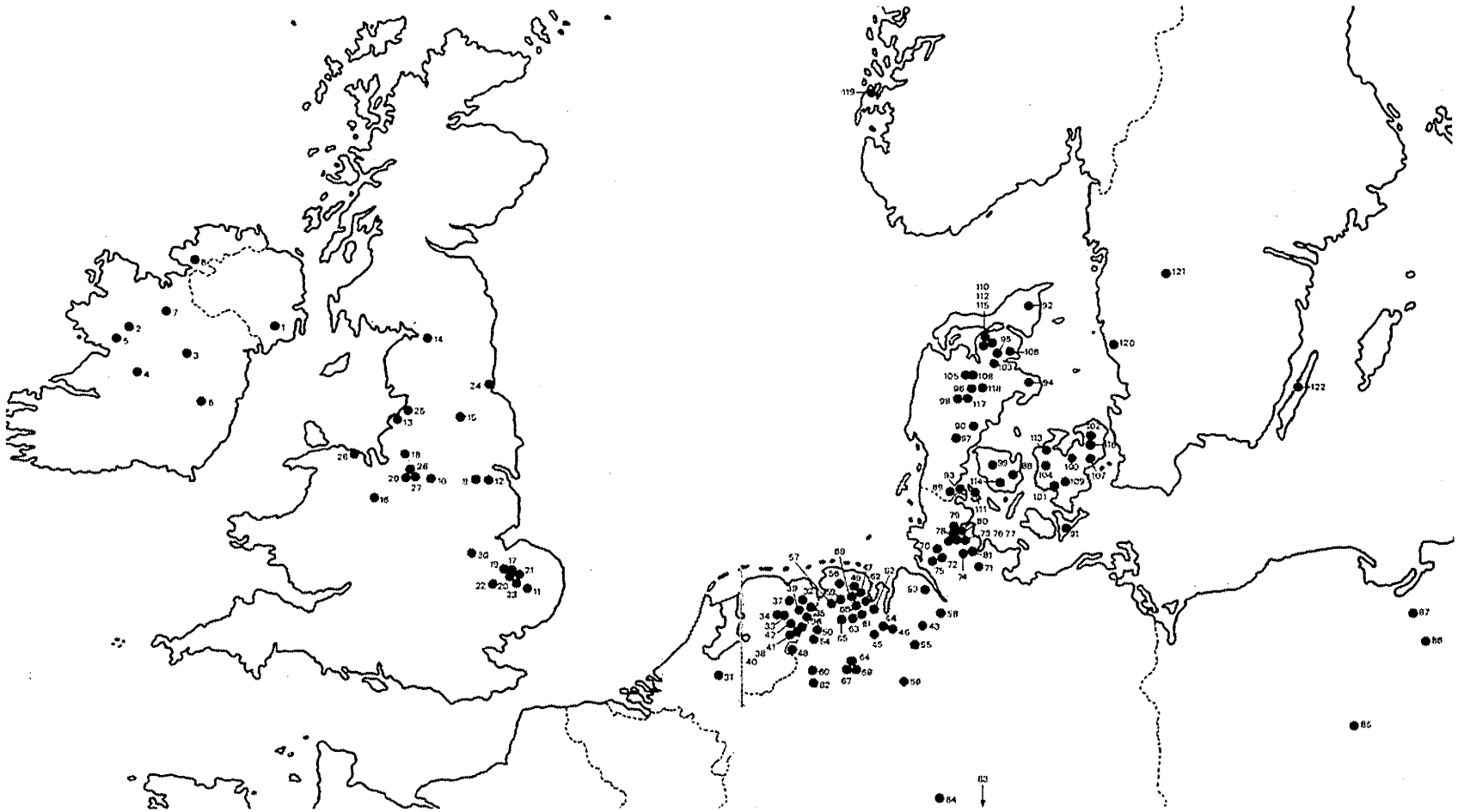


Figure 1: Bog body find spots from northwestern Europe (Source: van der Sanden 1996, 196-197). Reprinted with permission, 2005.

Previous and contemporary bog body studies

Historical bog body studies

Many bog bodies were never researched; some discoveries were possibly not even reported. Often they were not recognized as being of archaeological interest and they were usually re-buried (van der Sanden 1996, 49). Although it is likely the fascination with bog bodies began much earlier; the first known published record of a bog body is a single sentence reporting the 1640 find of a human body, which had probably been murdered, at Schalkholzer Moor in Schleswig-Holstein (van der Sanden 1996, 39).

Reports continued to make simple statements noting the date and time of the find, but soon included some description. One of the earliest written descriptive reports was published in 1734. The article stated that the bodies of a man and a woman, who had gone missing in a snowstorm in 1674, had been found after lying in peat moss for nearly 30 years. Balguy wrote that the preservative power of the peat was known so that when curious people opened up the peat they found that the bodies were "...no way altered, the Colour of their skin being fair and natural, their Flesh soft as that of Persons newly dead" (Balguy 1734: 414). A brief description of the bodies is included in the article and it was reported that the bodies were re-interred in the peat, and excavated in good condition again in 1716. The bodies were then interred in the churchyard and when examined some time later had decayed (Balguy 1734).

Soon there were reports of other bodies published, including the find of a woman with well-preserved leather shoes, from the site of Amcotts in the United Kingdom (Stovin

1747). A good description of the body was provided, including detailed comments on the skin, bones of the hands and feet, long hair and the presence of fingernails (Stovin 1747: 572). One of the shoes was re-discovered in the early 1990s and through knowledge of the style of footwear, the body was dated to the Roman period. A detailed description of the shoe was published in 1992, but it is unknown what happened to the body (Turner and Rhodes 1992).

The earliest detailed research on a bog skeleton is attributed to Lady Moira, who wrote of a body found in Ireland (Moira 1783). The skeleton had well-preserved hair, including a braid and was wearing several garments with different weaves. An effort was made to locate the skeleton when the documentation on the body was donated to the Royal Irish Academy (Wilde 1864). All that currently remains is the hair braid and a few textile fragments (van der Sanden 1996).

For nearly a century after Lady Moira's detailed article, on brief descriptive reports of bog bodies were published. Towards the end of the 19th century, the focus of the reports shifted from general description to more detailed description and organized analysis. In 1871 Johanna Mestorf, who later was appointed head of the museum that eventually became the Archaeologisches Landesmuseum Schloss Gottorf, published a catalogue of bog bodies. The catalogue listed 12 bodies from Denmark, Germany and Ireland and was published in the same year that the Rendswühren Man was discovered. The discovery of the Rendswühren Man was an important event in the history of bog body studies. The body was thoroughly autopsied and described, although little of this information was published. This was also the first bog body to be photographed. More details on the

documentation of this body are provided in Chapter 5, and all of the data related to the body are discussed in Chapter 7.

A second catalogue, published in 1873, listed 16 bodies (Handelmann and Pansch 1873). Mestorf, who was the first to use the term "Moorleiche" (bog body), continued to research bog bodies and published additional catalogues in 1900 and 1907. Both of those volumes contain basic descriptive information about the bodies, as well as detailed information about the accompanying clothing and textiles (van der Sanden 1996).

Bog body research continued with the 1918 catalogue of Hahne, which discussed 56 bog body finds from the Netherlands, northwest Germany, Denmark and Ireland. Hahne also published several articles on the bog bodies of Lower Saxony (eg. Kossina and Hahne 1911); the articles included detailed descriptions of the bodies and any accompanying clothing.

Immediately following World War II several stunning bog body discoveries were made in Denmark. Three bog bodies were found at the site of Borremose, one body each year for three consecutive years starting in 1946. Soon after, the Tollund Man (in 1950) and Grauballe Man (1952) were unearthed. The discoveries of these bodies lead to a new era of bog body analysis. Technology and physical anthropological methods had progressed to the point that thorough, multidisciplinary analyses were planned and undertaken for some of the bodies.

The first body found at the Borremose site was described in a 1947 publication by Thorvildsen. The article summarizes the discovery, excavation and basic physical survey of the body and accompanying skin cape (Thorvildsen 1947). In 1952 a second article was published that discussed all three of the bodies discovered at Borremose. Although detailed physical or anthropological analyses were not discussed, substantial trauma to the face of the second body, a woman, was noted (Thorvildsen 1951). A sample of the bowel contents was extracted from the 1946 bog body. Analysis of the sample showed seeds and fruits. These were mainly fragmented, but a few specimens were found intact. Several grass species were identified. A few animal hairs and a small amount of sand were also identified. This was likely on the food when it was consumed and was accidentally ingested. There was some evidence of wetland plants in the bowel contents. It was suggested that this may have been from the use of bog water for cooking or drinking, although the possibility that peat was forced into the intestine after death somehow was not excluded (Brandt 1950).

The Tollund Man was examined and the basic results published in 1951. The article provided an overview of the physical body and detailed description of the accompanying conical hat, leather belt and intricately plaited noose (Thorvildsen 1951). The article did not, however, provide a great deal of detail about the body. Later, a booklet was designed by the custodians of the Tollund Man, the Silkeborg Museum, for distribution to the general public. The publication had little additional detail about the body, although it did include a picture of the X-ray of Tollund Man's head; it also emphasized that Tollund Man was one of several bog bodies from the area and the bodies may have been ritual sacrifices (Thorvildsen 1962).

The examination of the Tollund Man included a thorough analysis of his final meal (Helbaek 1951, 1958). Since there are a number of similarities between the final meal of Tollund Man and that of the Grauballe Man, the results of the analysis are discussed below, with the data from the analysis of the gut contents of the Grauballe Man.

In 1956, the Danish journal KUML published a collection of articles related to the analyses of Grauballe Man. The articles included a general summary of the find (Glob 1956) and a report on the fingerprint investigastations (Andersen 1956) as well as the results of the various analyses. Details on the methods of conservation were also published (Lange-Kornbak 1956). The bog body was dated at the Carbon-14 Laboratory in Copenhagen. The results yielded a date of 310 A.D. ± 100 years (Tauber 1956). Another sample from the body was purified and dated again in 1979. This second sample yielded a date of 80 B.C. ± 55 years (Tauber 1979).

Geological and palynological investigation of the bog site was undertaken. The body was found in the slightly humidified sphagnum peat of Layer 5. Pollen analyses suggested that peat cutting in the bog had begun as early as the turn of the millennium since some of the layers were clearly regenerated peat, rather than original growth. The body was originally in an old peat cutting that was still full of water at the time. Pollen-analytical dating, from samples taken immediately underneath the body, suggested the individual dated to between A.D. 1 and A.D. 400, which corresponds with the C14 dates, and that the area had been heavily cultivated at the time (Jørgensen 1956).

The body underwent extensive forensic pathological investigations (Munck 1956), including radiography (Krebs and Ratjen 1956). Detailed descriptions of the body before and after cleaning were included. The entire body was well preserved with very dark skin and reddish hair as a result of the immersion in the bog, although internal organs had not survived and the bones were severely demineralized (Munck 1956). Due to the "bone structure" it was suggested that the individual was an adult male (Munck 1956, 137). Dentition was used to determine the man's age as "somewhat advanced" (Munck 1956, 137). Cause of death was attributed to a cut across the throat that went from ear to ear and severed the gullet; a gap between the third and fourth cervical vertebrae visible through the wound. The margins of the cut were generally smooth. The angle of the wound suggested that it could not have been self-inflected was likely the result of several cuts made by a second individual (Munck 1956). Fractures to the left femur, and left tibia, as well as facial wounds and cranial flattening were identified as post-mortem and taphonomic pseudopathologies (Munck 1956). The hair was originally dark coloured (Munck 1956).

It was noted that radiography of the bog body was somewhat difficult. The body was still waterlogged and was inflexible, which provided challenges for radiologists. The results of the radiological investigation confirmed that the body was that of a male of about 30 years of age. A depression and fracture line were identified in the right temporal region; this was attributed to a blow from a blunt object (Krebs and Ratjen 1956); this was not the cranial flattening identified as taphonomic by Munck. The tibia had an oblique fracture, although the fibula was not fractured. This was interpreted as a direct blow to the shin

(Krebs and Ratjen 1956:150). Some arthropathy was detected in the "breast region" and the joints, but no other palaeopathology was identified (Krebs and Ratjen 1956).

Following from his work on the analysis of the gut contents of Tollund Man, Thorvildsen also undertook detailed analysis of the last meal of the Grauballe Man (Helbæk 1959). There was 610 cc of food remains, more than twice the amount found in Grauballe Man. A wide range of grasses and grains were recovered and Helbæk included a comparative list of species found in the Tollund Man and Grauballe Man and indicated the relative frequency of each species (Helbæk 1959:84-85). Two plant species, barley and smartgrass, occurred as primary components in the final meals of both men, while what, oats and rye were present in lesser amounts. Barley was particularly prominent in the Grauballe gut contents and some grains showed evidence of scorching, likely through cooking (Helbæk 1959). Ergot, a fungus that attacks several species of grains, most commonly rye, was present. Ergot is reported to have hallucinogenic properties, and although it cannot be determined whether the consumption of contaminated grain was intentional, it has been suggested it was part of a specific ritual meal (Helbæk 1959, van der Sanden 1996). The hallucinogenic properties would, perhaps, ease the transition to the afterlife. The presence of rye confirms that the individual post-dated the birth of Christ, since rye was not known in Denmark until the first century A.D. (Helbæk 1959). As with both the Tollund and Borremose Man, everything consumed could have been kept in storage over the winter months since there was no evidence for seasonal fruit, berries or fresh herbs. It was suggested, partially on the basis of the final meal, that Tollund Man, Grauballe Man and the Borremose Man had been ritual sacrifices for the Iron Age

Midwinter Festival; they had died violently, in the winter and were "flung into a disused peat cutting" (Helbæk 1959:116).

A modern bog body study

The most recently excavated bog bodies that have been intensively studied are those from Lindow Moss at Lancashire in the United Kingdom. The excavation and subsequent analyses of these bodies set a precedent for future discoveries. A huge multidisciplinary investigation team worked with the bodies and the results were published as a comprehensive volume (Stead et al. 1986). The publication was divided into four sections: Excavation, Recording, Conservation and Dating; Medical and Human Biology; Environment and Food and Archaeology and Folklore, with several contributors in each section.

In May of 1983, a human skull was discovered during peat cutting. More than a year later a human leg with preserved soft tissue was discovered in the same area. Additional searches indicated the presence of more human remains. The decision was made to identify the maximum area of the body and excavate it as a peat block (Turner 1986). A multidisciplinary team was immediate established for the analysis, documentation and conservation of the bodies. Eventually, parts of as many as three or four bodies were excavated and identified from Lindow Moss. The main bog body, Lindow II, is also known as "Lindow Man" consists of skeletal material and soft tissue for most of the upper body (torso, both arms and the head), plus the right lower leg. Addition soft tissue appears to belong to the area of the pelvis, right thigh and left leg. Some of the bone and soft tissue was recovered at late as 1987 and was identified as Lindow IV. It is possible

that the Lindow IV material is actually part of Lindow II (Brothwell and Bourke 1995). Other body parts have been identified as belonging to Lindow I/III. Although the upper part of the Lindow II body was intensively studied, conserved and placed on display in the British Museum, the remaining material from Lindow and the material from Lindow I/III remains unstudied and frozen at the British Museum (Hill 2002, pers. comm.).

Initial investigation of the Lindow II body was non-invasive. Various attempts to get clear, comprehensible radiographs were largely unsuccessful because the body was contorted and still waterlogged. Xeroradiography, which used "selenium impregnated radiographs" (Bourke 1986) was much more successful and provided the first visual evidence of possible trauma: a fractured rib, possibly taphonomic; extensive damage to the third and fourth cervical vertebrae, possibly from a blow with a blunt object; a depressed fracture to the frontal area of the skull and a fracture of the occipital region, also likely caused by a blunt object (Connolly 1986). There was a wide range of soft tissue preservation. The entire upper body was flattened, a result of compression by the peat (Connolly 1986).

Lindow II was also imaged using computed tomography (CT). CT scanning provided clear images of the skull and showed "severely comminuted bones that were disorganized and distorted" (Reznek et al. 1986) and an amorphous mass that may have been brain tissue. Exceptional images of the vertebrae revealed the presence of *dura mater* in the spinal canal of many of the vertebrae, although the spinal cord itself was not detected. A shift in vertebral angle at the junction of the third and fourth cervical vertebrae was noted. The thoracic region of the spine showed evidence of Schmorl's nodes, although other

degenerative changes were not identified (Reznek et al. 1986). Skeletal demineralization was identified throughout the entire body. No abdominal or thoracic organs were identified (Reznek et al 1986).

Forensic examination of the body considered the extent of possible trauma and the extent of preservation. Severe discolouration of the facial skin and facial hair was noted. Some epidermal sloughing was evident and the entire facial region was compressed from the weight of the overlying peat. Several injuries to the head and neck were reported: "a laceration on the crown of the head; a possible laceration over the occipital region; the presence of a sinew loop around the neck and visible ligature marks on the front and sides of the neck; an apparent wound over the right side at the front of the neck" (West 1986, 77). The scalp laceration was identified an antemortem wound caused by a narrow-bladed blunt weapon, such as an axe. Microscopic analyis indicated both irregular wound margins, also visible macroscopically, and some swelling of the wound margin, which is also consistent with an antemortem injury. It was suggested that the wound, which rendered the victim unconscious, would have been fatal eventually, and was caused with the victim in a standing or kneeling position (West 1986:77-78). The possible laceration in the occipital region could not be confirmed. The sinew loop has several potential interpretations, including its possible use as a garrotte (West 1986). The wound to the underside of the neck was cleanly incised and could not have been taphonomic; it was likely intended to sever the jugular vein. In conjunction with the possible garrotte, the neck cut would have caused a substantial rush of blood. It was suggested the rib fracture was caused by a perimortem blow to the back of the chest (West 1986).

In terms of preservation, the body was generally in good condition. The results of the forensic investigation suggest the man went into the bog in cold weather, within a few hours of his death, since there was little or no evidence of post-mortem decomposition. It was also indicated that the trauma present on the body is similar to that seen on other bog bodies and may be indicative of ritual sacrifice (West 1986). No necrophagus insects were located on or near the body, even though several species would be active in winter. This also suggests that the body was immersed in the peat almost immediately after death Skidmore 1986).

Analysis of hair and fingernails was also undertaken. Scalp and facial hair were well preserved and some axial hair was observed. The fingernails were smooth and the ends had a "well-manicured" appearance, possibly suggesting that Lindow Man had not engaged in substantial manual labour (Brothwell and Dobney 1986).

Dietary analysis was undertaken through study of palaeofaeces (Hillman 1986; Scaife 1986), macroscopic gut contents (Holden 1986) and Electron Spin Resonance (ESR) for the detection of cooking (Robins et al. 1986). The results of the investigations indicated that the Lindow Man had consumed a range of coarsely-ground grains (Hillman 1986), probably as bread. ESR provided confirmation that the grains had been heated (Robins et al. 1986). Unlike Grauballe Man, there was no evidence of ergot or other potential hallucinogens in the gut contents of Lindow II (Hillman 1986). Palaeoparasitological analysis of the gut contents of the Lindow II revealed the presence of both whipworm and maw worm (Jones 1986).

A substantial amount of palaeoenvironmental analysis was possible, since both the area around the body and peat adhering to the body itself was sampled. Analysis of peat macrofossils (Barber 1986), palynology (Oldfield et al. 1986) and entomological investigations (Girling 1986) suggested that the period of time at which the body was incorporated into the peat was a period of cultural change. The period was characterized by forest disturbance and the clearing of the area for cereal agriculture (Oldfield et a. 1986) and a cooler, wetter climate (Barber 1986).

Radiocarbon dating of the Lindow II body was complicated and controversial. Accelerated Mass Spectrometry (AMS) was used to date several samples. Three samples were originally taken from scalp hair, a vertebra and vertebral muscle (Gowlett et al. 1986). The combined value for the three dates was 1960 ± 60 B.P.; once the data is classified at the 2σ level, the apparent difference in dates between the muscle and other samples is less significant (Gowlett et al. 1986:23). A series of samples from the body and surrounding peat were taken. Although most of the samples from the body fell within the same approximate date range, with a mean date of 1575 ± 30 B.P., the sample from the wrist bone was significantly different at 2420 ± 100 years B.P. (Otlet et al. 1986:29). A possible explanation for the discrepancy could not be ascertained. The complication and confusion of radiocarbon dating bog bodies is discussed in more detail in Chapter 13.

Other recent research has lead to the development of a database that listed 369 confirmed bog bodies, those corroborated by multiple sources although not necessarily still in existence, and provided basic demographic and archaeological data about the bodies, allowing simple analyses of the European bog bodies as a group (Brothwell and Gill-

Robinson 2002; Gill-Robinson 2000, 2003). Although it was possible to make simple generalizations about the bog bodies as a group, it was also evident that some limitations also existed. For example, it was not possible to conclusively determine sex for approximately 35% of the bog bodies in the survey and about 30% of the bodies could not be assigned to an age category. Of those that could be identified, approximately 60% were male or probable male. Of those for which an assessment of age at death was possible, approximately 80% were classed as adults, over the age of 18 years (Gill-Robinson 2003). Although there is a common misconception that bog bodies were physically abused around the time of their death, or that many bog bodies met violent ends, this research suggested that man not be accurate. In fact, only about 16% of the bog bodies (n=369), had recorded trauma or palaeopathology. With specific reference to inflicted trauma, only 48 incidents, a total of 32 individuals, were reported Gill-Robinson 2003). This number is much lower than might be expected if perimortem violence was common to this group. There is, admittedly, a flaw in this research. Since all of 369 bodies were not directly re-examined by the author, written records were used as source material. It is possible that initial investigations failed to record trauma or that the trauma was incorrectly interpreted in the original analysis. This is especially possible given the high incidence of pseudopathology seen in bog bodies. If, however, some of these injuries are the result of taphonomic processes, the incident of true trauma may potentially be even lower.

Re-examination of bog bodies

Elling Woman (1978)

One bog body to be re-examined was the Elling Woman, a Danish body originally discovered in 1938. In 1978, new forensic and radiological examinations of the body were undertaken. The physical examination indicated that the skin was preserved on the neck, chest and part of the head. The skeleton was blackened, distorted, demineralized and "rubber-like" (Gregersen 1980:56) and no internal organs had survived. The hair was intricately styled in a complex braid and had turned red in the peat. The facial area had been completely destroyed. The shape of the severely distorted pelvis and the gracility of the bones suggested that the individual was female. Age was established at 25 to 35 years, based on the epiphyseal fusion, lack of degenerative joint disease, a few visible cranial sutures and "joint surfaces of the pelvic bones" (Gregersen 1980:56). There was no evidence of intra-vitam skeletal trauma. A deep groove was noted around the neck, which was suggestive of hanging as a cause of death. There were no other signs of violence (Gregersen 1980).

The entire Elling body was subjected to plain film radiography. Seven cervical and nine thoracic vertebrae were identified, along with several ribs, which appeared to overlap in places. No signs of palaeopathology or degenerative diseases were identified. All of the bones were severely demineralized. Several "fracture-like lesions" were noted and attributed to post-mortem causes, specifically the excavation of the body from the peat (Langfeldt and Raahede 1980). Radiology confirmed the anthropological assessment of age and sex; this individual was a female, probably in her mid-20s to early 30s. (Langfeldt and Raahede 1980).

1948 Borremose Woman (1977)

When found, this body of an apparently young woman was not well preserved. The substantial damage to the head was believed to be perimortem. The neck was not sufficiently preserved to determine whether strangulation or hanging had occurred. The individual appeared to have been overweight at the time of her death. The body was dated to 770 B.C. ± 100 years. The body was conserved with a glycerine solution and a formaldehyde solution (Andersen and Geertinger 1984). In 1977 it was decided to undertake a full autopsy of the body. As part of that examination, a full radiological analysis was undertaken. The images showed the bones to be almost completely demineralized and severely shrunken. When living stature was calculated on the basis of the skeletal material, a height of 143 cm was calculated; it is unlikely that the figure was accurate. The methodology used for the calculation was not described. It was noted that the bones around the right knee had collapsed as a result of the pressure of the peat (Andersen and Geertinger 1984).

The crushed facial bones were collected and the cranium reconstructed by police forensic specialists. The cranial sutures suggested the individual was a female, aged 20 to 35 at death. The teeth were considerably demineralized and most had been lost post-mortem. Odontological investigations were inconclusive (Andersen and Geertinger 1984).

All of the skin was dark brown with no epidermis. Six nails were recovered from the peat, although it was not specified whether they were fingernails or toenails. The hair was red from the acidic environment of the peat and still attached to the scalp. There was no

evidence for scalping and no defense wounds to the hands or lower arms. (Andersen and Geertinger 1984).

Only fragments of the abdominal organs were preserved upon internal investigation and there was no evidence of pregnancy. A total of 65 tissue samples were taken from the internal organs. Histological analyses showed the presence of well-preserved connective tissue. No skin, muscle or viscera could be fixed and no blood was detected. Three pieces of tissue that had been selected for analysis in 1972, but never examined, were identified as brain tissue, an ear and a collapsed eye with eyelids (Andersen and Geertinger 1984, 113). There was no evidence of haemorrhage in either the eye or the ear tissue samples; the severe cranial damage was deemed to be post-mortem. Furthermore, given the poor preservation of the abdominal region, it was suggested that the body may not have been immersed in the peat for some time after death, allowing decomposition to begin (Andersen and Geertinger 1984).

Huldremose Woman (1990)

Another Danish body, the Huldremose Woman, originally excavated in 1879, was thoroughly examined for the first time more than a century later, in 1986 (Brothwell et al. 1990a). This research included the use of archival reports of excavations and early investigations, as well as physical and radiological examinations of the body. The analyses were essentially non-invasive, with the exception of a small sample of hair. After decades in storage, the body was still in good condition, despite some evidence for beetle damage, although it had not received any form of conservation treatment. The

scalp and teeth, reported to have been sent to the museum with the body, were missing by the re-examination. Adipocere was present on the thighs and buttocks (Brothwell et al, 1990a).

Several pathological features were identified. Lesions near the left axilla and the left upper arm were deemed taphonomic due to the ragged edges. The left forearm, which crosses over the chest, was distorted and flattened. It was suggested that the deformity of the left arm may have been due to a tight strap that held the arm in position while the bone demineralized post-mortem (Brothwell et al. 1990a). Both breasts and the area of the chest have moved laterally to the right, with some patches of taphonomic skin damage. The right arm presented a number of interesting anomalies. The lower portion of the arm had been amputated, perhaps twice: once above and once below the elbow; the elbow area is missing (Brothwell et al. 1990a). The lower part of the arm was excavated and remains with the body. The right hand was damaged during peat cutting, partially severing the fingers. The cut was clean and relatively recent, when compared to the cut marks at the amputation sites. Areas of post-mortem damage were reported on the left thigh and the inner aspect of the right knee. A number of straight cuts were observed: a 30 mm long cut in the area of the left tibia; a 31 mm cut on the left heel; a 7.5 mm cut below the damaged inner aspect of the right knee; near the right medial malleolus; a 30 mm cut on the upper surface of the foot and two cuts (20 mm and 15 mm) to the medial side of the right foot (Brothwell et al. 1990a).

The entire Huldremose body was subjected to plain film radiography. Severe demineralization was apparent throughout the whole body. A thin cranial vault was

evident but both sagittal and lambdoid sutures were visible. A defined brain mass was also visible, although it was clearly shrunken and appeared to be decomposed, since no structure could be seen (Brothwell et al. 1990a). Images of the vertebrae showed no clear degenerative joint changes, with the exception of some marginal "sharpening" on the sixth and seventh thoracic vertebrae. In the thorax, the costal cartilage was clearer than the ribs, scapulae or sternum. Parts of the intestinal tract may have been visible, but this could not be confirmed. The right clavicle is slightly thicker than the left; it was suggested that this may have been "an old well-healed fracture" (Brothwell et al. 1990a:168). The left humerus, radius and ulna were distorted. The initial X-ray suggested an unhealed fracture of the lower arm, but additional radiographs showed that the superimposition of a skin fold over an area of bone lead to the misinterpretation of the pathology; it was, in fact; a pseudopathology. No anomalies were detected on the detached forearm and hand (Brothwell et al. 1990a).

A particular challenge in this examination was the radiology of the pelvis. The position of the body is such that the legs are drawn up to the abdomen. The use of plain film X-ray meant that multiple layers of skin, flesh and bone were overlapping and obscured the internal area of the pelvis. Although the right femur had an abnormal curvature that had previously been interpreted as a healed fracture, the radiography by Brothwell et al. (1990a) demonstrated that the bone deformation was caused by the pressure of the peat.

During the re-examination, fine hair stubble was observed over most of the scalp. Although it was possible that the hair had been lost during excavation and cleaning,

Scanning Electron Microscopy (SEM) imaging of the hair showed that it had been cut close to the scalp with a sharp edge (Brothwell et al. 1990a).

A CT scan of the entire Huldremose Woman was taken at 8 mm intervals (Brothwell et al. 1990b).Upon examination of the CT scans, preserved gut area was identified and it was determined that there was sufficient gut content to warrant minimally-invasive sampling and detailed examination. A scalpel was used to cut a 5 cm by 3 cm section of skin and abdominal wall, which was folded open to expose the intestinal tract. A 4.5 cm section of the intestinal tract was removed and the muscle and skin folded back into place (Brothwell et al. 1990b). Two samples were taken from the gut. The final meal was determined to be composed of "...a mixture of approximately 3 parts rye grain (possibly with some wheat) to 1 part corn spurrey seed" (Holden 1999:52). There was also a large amount of weed seeds, as seen with Grauballe Man and Tollund Man. Holden (1999) also reports that the grain combination is similar to the composition of a dry, coarse bread was eaten by impoverished people in the Shetlands during the 19th century; perhaps the weeds were used to stretch plant resources in times of food shortage.

Kayhausen Boy, Neu Versen Man, Woman from Sedelsburg

Since 1996, several bog bodies from Lower Saxony have been undergoing re-examination. Although few details are available on these re-analyses, some preliminary results are published. The body of a young boy, Kayhausen Boy, was imaged using Magnetic Resonance Tomography (MRT). Moisture is essential for this examination, and this bog body had been conserved in a liquid environment. The body was excavated in 1922 and first examined in 1952. Originally identified as 8 to14 years old, during the

recent re-examination the boy was estimated to be approximately 6½ years old at the time his death (Pieper 2003:111). Palynological investigation of gut contents revealed the presence of cereals, fruits and various wild grasses. Forensic analysis identified three parallel stab wounds to the neck. The boy was bound in an unusual manner, with the binding drawn up between the legs front and back and wrapped around the neck, with additional binding at the ankles. Further analysis of the binding by a textile expert is planned. Samples of internal organs from the boy were taken during an extensive autopsy in 1952. At that time, the body was dissected and all internal organs were removed to jars that were inadequately labelled, making identification of the material nearly impossible. Endoscopic examination showed that some internal organs had been left in the body, but these had decayed to the point that identification was not possible (Pieper 2003).

The Neu Versen Man, also known as "Roter Franz" (Red Franz) because of his red hair, has also been re-examined. The body is mainly skeletal, although there is soft tissue covering areas of the upper body. The body has been identified as a male, 25 to 30 years old at the time of his death. It was reported that the Neu Versen Man possessed a badly healed right clavicle. This bone could not be located and the report of the fracture could not be confirmed or discounted. "Rider's facets", protrusions on the femoral head, were found in both legs, suggesting that the individual had been a horseman. There was also evidence of an injury on the right upper arm; this was possibly caused by an arrowhead (Pieper 2003). Cause of death has been identified as a cut throat, which was clearly visible once the body was turned over and the back of the neck region was exposed (Pieper 2003).

In the re-investigation of a third body, the "Woman from Sedelesberg", substantial corrections to the age and sex of the individual were made. This body is completely skeletonized. Although the body had originally been identified as an adult (20-40 years) woman, new analyses determined the individual to be male under the age of 16 years (Pieper 2003:107). The methods used for these revised age and sex determinations have not yet been published.

Grauballe Man (2000)

In 2000, a multi-disciplinary project for the complete re-examination of the Grauballe Man from Denmark was begun, including CT scanning of the complete body (Asingh 2003). The Grauballe Man was subjected to both plain film X-ray and CT scanning for radiological investigation. Although radiographs were taken during the initial examination in 1952, many of these have now been lost, although a few are available as photograph images from publications (Asingh 2003). It was, therefore, possible to determine physical changes since the 1952 investigations. Although the brain and spinal cord survive, they have shrunk in the past five decades. Several areas were identified where a dense cellulose material was used to reconstruct collapsed regions of the body. The skeleton was quite well preserved, although four lumbar vertebrae were missing. There was no archive documentation to support the missing vertebrae, so their absence was a surprise during the imaging (Asingh 2003). Three-dimensional reconstructions were created from the CT images and this work is still on-going (Asingh 2003, Lynnerup 2004, pers. comm.). The imaging not only provided new ways to examine the body in a non-invasive manner, it also provided thorough three-dimensional (3D) documentation of every aspect of the body. Through the imaging and 3D modeling process, reported

fractures of the skull and tibia were re-evaluated. The skull fracture was post-mortem and cause by the pressure of the overlying peat. Although the final analysis of the tibia is not yet available, it seems that the fracture might be perimortem.

Through the original autopsy incision five small samples of pelvic bone were extracted for microscanning. The samples showed good bone structure with a bone mineral content that was approximately 40% lower than a modern population; the demineralization of the bone due to the peat environment was evident (Asingh 2003). There is some possible evidence of a dental abscess, plus antemortem tooth loss as a young child and the presence of several caries. Enamel hypoplasia seems to be present at about age three, although these investigations are still in progress (Asingh 2003).

Other studies in progress include re-examination of the stomach contents, trace element analyses of hair and additional dental investigations (Asingh 2003). The complete results of this research have not yet been published. This project is an excellent example of the exceptional international collaborative effort required to completely re-examine, document and interpret a bog body.

Key compilation publications

In 1965, P.V. Glob's book "Mosefolket: Jernalderens Mennesker bevaret i 2,000 År" (Bog People: Iron Age Man Preserved for 2,000 years) was published in Denmark; an English translation soon followed. Although the public had been aware of bog bodies for many years, Glob's book was the first to bring detailed knowledge about the bodies to the

general public. The book was illustrated with many black-and-white photographs and provided a reading list for additional information (Glob 1969).

In the same year, the work of Alfred Dieck was published in Germany. Dieck spent more than 50 years researching and publishing on bog bodies, although he never examined any of the bodies himself (van der Sanden 1996). The once-seminal text and ultimate catalogue of more than 1800 bog bodies, *Die europäischen Moorleichenfund (Hominidenmoorfunde)* (The European Bog Bodies: Human Bog Finds) was published in 1965. For decades, this work would remain the primary source for researchers looking for information on bog bodies. As discussed above, much of the work of Dieck has recently been discredited.

In 1990, an excellent volume that collected much of the archaeological and anthropological data related to the Dutch bog bodies was published. The well-illustrated volume provided a complete multidisciplinary analytical overview of several Dutch bog bodies and skeletons. The publication provided a quick general overview of bog bodies (van der Sanden 1990a), with separate chapters outlining the key points related to the Dutch bodies (van der Sanden 1990b, 1990c). One chapter discussed the formation and function of peat bogs as a means of providing the environmental background to the bog bodies (Casparie 1990). Other chapters summarize pollen analyses (van der Sanden 1990d); attempts at DNA extraction (Osinga and Buys 1990) and blood typing (Connolly 1990); analyses of palaeopathologies (Uytterschaut 1990a), parasites (Paap 1990) and hair (Uytterschaut 1990b). Detailed analyses of final meals (Troostheide 1990; van der Sanden 1990e), footwear and clothing (Groenman-van Waateringe 1990; Reijnders-Baas

1990; Vons-Comis 1990) are also included. The book is, however, written in Dutch, with only a two-page English summary, which may potentially limit accessibility to readers not familiar with Dutch.

A volume that explored all aspects of bog bodies on a more general level was also written by van der Sanden. Published simultaneously in English, German and Dutch versions, the book provided a good general summary of all aspects of bog bodies. Like Glob's book, the van der Sanden volume made anthropological and archaeological information on the bog bodies easily accessible to both academics and the general public. Another important aspect of this work was a catalogue of bog bodies (van der Sanden 1996).

As part of the original Lindow Man volume, a catalogue of British and Irish bog bodies was published (Briggs and Turner 1986). In 1995, a volume that provided the follow up to the original Lindow analyses was published. It included data on excavations that had occurred following the original volume (Turner 1995a) and recent research on the Lindow I/III body (Branch and Scaife 1995; Brothwell and Bourke 1995; Dinnin and Skidmore 1995; Housley et al, 1995; Scaife 1995). The publication also included an overview of other bog bodies (Delaney and Ó Floinn 1995; Garland 1995; Ó'Floinn 1995a; Turner 1995b; van der Sanden 1995c) and a revised gazetteer of British and Irish bog bodies (Turner 1995c; Ó Floinn 1995b).

SUMMARY

Although there are a range of studies that can be undertaken in order to accurately interpret archaeological mummified human remains, it is often necessary to limit

investigations to non-invasive tests. Imaging, particularly CT scanning and reconstruction, can provide a substantial amount of data about the bodies without the need for destructive sampling. For the bog bodies, there is a particular need to re-examine early finds since many bodies were only cursorily examined prior to conservation and display. Projects such as the Grauballe Man re-investigation, and this research, set the precedents for international multidisciplinary collaborative research to re-evaluate the northwest European peat bog bodies.

CHAPTER 4
SETTING THE STAGE: IRON AGE ARCHAEOLOGY OF NORTHERN EUROPE

INTRODUCTION

Since most of the bog bodies in this research are from Iron Age Schleswig-Holstein, it is important to understand how people were living in the region at the that time. This chapter will offer a discussion of the definition of the chronology of the Iron Age in Schleswig-Holstein and Denmark and present the archaeological evidence for social structure, settlement, clothing, diet, burial practices and votive deposition during the Iron Age. Geographically, this chapter will emphasize the present-day Schleswig-Holstein region of northern Germany. Unlike Denmark, little is published on the archaeology of Iron Age of Schleswig-Holstein region. Recently two books have been published that provide detailed information on the Iron Age in Denmark (Hvass 2001; Jensen 2003a). Both of these volumes include aspects of Schleswig-Holstein in their discussions, since it is virtually impossible to separate the region from Denmark geographically, historically or culturally. It is generally accepted that Schleswig-Holstein is culturally and archaeologically comparable to southern Jutland and the Danish islands of Fyn, Lolland and southern Zealand.

DEFINITION OF THE IRON AGE IN NORTHERN EUROPE

Defining the Iron Age in northern Europe is complicated. There are several chronologies used for delineating the Iron Age in Denmark and northern Germany. In all cases the chronologies are based on archaeological typologies of artifacts such as pottery and, for later periods, metal work, as well as changing burial practices. Transitional periods are

difficult to assign definitively. There are numerous distinctive changes in ritual and settlement patterns between the earlier and later Iron Ages and it is the late Iron Age periods that are considered to be typical of general European Iron Age societies (Hedeager 1992b). As Hedeager notes "[T]he archaeological material of the Iron Age is much more complicated than that of earlier periods" (1992a:25, note 1).

There are several generally accepted subdivisions of the Iron Age and most authors specify their preference. Hedeagar (1992b) identifies seven phases to the Iron Age: Early Pre-Roman (ending at 500 B.C.); Late Pre-Roman (500 B.C. to A.D. 1); Early Roman (A.D. 1 to A.D. 200); Late Roman (A.D. 200 to A.D. 400); Early Germanic (A.D. 400 to A.D. 550); Late Germanic (A.D. 550 to A.D. 700) and the Viking Age (A.D. 700 to A.D. 1050). Jensen (1982) has a simplified chronology: Pre-Roman Iron Age from 500 B.C. to A.D. 1; Roman Iron Age from A.D. 1 to A.D. 400 and material from A.D. 400 to A.D. 800 is classified as Germanic Iron Age. Although there are numerous chronologies for the Iron Age in the literature, this thesis will use the following definition: The Iron Age began in approximately 500 B.C. and ended approximately A.D. 800 (Nørgård Jørgensen 2003). There are three primary subdivisions: The Pre-Roman Iron Age (500 B.C. to the birth of Christ); the Roman Iron Age (A.D. 1 to A.D. 380) and the Migration Period (A.D. 380 to A.D. 800). The Roman Iron Age is subdivided into "Early" and "Late" at A.D. 150. All of the date ranges are further subdivided into several phases, based on artifact typologies (Nørgård Jørgensen 2003, 200). Figure 2 shows a visual representation of this chronology. Since the dating of the bog bodies cannot be precise enough to fit into the phases, in this research distinction will be made only as: Pre-Roman Iron Age, Early

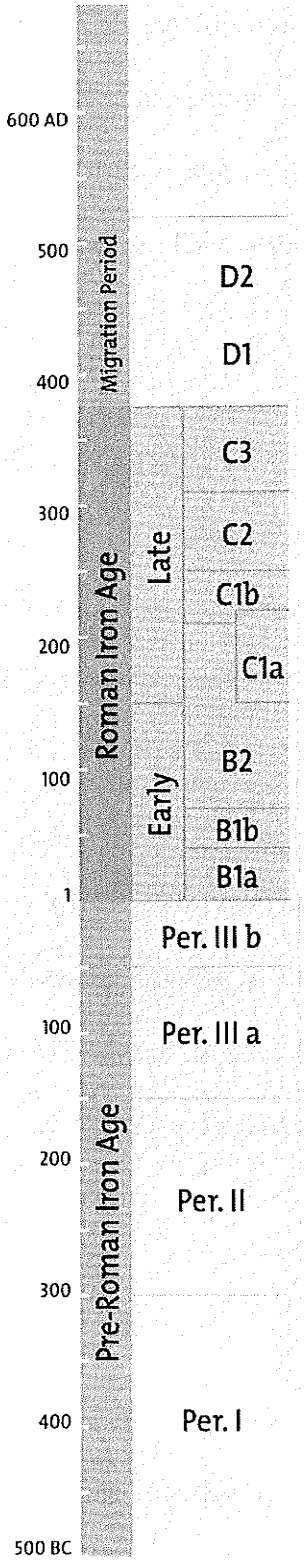


Figure 2: Timeline of Iron Age chronology (Source: Nørgård Jørgensen 2003:200) Reprinted with permission, 2005.

Roman Iron Age, Late Roman Iron Age and Migration Period. This chronology was selected over others since it was used consistently in a major research publication of National Museum of Denmark and in their recent exhibition *The Spoils of Victory: The North in the Shadow of the Roman Empire.* This is the most current Iron Age northern European chronology available.

LIFE IN IRON AGE NORTHERN EUROPE

The Iron Age in northern Europe is, in part, characterized by the invasion of the Romans. For the Schleswig-Holstein region, that occurred around A.D. 1. It has been suggested that coastal parts of Schleswig-Holstein were not suitable for settlement until the end of the first century A.D., because the region was too waterlogged (Todd 1992). The Celtic tribes in central Germany were used as a buffer zone against the Germanic tribes of the north (Hedeager 1987). Germanic tribes were forcibly re-settled by the Romans and regions north of the established German frontier at the Limes were dominated by the Romans. The region is sometimes referred to as "Barbaricum", since the Romans believed the people living in northern Europe to be barbarians (see Figure 3).

Settlement and subsistence

Subsistence

During the pre-Roman Iron Age the Celtic field system was the primary agricultural practice. In this method "rectangular plots bounded by low banks (lynchets) of stones and soil" (Hedeager 1987, 133) are farmed, often over very large areas. It was likely that there was a scheduled system of cultivation and fallow periods.



Figure 3: The region known as "Barbaricum" (Source: Jørgensen et al. 2003: inside front cover). Reprinted with permission, 2005.

In the Roman Iron Age, the Celtic field method was discarded for intensive agricultural methods. This was a period of agriculture plus animal breeding, with reciprocal system: meadowland hay was fed to the livestock that provided fertilizer for the fields (Hedeager 1987). There is not enough archaeological or palaeoenvironmental evidence to determine if the shift in agricultural style occurred throughout northern Europe at the same time, or in some regions earlier than others. Palaeoenvironmental evidence does indicate that the climate had become warmer and drier just before the agricultural transition. At the same

time, large scale deforestation occurred as more land was cleared to meet the need for crops. It is possible that in areas with poor soil quality, agricultural soil exploitation may have occurred. This would have encouraged the shift to intensive agriculture (Hedeager 1987).

Several bog bodies have well preserved gut contents that have provided knowledge about some of the food consumed during the Iron Age. These were discussed in more detail in the previous chapter. Although it has been proposed that bog bodies were fed a special meal immediately prior to their death, it is impossible to say whether or not the final meals of bog bodies reflect a ritual practice or the standard diet of the Iron Age (Helbæk 1959). Helbæk (1959) also believes that although Iron Age diets would certainly not have been purely vegetarian, little meat was consumed. This is based upon the evidence of gut contents from several bog bodies and the limited faunal material recovered from Iron Age sites in northern Europe; more animal bones are recovered from Neolithic than Iron Age sites (Helbaek 1959).

Evidence of Iron Age diet is also available through carbonized plant remains and imprints on the pottery found as part of several votive offerings. From the pottery it is clear that weeds and wild plants provided a substantial source of food and not just seasonal supplements to the domestic plants (Helbæk 1959).

Food storage was also a key component of Iron Age society. Since no seasonal plants such as fruits or berries were identified, it is possible that the meal was made from grain

that had been stored. Although the lack of fresh berries and fruits has previously been interpreted as conclusive evidence for a winter death (Helbæk 1959) there are other possibilities. For example, if the food was consumed in early spring it may have been prior to harvest of seasonal plant items or it may be that seasonal foods were available and, for some unknown reason, excluded from the meal. Furthermore, if the individual was preparing, or being prepared, to meet death, it is possible that a special meal representing the remainders of the previous season's harvest was consumed in an effort to appeal for a bountiful harvest in the forthcoming season so even summer or early autumn (just prior to harvest) would be a reasonable possibility for the season of deposition.

Settlements

Most early Iron Age settlement sites consisted of 5 to 15 homesteads as a small village. Each structure was a long-house with both residential and byre accommodation (Hedeager 1987). The majority of settlement buildings were rectangular, five to six metres in width and oriented east-west. Two parallel rows of interior posts provided support for thatch roof and the walls were often timber, usually with wattle and daub, although walls of soil and turf have also been identified. There is variation between sites and over time, but some villages were fenced, while others were not. The villages usually consist of several large and small farmstead longhouses, with a population of around 50 people, and two or three storehouses (Hedeager 1987; Jensen 1982). A collection of sites from the Over Jerstal region of southern Jutland is representative of Iron Age settlement site in southern Denmark and northern Germany. The sites included both fenced and

unfenced villages, three large farmsteads, two cemeteries and an enclosure with a surrounding ditch (Ethelberg 1995).

By the later Roman Iron Age, farmsteads increased in size and many became enclosed by stone fences (Storgaard 2003) Most farms had more livestock and generally increased productivity. New querns and weaving techniques were developed and iron-smelting practices were improved. Rye was present, but had not spread to all parts of northern Europe at this point (Hedeager 1987; Robinson and Siemen 1988). At this point, more land was owned by fewer people and many people worked land owned by others as a "class of landless farm workers" (Storgaard 2003:109). One example of these changes is the Danish site of Vorbasse. Vorbasse went from a single farmstead of around 2,700 m^2 around the birth of Christ, to a village of multiple farmsteads totaling 135,000 m^2 by A.D. 400 (Hedeager 1987:137).

Clothing and textiles

Clothing and textiles may be recovered from grave sites or bog deposits. The bog deposits are discussed below. Although the textiles recovered from grave sites are rare and often fragmentary, they can provide some evidence for the clothing of the Iron Age. At one inhumation site from north Jutland, Sejlflod, four different fabrics were recovered from the same grave (Bender Jørgensen 1979). At another site, specific weaving patterns, including a type of houndstooth, could be identified in textile fragments (Bender Jørgensen 1979). Wool was commonly used. Linen was used after the third century A.D.. There is no evidence of luxury fabrics such as silk or gold threads; these appeared in the Viking period (Munksgaard 1974). In the Iron Age, dyed textiles appear for the first

time. Fabrics of blue, red, green and yellow have been identified (Munksgaard 1974). A number of plants were used as dye sources: tree bark, fruit peelings, leaves, herbs, roots, lichen; it is known that woad (*Isatis tinctoria)* was used for blue dyes (Schlabow 1976c:35).

There were changes in the style of clothing between the Bronze Age and the Iron Age. This is attributed to changes that had occurred in the Hallstatt culture of south and central Europe, where tunics, breeches and long skirts were common (Munksgaard 1974). Fur and leather capes of various styles, often made of sheepskin, are associated with both males and females (Hald 1980). The common clothing for males included shirts and breeches, along with a *sagum*, a rectangular cloak. Leggings have been found at some sites. Clothing known from Iron Age bog and burials in northern Europe is similar to references recorded in contemporary Roman literature and illustrated in sculpture. Females wore long, full skirts and blouses, often with a shawl or wide scarf, although there is no evidence for female styles of dress in Roman sculpture (Muksgaard 1974). A single piece of leather formed each shoe, with a seam at the heel. Shoes were often laced over the top of the foot. By the second century A.D., a Roman influence is visible in some sandals (Munksgaard 1974:207). Hair coverings are common: leather caps for men and bonnets or hairnets for women (Munksgaard 1974). Margarethe Hald's volumes, *Jernalderens Dragt* (Hald 1962) and *Ancient Danish Textiles from Bog and Burials* (Hald 1980), contain of detailed discussions and illustrations of Iron Age clothing. In some cases, modern reconstructions have been made (Gebühr 2002; Anonymous 1996).

A study of the hairstyles of bog bodies shows a link between Roman styles and the women of Iron Age northern Europe, although the women themselves were locals (Munksgaard 1978). A specific style of hairnet, made in the "sprang" technique, have been found with several bog bodies: Store Arden, Haralskær and the Windeby child, for example (Munksgaard 1978). This provides evidence of the adoption of style influences from southern Europe.

Trade and crafts

Trade

Although the Romans had a market economy and widespread usage of complex coinage, Free Germany, as the area north of the Limes was known, did not have a market economy. Although the Free Germans probably used money, there were likely moneyless markets as well (Hedeager 1987:126). There is a substantial amount of archaeological evidence for trade between Roman and northern Europe. Practical, everyday items such as pottery or brooches were most common in the border regions (up to 200 km from the border); prestige goods such as bronze drinking vessels, glass or silver bowls, weapons and coins were found, in lesser amounts, further north, up to 400 to 600 km from the border (Hedeager 1987). It is possible that the northern Germans were trading hides, grains and amber south to the Roman regions, although there is no archaeological evidence of the specific trade commodities that were sent from Germany (see Figure 4). The amber was a particularly valuable commodity to the Romans since it was viewed as a luxury item (Storgaard 2003). It is likely that the Romans sought economic and political gain from the northern regions, while the Germanic tribes would have cherished Roman

prestige goods, gold and silver, coins and weapons – status symbols in Germanic culture (Hedeager 1987).

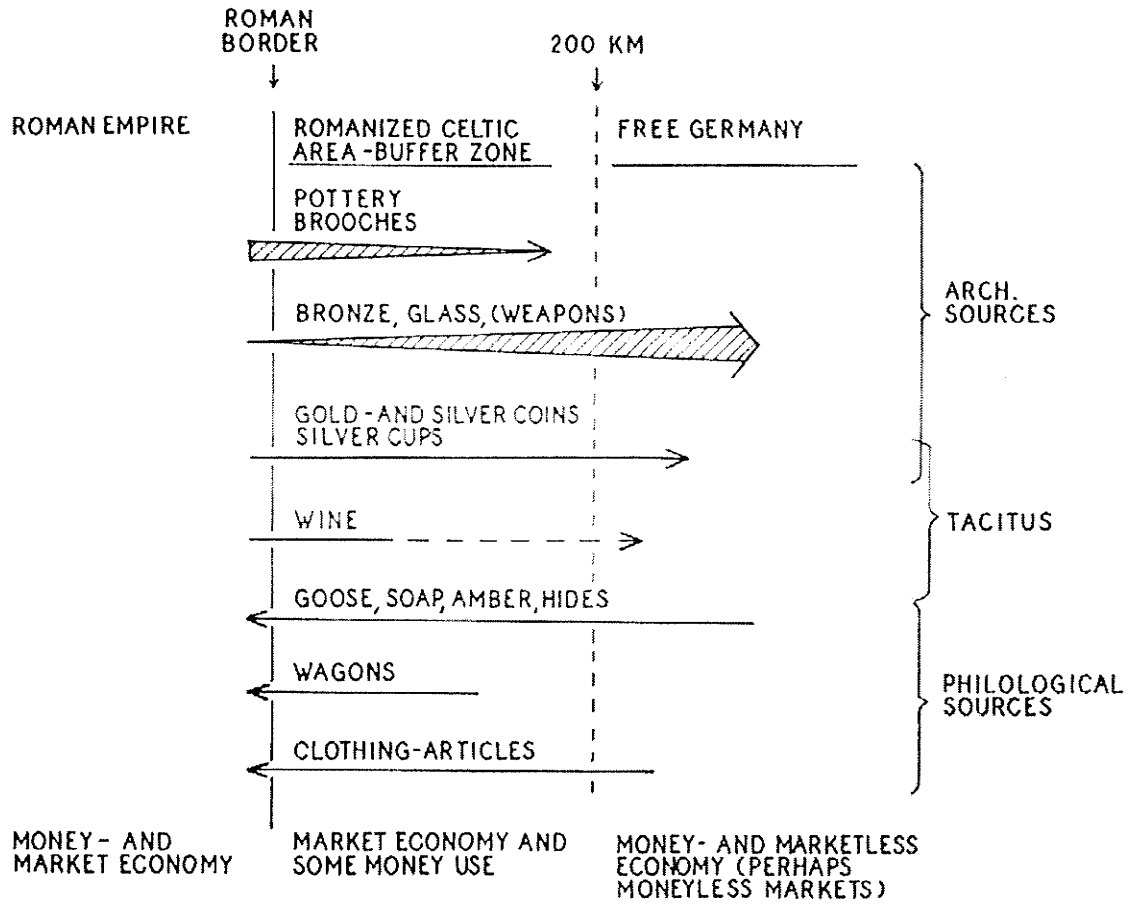


Figure 4: Patterns of trade between the Roman Empire and Free Germany (Source: Hedeager 1987:127). Reprinted with permission, 2005.

Eventually Roman imports lacked purchase power; they were markers of social or political connections and were not used as further trade goods. "Such imports were not so much evidence of material wealth but primarily of exalted connections and political alliances, and indicative of some knowledge of the Roman way of life (Hedeager 1987:130).

Crafts

Metal would have been too luxurious for many daily uses. Utensils were made of wood, leather or clay. Weapons were most often made from bronze, a practice that continued throughout the Iron Age. The majority of the pottery was hand thrown, although some pieces were formed on a wheel (Thompson 1965). Iron extraction and forging were common. During the second century A.D., for the first time, craft working specialists appear in this region (Storgaard 2003). Furthermore, a formal standing military was created; this was an important shift from trained peasants with assorted equipment to a trained, supplied, professional military with soldiers and officers (Storgaard 2003:109).

Germanic craftsmen are associated with iron costume ornaments and jewelry, as well as jewelry of bronze and precious metals. There is no evidence that copies of Roman imports were made locally (Hedeager 1987:130).

Numerous clay anthropomorphic human figures, including busts and relief masks, dating to the Early Iron Age have been found. Although it would be possible to interpret these as human representations for ritual deposition, they have not been found in the usual centres for ritual deposition. Busts have been found at settlements and most of the masks are from graves. It is said that "...certain "busts" are so detailed that they could easily represent individual persons" (Lund 1990:76). Perhaps these carvings are a way of keeping distant relatives close, similar to photographs used today.

Originally, written correspondence between the Romans and Germanic chieftains was in Latin. Many Germans likely learned to speak Latin, although the original tribal languages

were likely retained locally (Thompson 1965). Runic inscriptions dating from A.D. 150 to A.D. 500 have been found in Scandianvia and Schleswig-Holstein, indicating use of *the older futhark* runic alphabet of 24 letters during the Iron Age. This was a precursor to the 16-rune alphabet, *the younger futhark*, of the Vikings (Stoklund 2003). Examples of *the older futhark* were found on artifacts of "gold, silver, bronze, iron, bone and wood, including weapons, tools and ornaments" (Stoklund 2003:172). A number of objects with runic inscriptions from Iron Age war booty sacrifices at Vimose, Thorsbjerg, Illerup and Nydam bogs have been excavated.

Burial practices, beliefs and votive deposits

Burial practices

The predominant method for the disposal of the dead in Iron Age Schleswig-Holstein was, overwhelmingly, cremation (Todd 1992). Cremation burial fields, some with small mounds, are common in both Schleswig-Holstein and parts of the Jutland peninsula of Denmark (Andersen 1989). Although many cremations were contained within a clay urn, in some cases the remains were placed in the ground without any surrounding container. In same cases, charring was visible on the soil or on pottery sherds, possibly suggesting that cremation was carried out at the site (Andersen 1989).

Identifying patterns of burial from the Iron Age in northern Europe, including Schleswig-Holstein, is particularly complicated. There is a wide range of grave styles and although attempts have been made to link these varied methods to specific cultures or time periods, this has not been completely successful (Andersen 1989). Although there are some rich inhumation graves, these are rare. A further complication is that cremations interred

directly on the soil in a burial pit (as opposed to those in urns) are very poorly preserved. There is tremendous bone fragmentation and only very small amounts of skeletal material can be recovered, making anthropological analysis virtually impossible (Andersen 1989). Thorough studies of grave goods found in burial contexts, whether cremation or inhumation sites, have been undertaken, but are far too detailed to be discussed in this thesis (eg. Knorr 1910).

Graves that are "defined by the presence of precious metals and Roman imports" (Gebühr 1997:113) are known as "princely graves". These are often considered to be indications of a high status burial. It has been suggested that the high status Roman goods found in these princely graves may have been politically motivated gifts from the Romans – a form of bribery to local chieftains (Hedeager 1987). In Schleswig-Holstein, inhumation of any type was unusual, so the presence of princely graves implies a variation from standard burial practices (Todd 1992). "All graves reflect a general custom of depositing different types of personal equipment, including Roman imports. It is therefore reasonable to assume that variations in grave equipment reflect socially and economically determined variations"(Hedeager 1977:218). Furthermore, the graves are not completely representative of the general population but reflect social and political factors (Hedeager 1977).

Over the Iron Age there changes in the artifacts deposited both in burials and hoard contexts. Figure 5 shows these changes over the time of the Iron Age. Burial wealth, including the deposition of weapons peaked around A.D. 200-300, while hoard deposits were reduced during the same time period. Hoard deposits flourish both at the start and

the end of the Iron Age, although the contents of the deposits changed: ritual objects and neck rings were most common at the start of the Iron Age, while weapons went from a burial context to a hoard context.

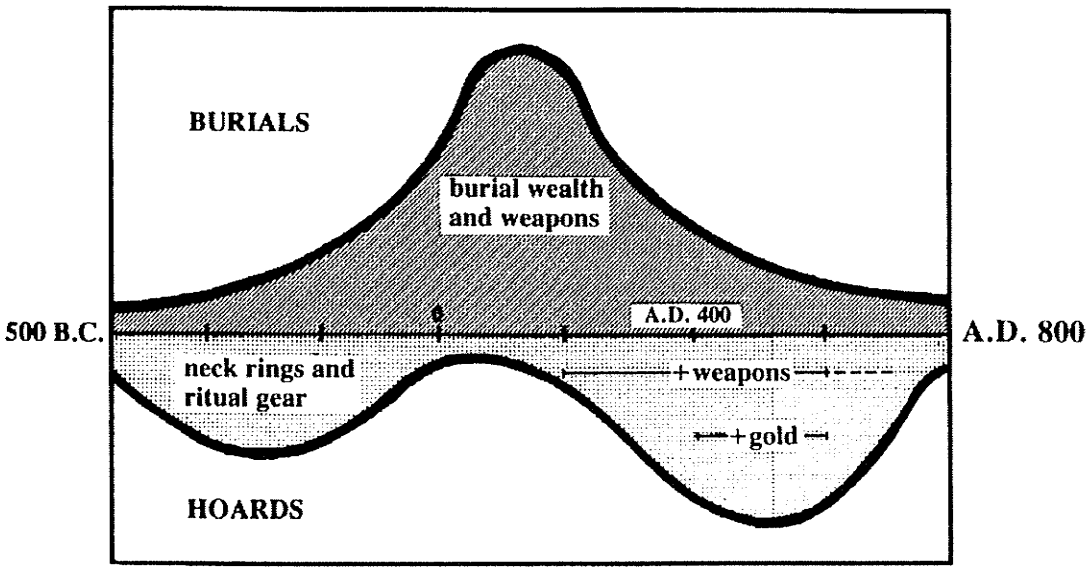


Figure 5: Change of artifact deposition patterns during the Iron Age (Source: Patterson 1993:260).

Beginning in the Early Iron Age in eastern Holstein and extending through the Older Roman Iron Age, males and females in northern Germany were often interred in separate cremation cemeteries (Gebühr 1997); there was some geographical variation in the region over the centuries. The gender-separated cemeteries were recognized archaeologically through the identification of mainly weapons at some sites (male), with dress ornaments present at others (female). Where osteological analysis on the cremated human remains was undertaken, the skeletal evidence supported the artifact-based interpretations (Gebühr 1997). While it has been suggested that the male cemeteries were mainly for the rulers,

many children have been identified in male cemeteries and there are no other cemeteries where non-status males would have been buried (Gebühr 1997).

Beliefs

Roman writers discuss the religion of the barbarians. Caesar indicated that "the Germani only worship gods they can see, like the Sun, Fire and the Moon, but they have no knowledge of other gods" (Grane 2003:144). Tacitus discussed Mercury (the Latin name of Woden), for human sacrifices were made, as well as Hercules (Germanic god Donar) and Mars (Germanic god Tiw), both of whom required only animal sacrifices (Grane 2003). Nerthus, a fertility goddess, was also mentioned by Tacitus. Specifically he referred to her chariot, which was drawn by cows, and that feasting and revelry followed wherever the goddess went. War was forbidden when the goddess visited. Links have been made between a wagons found in peat and the chariot used by Nerthus (Grane 2003). The Germani had no churches or temples, but worshiped in the outdoors at "natural places such as groves and forests or islands" (Grane 2003:145).

Hoards and votive deposits

The term "votive deposits" refers to objects, and occasionally people, that have been placed in sacred environments as offerings "...to appease, thank, or enhance the success of pleas, prayers or supplications" (Darvill 2002:457). In northern Europe during the Iron Age many lakes and peat bogs became the sacred environments for the deliberate deposition of objects such as pottery, weapons, tools, and *objets d'art* (Todd 1992). Animals were also deposited and, on some occasions, humans. Although votive deposits are specifically sacred, secular deposits also occurred in northern Europe during the Iron

Age. The separation between "hoard" and "votive deposits" is a fine line. Some view hoards as deposits with an intention to retrieve after a period of time, while votive deposits were meant to be given to the gods as gifts and were not going to be reclaimed (Liversage 1980). While secular deposits are often identified as "hoards" rather than as "votive deposits", the term "hoard" can be applied to the deposition of both sacred and secular objects (Darvill 2002; Fonnesbech-Sandberg 1985) and both terms are frequently used interchangeably in the literature, particularly in translation. For individual artifacts the distinction is even more difficult, but it is possible that individual objects that were found in small bogs were offerings on a private or family scale.

The knowledge of hoard and votive deposits is dependent upon the material that has been recovered. During peat harvesting operations archaeological objects, in particular silver and gold, were often found. It is known that parts of some hoards were sold or melted down after excavation (Fonnesbech-Sandberg 1985). Furthermore, the interpretation of the material that has been preserved is limited since the specific archaeological context is seldom known. Kaul (2003a) stated: "This is a common problem with the interpretation of finds from field and bog; in many cases it can be difficult to tell whether the deposition had a practical function or was related to religion and rituals" (Kaul 2003a:37).

The Gundestrup Bowl is one example of an artifact that has been the subject of repeated discussions regarding interpretation (Bergquist and Taylor 1987; Kaul 1995; Klindt-Jensen 1959; Taylor 1992). The Cauldron was discovered in a Danish peat bog in 1891 and displayed in the National Museum of Denmark. Estimates of the date of the artifact

range from second century B.C. to the eighth century A.D. and its location of origin has been identified as Scandinavia, Gaul or Thrace (Bergquist and Taylor 1987), an area between the Black Sea and the Aegean Sea that is present day Bulgaria and Rumania (Haywood 2001; Taylor 1992). The cauldron consists of concave and convex silver plates with elaborate low relief images that are often identified as Celtic (Kaul 1995; Klindt-Jensen 1959; Taylor 1992). The unusual images and the extraordinary silversmithing are completely unique. Since the cauldron was found without any other artifacts and in a bog, with no apparent links to local settlements, individuals or a population, it is impossible to ascribe a cultural identification or meaning. Clearly the object was imported, since it bears no resemblance to anything that is known to have been crafted locally (Kaul and Martens 1995).

The populations of Iron Age northern Europe were, until the second century A.D., based on a chieftain with a warrior elite to support him. It was a time of frequent and intense conflict over territory and customs and the votive deposits of this period, whether war booty or not, provided ritual support for the actions of the chieftain and his military (Ørsnes and Ilkjær 1993). It has been suggested that the changing social structure late in the Iron Age was the result of acceptance of the role of the ruling elite. This is reflected in reduced numbers of votive offerings when the need to demonstrate the power of the chieftain and his chosen elite to the rest of the population was no longer necessary (Ørsnes and Ilkjær 1993).

The primary focus of the votive deposit changed over time and this may be a reflection of changes to the social environment at the time. The earliest deposits were mainly pottery, possibly containing food (Kaul 2003a), and were possibly fertility offerings (Andersen 1996). Around the same time there were substantial deposits of agricultural equipment, including plough parts and yokes, as well as many wheels and wagon parts (Kaul 2003a). There were also human and animal bones and a range of wooden objects such as poles, wheels and anthropomorphic figures (Kaul 2003a). Towards the end of the first two centuries of the Roman Iron Age, smaller fertility-based offerings shifted towards very large weapon deposits that may be related to the war booty theory or offerings to the war deities (Andersen 1996). Many of the bog bodies date to the period of the Roman Iron Age and may have been either fertility or war offerings. Although the same objects as previously deposited were still offered, votive deposits towards the end of the Iron Age shifted to large collections of jewellery, especially gold (Jensen 1982; Kaul 2003a). The change in deposition habits may reflect a society that was seeking support for daily agricultural activities, until military activity increased and warfare became part of daily life. As the social structure shifted from chieftains to a wider ruling elite, the deposits then returned to offerings of valuable civilian objects instead of military objects (Ørsnes and Ilkjær 1993).

One special type of offering, often made to Woden and Tiw, were war sacrifices. Prior to battle, tribes might make a vow to sacrifice both the prisoners and the booty collected from the enemy in the event of a victory (Grane 2003). A number of very large votive deposits of weaponry, boats, armour and clothing have been excavated (Ilkjær 2003).

These have been identified as "war booty" deposits which were made following victory in battle. One site, Hjortspring, is the oldest war booty sacrifice, dating to about 350 B.C.. The find consisted of a wooden boat, plus numerous spearheads, spear shafts, several swords or sword parts, several coats of mail and more than 50 wooden shields (Randsborg 1995). There were also many other wooden objects, including bailing scoops, a dish and a plate (Kaul 2003b). All of the objects, including the boat, had been deposited when the soldiers waded out the centre of the small lake and physically pressed them under the water.

Several other significant Iron Age war booty depositions have been excavated from a number of sites in Denmark and Schleswig-Holstein. All of the sites have yielded substantial amounts of weaponry, as well as clothing, armour and many other artifacts. The best examples of these sites are Vimose (Jensen 2003b); Ejsbøl (Andersen 2003); Nydam (Jørgensen and Vang Petersen 2003; Rieck 2003);

The presence of Roman goods associated with burials in Denmark is consistent throughout the Iron Age. Beginning in the pre-Roman Iron Age, a few aretfacts are found, often in a votive context. By the Roman Iron Age the goods are appearing in greater quantities. Artifacts such as gold rings and silver brooches are now often found in grave contexts, but not in a votive context. At this time, weapons are found in graves in Jutland and the Danish island of Fyn. By the late Roman Iron Age, various Roman imports are evident in graves, but there is little evidence of weapons in graves at this time (Hedeager 1987).

One important category of votive deposits is that of wooden figures, many of which are in anthropomorphic forms. Although these figures from the wetlands of northwestern Europe date from most time periods, the greatest number is attributed to the Pre-Roman and Roman Iron Ages. It is likely that the number of surviving objects is only a small proportion of what was originally deposited; unfortunately, the archaeological context of many of the surviving figures is unknown (Capelle 2003). There are two main types of figures from the Iron Age: "plank-shaped figures alongside trackways are presumably believed to possess protective powers and the predominantly naturally shaped that are associated with offerings" (Capelle 2003:129). Many of the figures display prominent genitals and it has been suggested that these were dedicated to fertility; food offerings have been found with some of these figures. Although it is not possible to determine the exact purpose the wooden anthropomorphic figures in the northern European wetlands, it is possible that some were representations of deities.

Two very large wooden anthropomorphic figures from the Pre-Roman Iron Age are part of the collection of the Archaeologisches Landesmuseum, Schloss Gottorf. In fact, both figures are currently displayed in the same exhibition room as the bog bodies. Discovered during peat-cutting in 1946 near the town of Braak, the figures are very large, standing at 2.75 m and 2.29 m tall (Dietrich 2003). One figure is clearly male and the other female and they appear to have been created as pair. There is little evidence of weathering, so it was suggested that both figures were deliberately buried in the peat shortly after construction (Dietrich 2003).

It is unknown whether some, or all, Iron Age bog bodies represent votive offerings. It is likely that if all bodies were votive offerings there should be similar patterns of preparation, disposal and cause of death, but recent research has shown that this evidence does not exist (Gill-Robinson 2000). It is certain, however, that some bog bodies were votive deposits. Whether the bodies were deposited in offering to fertility or war deities cannot be ascertained; both have been suggested (Glob 1969; Randsborg 1995). Alternative theories for the interpretation of bog bodies are explored in Chapter 13.

Social and political structure

At the start of the Iron Age the regions of northern Europe were divided into a "patchwork of many small chieftaincies" (Storgaard 2003:108). Although there were strong relationships between the main families of the chieftaincies, there were regional differences and somewhat limited mobility of the groups (Storgaard 2003). In the period from A.D. 1 to 200 there was a clear increase in social stratification in northern Europe. There is evidence that greater amounts of wealth were incorporated in fewer burials, suggesting a process of centralization of power. Rather than several regional chieftains whose power was based on kinship, the power shifted to a single centre. Part of this may have been linked to the development of greater military organization and increased trade with the Romans (Hedeager 1987). Archaeological evidence supports this theory through a concentration of graves with prestigious Roman imports, rather than the wider distribution of these goods that was seen in graves from before the birth of Christ.

During the second century A.D., "the warrior elite separate from the traditional clan-based society and became the aristocracy" (Hedeager 1993:122). The new group had strong alliances with one another, as well as wealth. The new leaders could inspire the loyalty of their military through wealth. A system of reciprocity operated whereby military service and loyalty were exchanged for money. The aristocratic was dependent upon income from war and raiding to maintain an appropriate lifestyle, since agriculture alone did not provide sufficient wealth (Hedeager 1993). The cycle was on-going: the wars and looting paid the military who had participated to acquire the booty. Society became more stratified. As discussed above, farmsteads increased in size and a move was made to intensive agriculture. As part of this, farms became independent economic units that functioned within the sphere of village life (Storgaard 2003).

The gender separation of cemeteries of northern Germany and parts of Denmark may reflect differences in social status between men and women in the Roman Iron Age. It is possible that women in this region were of lower status than men (Gebühr 1997). The interpretation that women held lower status is not universal. Other authors have suggested that some Germanic women had high status and, through marriage, could assist in the formation of political alliances between tribes (Hedeager 1987).

While valuable Roman imports were found mainly in male graves in the Lower Elbe area of central Germany, in Denmark the majority of Roman imports were associated with female graves. It has been suggested that the differences between the Danish graves and the central German graves were the result of differences in the social structures of those populations. The Danish societies were generally peaceful with a ruling elite class, while

the Elbe societies were military based (Gebühr 1997). Schleswig-Holstein is geographically located between these regions and there may have been social influences from both areas. From analysis of the artifacts with cremation burials, it appears that in the East Holstein region the women were typically responsible for household duties, while in Denmark women were buried with more personal ornaments and fewer implements of household management (Gebühr 1997).

It was possible to link grave goods to age, sex and rank of the population. As seen in Figure 6, the group designated as "warriors" were young, active males who were buried with swords. Older males were never buried with weapons, suggesting that they were no longer active in battle; they were not defined as "warriors". Spurs indicate high status. They may be combined with grave goods of gold and, sometimes, Roman imports. There are no weapons associated with this age group. Both spurs and weapons exist in the graves of young man. This suggests that the "right to be a warrior and access to wealth are not achieved but inherited" (Hedeager 1987:130). One example of evidence for this stratification and artifact distribution is found at the Danish site of Over Jerstal (Ethelberg 1995).

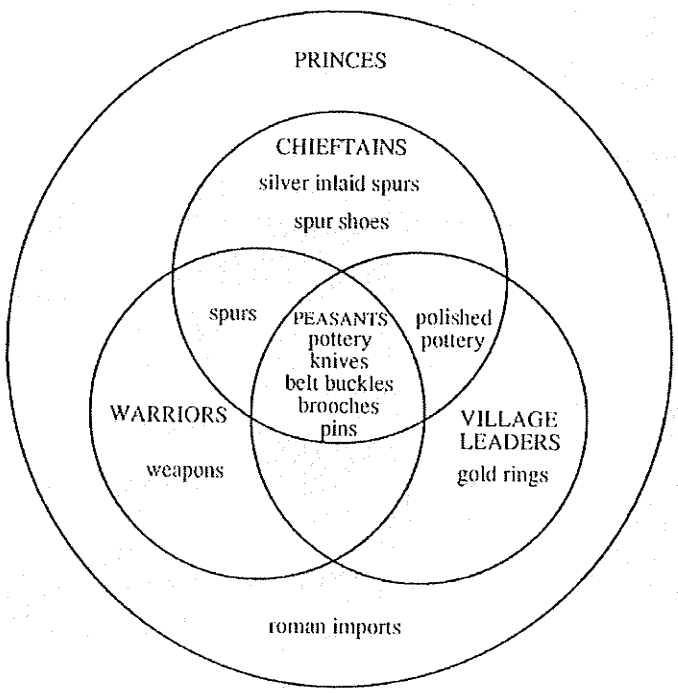


Figure 6: Stratification and grave goods during the Early Roman Iron Age in southern Denmark (Source: Ethelberg 1995, 132). Reprinted with permission, 2005.

SUMMARY

The Iron Age was, in general, a period of great political and social change in northern Europe. Although specific information is not always available for Schleswig-Holstein, comparable information from some Danish sites can be used to examine life in the Iron Age. Over the course of the Iron Age, particularly after the birth of Christ, the Romans were a strong presence in the north and influenced fashion and other material goods. Agriculture was the primary means of subsistence, but around the start of the Late Roman Iron age, the change in political structure from chieftains to a ruling warrior class of aristocrats meant that many peasants were working for other people. At the same time, the structure of the farmsteads changed. During the Iron Age there were also a number of changes to burial practices on a region level. Cremation was the predominant method for

disposal of the dead in Schleswig-Holstein, but some inhumations exist. Some of the inhumations included particularly rich prestige goods. Votive deposits of all types of objects, for various reasons occurred throughout the Iron Age. In general, the Iron Age in northern Europe was characterized by a period of change throughout the entire area, often differing on a regional level.

CHAPTER 5
MATERIALS

INTRODUCTION

In order to provide a comprehensive assessment of the bog bodies at the Archaeologisches Landesmuseum, the research materials included not only the bodies themselves, but also all written documentation pertaining to the bodies. Although there are only a few publications related to this collection of bog bodies, the museum archives included documentation related to the discovery, excavation and analysis of each body. This chapter outlines the materials used in this research, both the archival documents and the individual bodies. Figure 7 shows where each of the bodies was found and identifies the town of Schleswig, where the bodies are currently curated.

ARCHIVAL MATERIALS

The Archaeologisches Landesmuseum maintains archival files listing all archaeological finds held at the museum, categorized by site name and geographical region. Individual finds are labeled with a museum accession number, normally beginning with "KS". A total of 370 documents, totaling over 800 pages of text, were examined during the course of this research. A complete list of the documents can be found in Appendix B. Although each of the documents was not individually translated and transcribed, translation of all relevant information from these documents was undertaken by the author, and incorporated into the results. Table 1 presents a summary of the archival items reviewed, including the number of text documents, sketches, maps and photographs examined.



Figure 7: Map of Schleswig-Holstein showing the find locations of the bog bodies and the Kühsen skeleton The Archaeologisches Landesmuseum Schloss Gottorf, Schleswig is circled (Source: Witt and Vosgerau 2002, 415)

File name	Original written docs	Transcribed documents	Total pages of text	Sketches	Maps	Photos
Rendswühren	36	20	114	0	0	4
Damdendorf	82	21	149	3	4	32
Osterby I	39	0	36	9	2	14
Windeby I and II	111	0	212	11	3	87
Windeby – Shell middens	24	0	61	2	9	33
Dätgen	73	0	226	42	6	84
Kühsen	5	0	10	3	0	5
TOTAL	370	41	808	70	24	259

Table 1: Summary of archival materials examined. "Transcribed documents" represents the number of pages available in transcription; these pages are legible versions of the original texts. Numerous text documents are several pages in length and the "Total pages of text" column represents the total number of document pages examined in each file.

Rendswühren

In the case of the two bodies found near the end of the 19th century, Rendswühren in 1871 and Damendorf in 1900, the documentation was entirely handwritten in a traditional style of German calligraphy that was completely illegible to anyone unfamiliar with that type of script (see Figure 8). In 1993, F. Wolter was contacted by the museum and several of the handwritten documents from the Rendswühren file were transcribed into modern German script. Typed copies of these transcriptions were available in the museum archives.

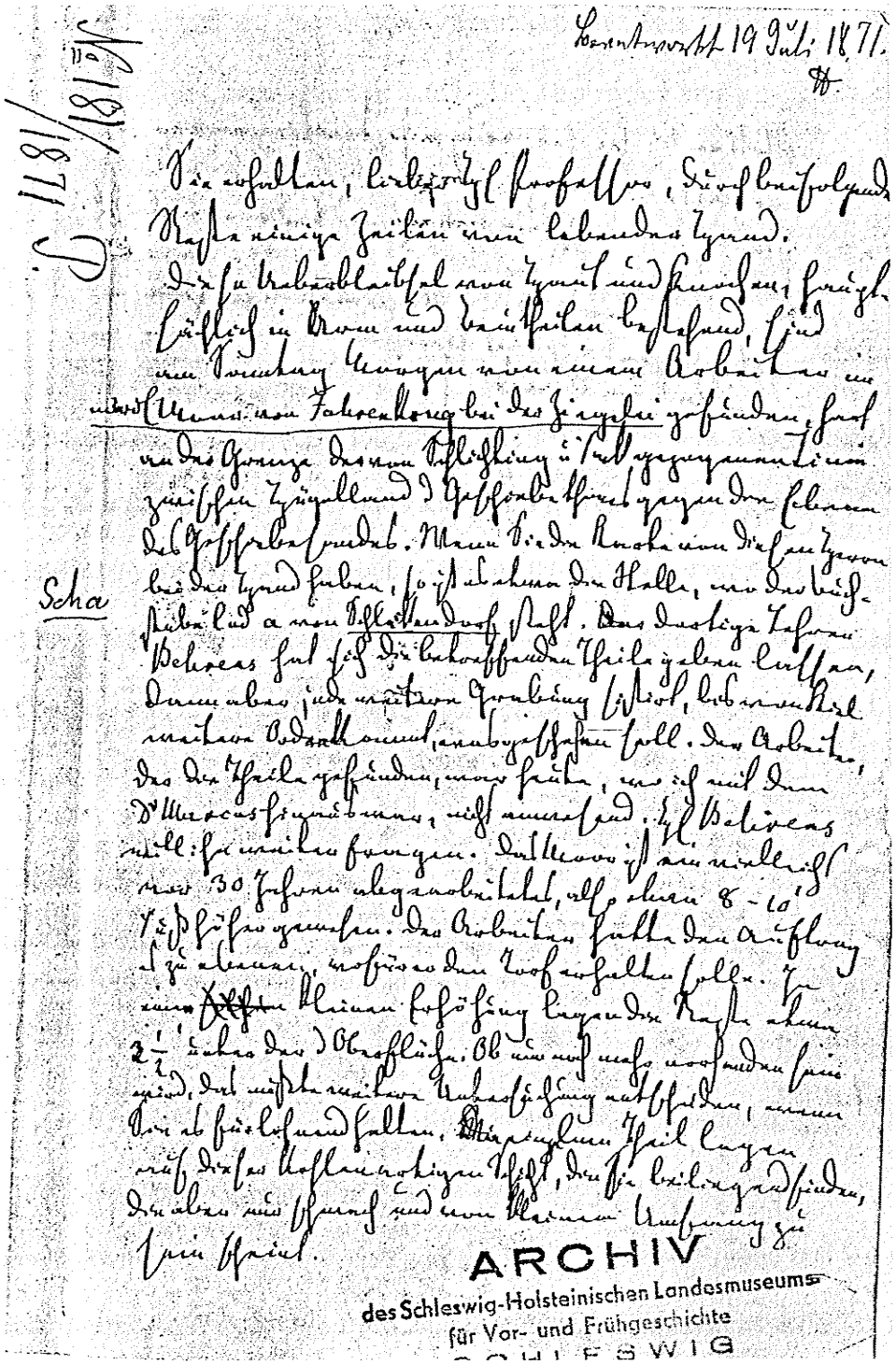


Figure 8: Sample of a handwritten document from the Rendswühren file before transcription. (Source: Buttel 1871)

There were three folders for the material from Rendswühren, filed under the region "Kreis Plön", with all documentation in date order. This region was previously known as "Kries Bordesholm" and some documents use that reference. The first file contained details on the bog body (no KS number), while the other files contained reports of aretfacts from the region. The bog body file consisted of approximately 25 handwritten documents that were illegible because of the writing style, some with recent typed transcriptions, including reports on the discovery, excavation and autopsy of the body. There were a few newspaper reports and a copy of a journal article (Virchow 1871) about the discovery and excavation of the body. This is the only known publication about the Rendswühren body. There was a single posed photograph taken of the body shortly after discovery and a more recent photograph of the body on display. A complete list of the material examined can be found in Appendix B.

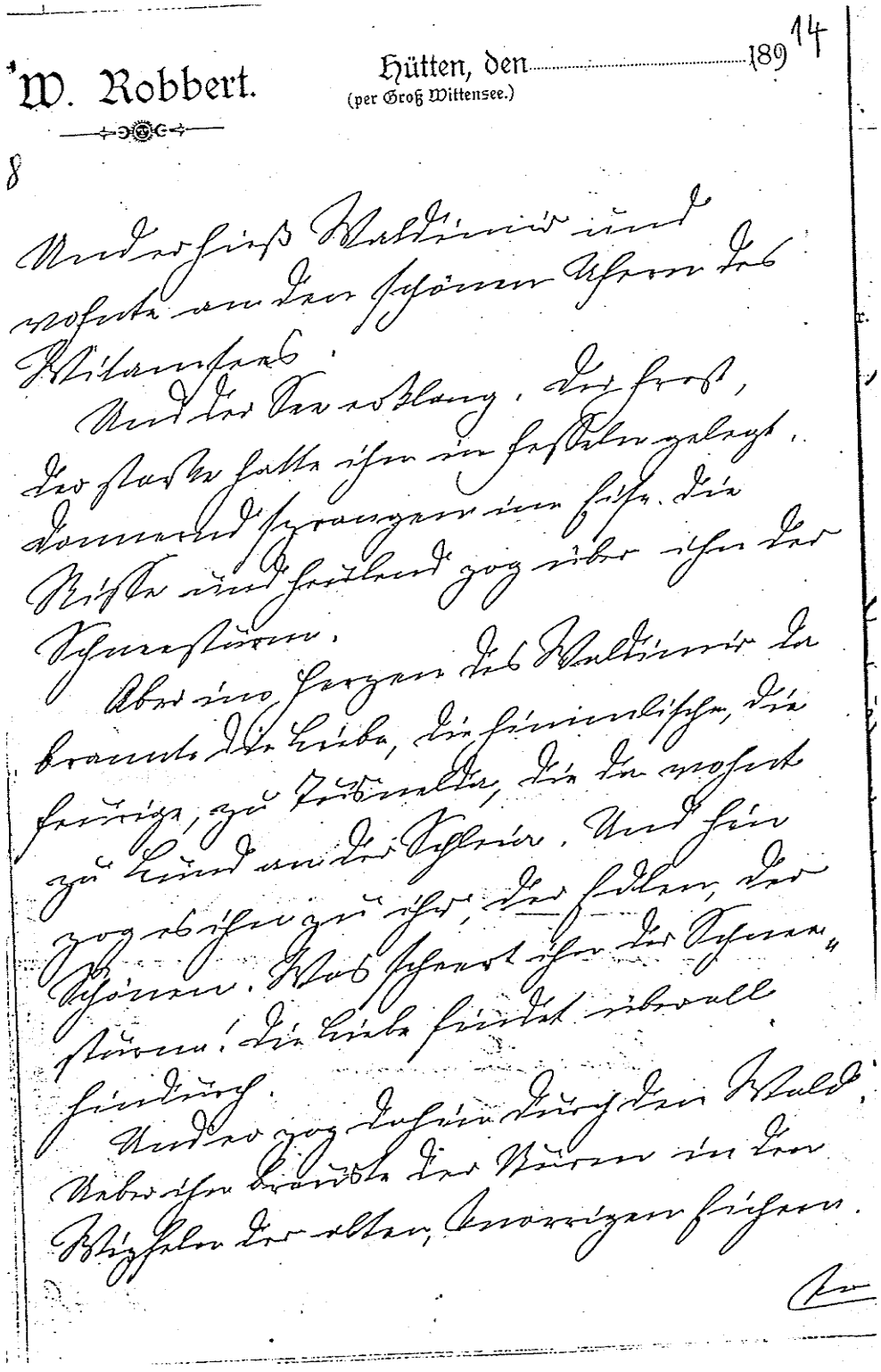
Damendorf

There were four files containing information on discoveries near the town of Damendorf, in the region of Kreis Eckernförde. Although three bog bodies were listed in the files (found in 1900, 1934 and 1947), only the 1900 body is preserved. The 1934 find consisted of a skull with no preserved soft tissue. The find has not been dated and has been excluded from this research because of the lack of both soft tissue and a confirmed date. Hair from the 1947 body has been conserved and mounted for display. It, too, was undated and in its present condition was not suitable for inclusion this research. All archival data pertaining to the bodies was thoroughly examined. Where there were reports of Iron Age artifacts from the same site, or nearby, these documents were also examined. A complete list of the materials examined can be found in Appendix B.

In the case of the file on the 1900 Damendorf body, documents were written in the same old script as seen with the Rendswühren documentation (see Figure 9 for an example of a document before transcription). Most of the documents from this file were transcribed by two volunteers from the town of Schleswig, A. and E. Martensen, specifically for this research, at the request of the museum. Legible handwritten copies of the transcriptions are now available in the archives. The documents were transcribed specifically for this research. Had these transcriptions not been undertaken at this time, it is possible that the data contained within the original documents may have been lost forever. Despite the dedication of the transcribers, there are some gaps in some of the documents and the unusual script was completely illegible to even those familiar with that style of handwriting. Some of the documents were faded, which contributed to the reduced legibility of the handwriting and the complexity of the sentence structure.

Osterby

There were three files for the site of Osterby, Kreis Eckernförde, with documentation filed in order by date from discovery from the earliest (1845) to the most recent (1989). The documentation related to the skull was found in the second file. Any documents reporting or describing artifacts that pertained to either the bog site or local dryland sites were also included in the archival search. The bog body file included discovery and


W. Robbert.

Hütten, den 189 14
(per Groß Wittensee.)

8

Figure 9: Sample of handwritten document from the Damendorf archive before transcription. (Source: Robbert n.d.)

excavation reports, general correspondence about the skull, black and white photographs of the skull before and after restoration, and pencil and pastel drawings of the skull. A complete list of the materials examined can be found in Appendix B.

Windeby I and II

The documents for Windeby I and II were archived in the same file. This file consisted of five cardboard document folders kept in Karton 32, Paternoster 4 and one smaller folder containing 9 separate sets of documents related to the Windeby site Two files reporting other archaeological sites and artifacts not related to the bog bodies were also kept in the main regional file (Kreis Eckernförde) under the site name of "Windeby (Domlandsmoor)". The files contained excavation reports, correspondence, analytical reports, maps, sketches and photographs. Although some X-rays from the Windeby I body exist, the originals were not located during the course of this research; only published photographs of the X-rays were available. Two X-rays of the throat area of the Windeby II body exist and are stored flat in an envelope in Paternoster 7 of the archives. In addition, a separate file related to the excavation of an Iron Age shell midden near the Windeby site was also examined. The midden file contained just over 65 pages of excavation information, sketches and 33 photographs from the site. Since this file provides some contextual data for the bodies, including potential evidence of diet, the documents were included in the archival research. A list of the documents from the Windeby files can be found in Appendix B.

Dätgen

The material for the Dätgen body was found in three folders under the region of "Kreis Rendsburg". In the first folder, a file labeled as "Die Moorleiche im Dätgener-Moor Krp. Nortorf, 1906" ("The Bog body in Dätgen Moor, Krp Notorf, 1906"), in fact, referred to a bundle of clothing and some hair (KS 11920) as well as an urn (KS 11919); there were no other parts of a body found at that time. The files for the bog body (KS C410), found in 1959, were found in the first and second folders, with an additional folder, including photographs, in a box filed at Paternoster 4, Karton 16. The head and the body were found at different times, but have been assigned the same accession number. The body is KS C410a and the head is KS C410b. This discrepancy is discussed in more detail in Chapter 11, with the results of the research related to this body. Some of the documents referred to the body from "Schülper Moor", but this is the same body as KS C410. The bog where the body and head were found was known as the "Schülper Moor", but the site has always been know by the name of the closest town, Dätgen.. There were several X-rays of the body after conservation and three images of the head. The X-rays for the body were in one envelope and those of the head in a separate envelope (labeled as "Dätgen II"); both envelopes were stored flat in Paternoster 7 of the archives.

A Roman Iron Age settlement site was located near the village of Notorf, close to the find spot of the Dätgen body and information from this site was found in the third folder. The archival material on this site was included because of its temporal and geographical relevance to the bog body location.

Kühsen

The single file on this skeleton was kept in the regional file for Kreis (Herzogtum) Lauenberg, under the site name of Kühsen. There were only a few documents in the file, including five small photographs of the excavation mounted on a single page. This documentation consisted of a report of the discovery and correspondence noting that the skeleton was sent to Kiel for anthropological analysis and returned to the museum. There was, however, no report from the anthropological analysis in the file. A list of the material examined can be found in Appendix B.

THE BODIES

This section provides a brief overview of each of the physical remains and associated artifacts examined during this research. The assessment of all of the bog bodies are limited to the bodies themselves and do not include examination of any of the accompanying textiles. Five complete bog bodies, one skull with a mandible and one skeleton were included in this research. The bog skeleton was recovered from alkaline peat, rather than the acidic peat of the bog corpses, and was included as a comparison for taphonomic variation between bodies in the two types of peat. Although radiocarbon dates are presented in this section, these serve only to reinforce that the corpses are from the Iron Age. The skeleton has not been radiocarbon dated, nor is it assigned to a temporal period by stratigraphy. The radiocarbon dates, and all other aspects of the bodies, are discussed in detail in Chapters 7 through 12, each of which are devoted to one of the bodies; Windeby I and II, however, are discussed in the same chapter. A critical synthesis of the data from all chapters will be presented in Chapter 13.

Rendswühren

On June 1, 1871, the body of an apparent adult male was discovered during peat cutting on the Rendswührener Moor. The body from Rendswühren is generally well preserved and appeared to be virtually intact (Figure 10). The skin surface is mainly smooth and very dark brown to black in colour. Although the skin texture is visible, the overall appearance is shiny. There are a few dull patches. Part of the left foot is currently wired to the rest of the foot and there is a visible binding holding the left radius and ulna in place. There is a leather cuff around the right ankle. There is no visible evidence of trauma or pathology anywhere on the body. The body is fully extended, lying on his back with his left arm resting on an artificial peat mound. A piece of brown woven fabric and a matching felt undercloth, covers the genital area of the body.

A piece of the textile accompanying the body was radiocarbon dated in 1995, with a resulting date of 1960 ± 50 BP (van der Sanden 1995a), the Early Iron Age. The body itself has not been radiocarbon dated. This body is currently on display as part of the Iron Age exhibition on the third floor of the Archaeologisches Landesmuseum in Schleswig.

Damendorf

The body found in the Damendorfer Moor on May 29th, 1900 is quite well preserved, but very flat (see Figure 11). The only visible three-dimensional structures on the body are toes on both feet. There are numerous visible tears to the skin of the body. These skin



Figure 10: Rendswühren Man in display case (Photo: Heather Gill-Robinson)

tears will be discussed in more detail later in this thesis. The body is fully extended with bent knees. The right arm is flexed and the left arm extended over the head.

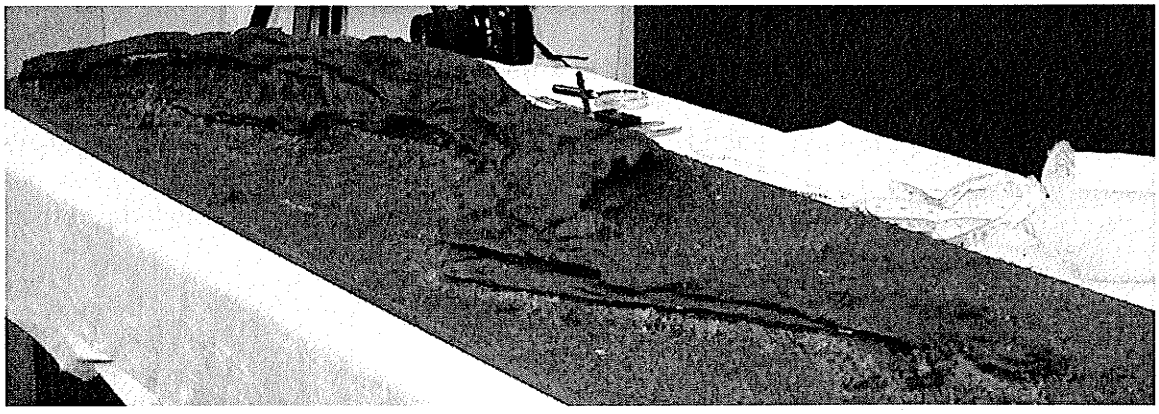


Figure 11: Damendorf Man (Photo: Heather Gill-Robinson)

Textiles that accompanied the Damendorf body were radiocarbon dated in to 1780 ± 45, the Late Roman Iron Age, in 1994. The body itself has not been radiocarbon dated. The body is currently on display in the Iron Age exhibition at the museum. Several pieces of clothing were found with the body; these artifacts are not displayed with the body, but in a series of separate display cases adjacent to the bog body section.

Osterby

An isolated skull wrapped in animal hide was discovered on May 26th, 1948, during peat cutting on the Köhlmoor, southeast of the village of Osterby. In appearance this individual consists of a small, gracile cranium and a mandible (Figure 12). All visible bone is dark brown to black in colour. The skull is topped with coarse reddish-hair bound closely to the scalp and finished with an elaborate hair knot, the Suebian knot, over the right fronto-temporal region. Some of the hair is loose. A small amount of skin is visible over the left fronto-parietal region and extending downwards over the temporal area.

A sample of hair was radiocarbon dated in 1994. The resulting date was 1895 ± 30 B.P., or the Early Roman Iron Age. The skull and mandible are mounted on a solid rod and displayed in the same area as the other bog bodies. Although the head was found wrapped in hide, neither the hide itself nor a reconstruction of it are on display.



Figure 12: Osterby Man (Photo: Archaeologisches Landesmuseum Schloss Gottorf)

Windeby I

The Windeby I body, most commonly known as the "Windeby Girl" was the first of two bodies found during mechanical peat cutting on the Domlandsmoor, near the town of Windeby. The Windeby I body was found on May 19th, 1952. The second body, discussed below, was discovered June 9th, 1952, approximately three to four metres from the body of Windeby I.

The body identified as Windeby I is separated into two parts: the osteological material and the shell of the body. The body that is currently on display in the museum consists of a shell of skin, and possibly muscle, which has been treated with an unknown formulation during conservation in the 1950s. The body is displayed laying partially on its right side, similar to the position in which it was discovered (Figure 13). There is an area of the

thorax and abdomen covered by mock peat. This area of the body was originally not preserved and the covering of this area reflects its unsuitability for display in its original condition. There is a fur cape around the shoulders of the body. Several ribs, the left scapula and both clavicles were used in the display, but the remaining osteological material was removed from the body for conservation. The head is present, but the skull and brain were removed and the area filled with plaster for display. The plaster has a hole so that the head can be mounted on a pole that connects to the rest of the body. There is currently a brown fabric band across the eyes to mimic the sprang-woven band that was found over the eyes at excavation. There is hair present on the scalp. The body is displayed with several wood poles that were found with the body. The right arm is bent upwards with a small wooden pole resting just above the elbow. The feet are fairly well preserved and crossed just above the ankles. The right ankle and foot lie at an unnatural angle. The skin is roughly textured and the body quite firm to the touch. Unlike most bog bodies, this body has been permanently formed in its current position during conservation and cannot be separated from its base or laid out for further physical examination.

The Windeby I body was most recently radiocarbon dated in 2002. At that time samples from the fur cape found on the body, as well as a sample from the left femur, were subjected to AMS dating. The results indicated that the cape and body dated to approximately 1950 B.P., the Early Roman Iron Age.

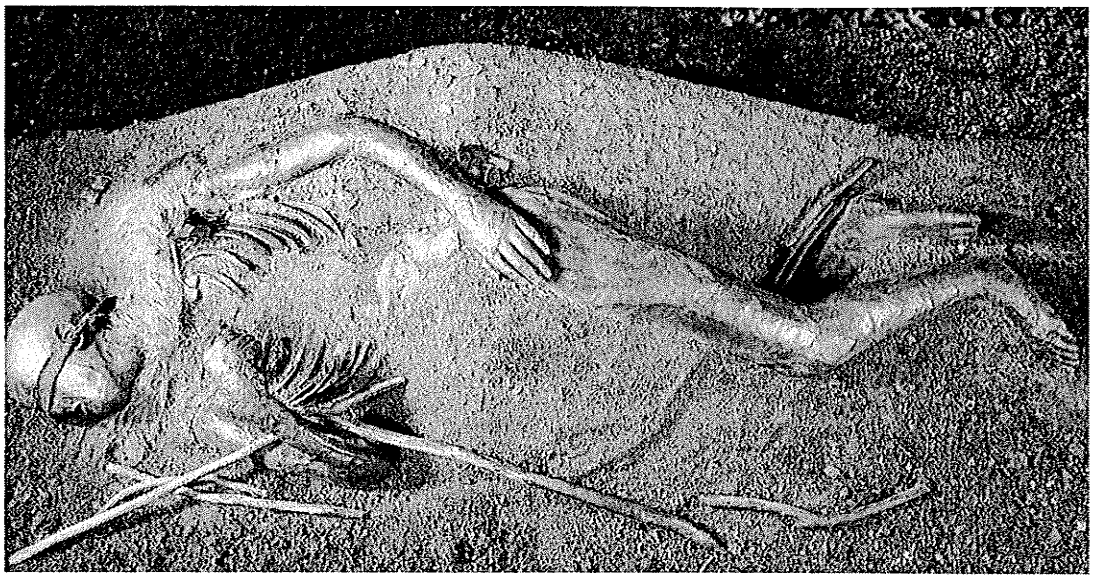


Figure 13: The Windeby I body on display (Photo: Archaeologisches Landesmuseum Schloss Gottorf)

Windeby II

The body rests on a structured base. The head and thorax rest on a small mound, while the area of the pelvis and the legs drape down the mound (see Figure 14). There is virtually no structure remaining to the body. It is possible to identify the face and determine that the arms are bent and crossed over the chest. There is a slightly wrinkled texture to the arms and head, suggesting greater thickness than the rest of the body, but a depth measurement could not be taken at any point on the body. There are a few bone fragments remaining and these were removed from the body, most likely during conservation, and are partially mounted in a wooden box with a glass lid.

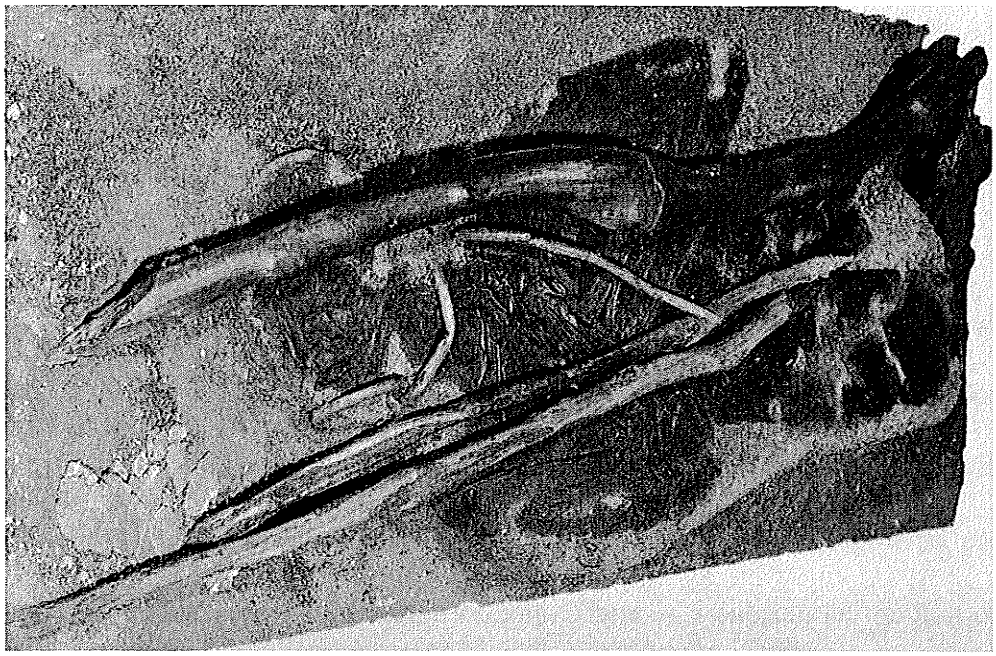


Figure 14: Windeby II mounted for display (Photo: Archaeologisches Landesmuseum Schloss Gottorf)

A sample from the hazel twig wrapped around the neck of the Windeby II body was radiocarbon dated, most recently in 2002. The results indicated a date of 2231 B.P., which is Pre-Roman Iron Age. A previous radiocarbon date provided a result of late Mesolithic and has been discounted (van der Sanden 1995). Although this body has been on display in the past, it is not currently displayed. The body was covered with layers of acid-free tissue paper, topped with a layer of plastic and kept in a storage area of the museum.

Dätgen

A headless corpse was found during peat cutting on the Großen Moor, near Dätgen, in September 1959. Six months later, an isolated head was found at the same site. It was assumed that the head and body belonged to the same individual (Struve 1964, 1967). In

1906 a bundle of clothing was found close to the find site of the body. It was assumed that the clothing belonged to the corpse excavated in 1959 (Struve 1967). These assumptions are discussed in more detail in Chapters 11 and 13.

The Dätgen body was covered in acid-free paper and stored in a box with glass sides and top. Parts of the upper thorax, all of the pelvis and most of the femora are still encased in skin and muscle tissue, although this tissue is extremely fragile and crumbles with only slight pressure (Figure 15). The head is preserved only as crumbled fragments, pieces of scalp; no identifiable pieces of cranium remain. There is a substantial amount of well-preserved hair resting on top of the crumbled fragments, including an elaborate Suebian hair knot that is similar in style, but not identical, to that of the Osterby cranium.

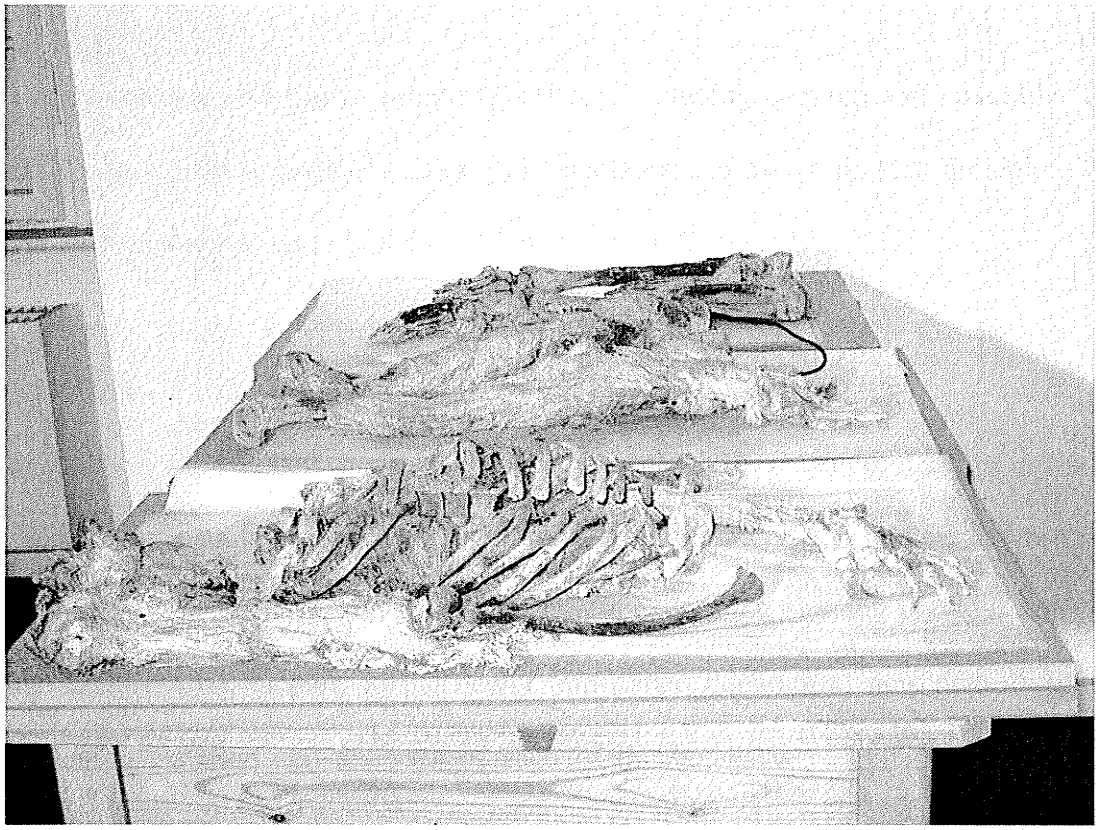


Figure 15: Dätgen Man (Photo: Heather Gill-Robinson)

Samples from the textiles found in 1906 were used to date this body. The date 1760 ± 80 B.P. is Late Roman Iron Age. This body is not currently on display, although there are plans to include the body in a special exhibition beginning at the end of 2005.

Kühsen

On May 9, 1960 a skeleton was found in peat near Kühsen, Kreis Herzogtum Lauenburg. Although there is a brief excavation report in the archives, the only published report on this skeleton is limited to a single paragraph in a general summary about the discovery of the Dätgen body (Struve 1964), which was found only a few months earlier. The body is kept in the organic storage area of the museum and has not been radiocarbon dated.

The body consists of a nearly complete skeleton, including cranium and mandible. The bones are generally in good condition and osteological examination was possible. The results of the examination of this skeleton are found in Chapter 12.

SUMMARY

The analysis of the bog bodies of the Archaeologisches Landesmuseum included examination of data both from the archives and from the individual bodies. The archival sources contributed information on the discovery, excavation and any previous analyses of the bodies. Due, in part, to the newly transcribed documents, new data about the discovery, excavation and analyses of each of the bodies were obtained through the archive files. Even in the case of the bodies with legible files, previous researchers had explored little of the archive data; even the museum was unaware of the contents of some

of the documents. Analysis of the bodies provided a current assessment of their condition and detailed information about each individual. The results of these analyses are presented in Chapters 7 though 12 and discussed in Chapter 13.

CHAPTER 6
METHODS

INTRODUCTION

This research uses two resources based at the Archaeologisches Landesmuseum, Schloss Gottorf: the bog bodies and the unpublished archival material related to each of the bodies. Table 2 shows which analyses were undertaken for each body. Although several supplementary scientific analyses have been arranged through collaborative international research projects, these analyses were arranged to provide additional specialised data to enhance the interpretation of the bog bodies. The primary focus of this research was the anthropological re-analysis of the bog bodies. The main methods used to meet this objective were the archival research to fill in substantial gaps in knowledge about each of the bodies; thorough physical re-examination of the each bog body in their current state and extensive analysis of the images of each body, including three-dimensional reconstruction and modeling. Furthermore, the array of data accumulated from such a wide range of sources was used to interpret each individual bog body. Additional data about the environmental conditions conducive to bog body preservation, previous and current bog body studies and life in the Iron Age in the research region of Schleswig-Holstein were acquired from published sources. This published data provided a solid framework within which the bodies could be interpreted. This chapter summarises the methods used to study and interpret the bog bodies, both in the archives and in the laboratory.

ANALYSIS	RENDS	DAMEN	OST	WIND I	WIND II	DÄTGEN	KÜHSEN
Visual assessment	YES	YES	YES	YES	YES	YES	YES
Metrics	SOME	SOME	SOME	YES	NO	SOME	YES
Digital X-ray	YES	YES	NO	NO	NO	SOME	NO
MSCT	YES	YES	YES	SKULL, PELVIS	NO	YES	SKULL, PELVIS
3D Reconstruction	SKULL	YES	YES	SKULL, PELVIS	NO	LIMBS	SKULL, PELVIS
3D Modeling (printed)	NO	NO	NO	SKULL, PELVIS	NO	LIMBS	PELVIS
Stable isotope analysis	NO	YES	YES	YES	NO	YES	NO
Trace element analysis	NO	YES	YES	YES	NO	YES	NO
DNA	NO	NO	NO	YES	NO	NO	NO
Archival research	YES	YES	YES	YES	YES	YES	YES

Table 2: Analyses conducted on the Schloss Gottorf bog bodies

ARCHIVAL STUDIES

The examination of the archival documentation related to the bog bodies in this collection was an important aspect of this research. Although the documentation is not consistent throughout the files, each file normally includes a report of the find, a basic excavation report and photographs or sketches. A list of the documents examined in each of the files can be found in Appendix 1.

Archival files at the Archaeologisches Landemuseum are categorised geographically by region (Kreis) and subdivided by the specific location of each find (eg. Windeby, Kries Eckernförde). Substantial documentation exits for the Windeby I and II bodies and the Damendorf body, including multiple files stored in a cardboard carton and larger photographic and X-ray images stored in a separate "hanging closet". Files were requested by site name (eg. Windeby, Kries Eckernförde) from the museum librarian, who immediately retrieved the documents and cartons from the central storage units. Files and documents could not be removed from the library area at any time and every file had to be returned to secure central storage units prior to the departure of the librarian each day.

Each file was initially reviewed by the author to determine its contents and estimate readability of the documents. In the case of the Damendorf and Rendswühren files, many of the documents were written in a form of calligraphy that required transcription to modern German. Although this had been partially accomplished for the Rendswühren material, arrangements had to be made for transcription of a substantial amount of material from the Damendorf file, as discussed in detail in Chapter 5.

All documents were in German and some were very complex, while others were quite brief. Although complete written translations into English were not made, notes were taken and reference was made directly to the material during writing. Photocopies were made of the majority of the textual material to allow direct reference by the author after research at the museum was complete. Some images were scanned or copied for use in this research.

PHYSICAL ANALYSES

Although some of the technical methods used may be similar, the discipline of mummy studies requires a different approach to human osteological analyses of skeletal remains. The rarity of soft tissue bog bodies makes them especially precious. Museums are understandably protective of the bog bodies and research involving the physical remains of the bodies themselves may be restricted. Sampling may be prohibited or restricted. In the case of this research, limited invasive sampling was permitted for specific analyses. Approval was obtained from the Museum Director and the Conservation and Display Units prior to sampling.

Mummy studies are, by their very nature, highly multidisciplinary. The physical anthropologist working with mummies has to be especially aware of non-invasive methods or those that require only very limited samples. In particular, there has been only limited physical research on bog bodies in the past. Some methods that have been successfully used in the study of other mummies have previously been largely unsuccessful with bog bodies. Most publications indicate that DNA could not be successfully extracted from bog bodies (Bermingham and Delaney 2000; Menon 1997). Until recently, this was true. New research at the Paleo-DNA Laboratory of Lakehead University in Ontario, Canada, has lead to the development of appropriate methodology for the DNA analysis of peat bog bodies (Matheson et al. n.d.).

As a complete re-analysis of a collection of bog bodies, this research provided the first opportunity to test several new analytical techniques for their effectiveness with bog

bodies. These new techniques required specialist equipment and experience not within the realm of expertise of the physical anthropologist. Through collaborative research links with other experts in mummy studies even more data can be collected through a single project, protecting the bodies from future multiple examinations, which may cause damage. The physical anthropologist is then responsible for the collection of data from the specialist analyses and combining that data with the information collected from archival studies and physical examinations in order to place the bodies in the appropriate archaeological context. This research required the assistance of several specialists to ensure that the greatest amount of data possible was collected with a minimum amount of physical disturbance of the somewhat fragile remains.

Aufderheide (2003) identifies three categories of mummy study methodology: morphology-based, physical and biochemical. Morphology-based methods are dissection and palaeohistology. Physical methods may be radiographic or endoscopic. Biomolecular methods include DNA, amino acid racemization and mass spectrometry. These methods, and their applications in mummy studies, are clearly defined by Aufderheide (2003). Only radiographic and some biomolecular methods were possible within the scope of this research. Since invasive analysis and destructive sampling were either not permitted or severely restricted, there was no possibility of undertaking any morphology-based methods. Imaging methods were of paramount importance. Some biomolecular testing, specifically, stable isotope analysis, trace element analyses and ancient DNA, was possible. This chapter discusses the methods used during this research.

METRIC ASSESSMENT

Soft tissue

There are no prescribed standards for measurements of mummified human remains and it is recognized that the reproducibility of external measurements of mummies is limited (Aufderheide 2003) because each mummy is a unique case. Seldom will two mummies be preserved in exactly the same condition. Furthermore, unlike osteological metric assessment, standardized landmarks for reference have not been defined. "[A]nthropometrics cannot be fully recommended due to the fragility of the dried bog corpses on the one hand and the uncertainty of the reconstruction on the other, because the degree of shrinkage of the bones caused by the acid bog environment always remains an unknown factor" (Pieper 2003:110). All of the bodies in this collection that had remaining soft tissue were measured for maximum length, width and thickness, except the Dätgen Man. The condition of the Dätgen Man was such that there is a substantial risk of damage to the soft tissue with the slightest movement. In order to protect the body, no measurements were taken from the body. For the other bodies, points for specific measurement, for example maximum length of the foot, were identified and measured using a soft plastic-coated seamstress measuring tape. The plastic coating assisted in preventing the tape from stretching and rendering measurements incomparable. The approximate location of each of the individual measurements was noted, but it may be difficult to replicate the exact location of specific points, due to the lack of available standardized points. No measurements from any of the bodies were taken from radiographs due to the high degree of distortion in the X-rays. This was due to body angle, and image artifacts that made it virtually impossible to identify and accurately

measure skeletal features. The maximum femur length of Dätgen, however, was calculated using the MSCT scan images, in order to allow for an estimation of stature.

Osteometrics

In the cases of the Windeby I adolescent, Osterby skull and the Kühsen skeleton, standard osteometric analyses were possible. All measurements were taken with spreading or sliding callipers following the guidelines of Buikstra and Ubelaker (1994). An osteometric board was not available and a modified form of an osteometric board was created with pieces of wood, a measuring tape and grid paper.

The Osterby skull had virtually no soft tissue remaining, although the hair had been replaced over the bone. Although may of the standard skull measurements were possible, the presence of the hair prevented some data collection. The skull had been severely crushed in the peat and following excavation the cranium was reconstructed. The reconstruction of the skull may have affected the original shape. Since the skull was substantially reconstructed prior to display, the interpretation of the craniometric data is dubious, as the cranium as it currently exists is likely different from its original shape due to taphonomic and conservation processes.

Most of the bones, with the exception of the left scapula and clavicle and several ribs on both the left and right sides, had been removed from the body of the Windeby child during the conservation of the body for museum display. Standard osteometric assessment could be conducted on the complete skull with mandible as well as all long bones, most vertebrae and several hand phalanges. Full osteometric assessment of the nearly complete

bog skeleton from Kühsen was also completed using standard methods. Although some osteological material was visible and accessible on the Dätgen body, the body was too fragile for traditional methods of measurement. Most bones had at least partial soft tissue coverage, which prevented full and accurate osteometric assessment. Damendorf and Windeby II did not have enough skeletal material remaining for osteometric assessment.

NON-METRIC ASSESSMENT

Non-metric assessment was conducted with direct visual observation, often with the aid of a magnifying glass. An effort was made to identify non-metric diagnostic traits for age, sex and palaeopathology, where possible. For example, the presence of visible genitalia provided absolute indicators of sex.

Table 3 shows the morphological traits assessed for the determination of sex for each body in this collection. Where genitalia were visible, this was taken as definitive evidence of sex. This method of sex assessment was possible for Rendswühren, Damendorf and Dätgen.

Where no genitalia were preserved, skeletal morphological assessment was undertaken. This method was used for Osterby, Windeby I and Kühsen. Two areas of the skeleton

Method	Rendswühren	Damendorf	Osterby	Windeby I	Windeby II	Dätgen	Kühsen	Reference
Soft tissue observation	YES	YES	NO	NO	NO	YES	NO	
Cranial morphology:								
Nuchal crest	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Mastoid process	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Supraorbital margin	NO	NO	YES	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Glabella prominence	NO	NO	YES	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Mental eminence	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Orbits	NO	NO	YES	YES	NO	NO	YES	WEA 1980
Mandibular condyle	NO	NO	YES	YES	NO	NO	YES	Schwartz 1995
Os Coxae morphology:								
Pelvic aperture	NO	NO	NO	YES	NO	NO	YES	WEA 1980
Obturator foramen	NO	NO	NO	YES	NO	NO	YES	WEA 1980
Ventral arc	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Subpubic concavity	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Ischiopubic ramus ridge	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Greater sciatic notch	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994
Preauricular sulcus	NO	NO	NO	YES	NO	NO	YES	Buikstra & Ubelaker 1994

Table 3: Methods used for determination of sex

were used for sex determination: the skull and the *os coxae*. On the skull, seven traits were assessed for degree of expression. Assessment of five traits was based on the guidelines of Buikstra and Ubelaker (1994): the nuchal crest, the mastoid process, the supraorbital margin, the prominence of the glabella and the mental eminence. All features were rated on a five-point scale, with lower scores representing feminine features (Buikstra and Ubelaker 1994). Two other features were also used in the determination of sex: the shape of the orbits and the mandibular condyle. Based on the features suggested by The Workshop for European Anthropologists (WEA 1980), orbits that are "round with a very sharp border" (WEA 1980:523) are indicative of a female. Orbits that are "quadrangular and very rounded" (WEA 1980:523) are indicative of a male. Finally, the mandibular condyle is smaller in females and larger in males (Schwartz 1995:280).

Seven traits were also assessed on the *os coxae*. The pelvic aperture and obturator foramen were assessed based on criteria from the Workshop of European Anthropologists (WEA 1980). A pelvic opening that is "very broad and oval" (WEA 1980:518) is indicative of a female, while the male is "very narrow and heartshaped" (WEA 1980:518). On a typically female pelvis, the obturator foramen will normally be triangular in shape, wide and have sharp edges (WEA 1980:518). A typically male obturator foramen will have rounder edges and be more oval in shape (WEA 1980:518). Five traits were assessed based on the guidelines of Buikstra and Ubelaker (1995). These traits were: the ventral arc, the subpubic concavity, the ischiopubic ramus ridge, the greater sciatic notch and the preauricular sulcus. Based on the Phenice technique, the ventral arc, subpubic concavity and ischopubic ramus ridge were scored on a scale of "unobservable, 1=female, 2=ambigious, 3=male" (Buikstra and Ubelaker 1994:16). Of

these three features, the ventral arc is considered to be the most reliable. The greater sciatic notch was scored on a scale of 1 to 5, with figures of 1 and 2 indicating female and figures of 4 and 5 indicating male. The preauricular sulcus was scored from 1 to 4 based on the width and depth of the trait. It is believed that the preauricular sulcus is more common in females than males and a higher score is more indicative of a female (Buikstra and Ubelaker 1994:18).

Table 4 shows the morphological traits assessed for estimation of age for each individual in this collection. These methods could only be applied where appropriate skeletal material was present and visible for analysis and could not be attempted with Rendswühren, Damendorf or Windeby II. Traits were assessed on two areas of the skeleton: the cranium and the post-cranial skeleton. Where dentition was available, the eruption of the dentition was noted as an indicator of age. Several diagrammatic representations exist for comparison of dental eruption (see Ubelaker 1989:65), and these were used for guidance in this research. Suture closure was observed where unaltered cranial sutures were visible. Although this method is not flawless, it can provide an estimate of age on the basis of the degree of closure of specific sutures and meeting points. This research followed the guidelines of Buikstra and Ubelaker (1994) and recorded "10 ectocranial, 4 palatal and 3 endocranial locations" (Buikstra and Ubelaker 1994:32) for age determination. The sutures and points were scored on a scale of 0 (open) to 3 (complete obliteration), where possible (Buikstra and Ubelaker 1994, 32).

On the post-cranial skeleton, the state of ephiphyseal fusion was assessed and age estimations calculated based on the guidelines in the Workshop of European

Method	Rendswühren	Damendorf	Osterby	Windeby I	Windeby II	Dätgen	Kühsen	Reference
Cranial traits:								
Dental eruption	NO	NO	NO	YES	NO	NO	YES	Ubelaker 1989
Cranial suture closure	NO	NO	NO	YES	NO	NO	YES	Buikstra and Ubelaker 1994
Post-cranial traits:								
Epiphyseal fusion	NO	NO	NO	YES	NO	SOME	YES	WEA 1980
Public symphysis	NO	NO	NO	YES	NO	NO	YES	WEA 1980
Sternal rib ends	NO	NO	NO	YES	NO	YES	YES	İşcan and Loth 1989

Table 4: Methods used for estimation of age

Anthropologists (WEA 1980), Ubelaker (1989:70-71) and Buikstra and Ubelaker (1994:43).All points where epiphyseal fusion could be assessed were examined and data recorded. Pubic symphyses were also examined for Windeby I and Kühsen in order to estimate age. Age-related change is visible in the texture of the pubic symphysis. Assessment based on the Todd system defines the first stage as characterized by well-defined ridges and margins, while the last stage is characterized by erosion of both the surface and the margins (İşcan and Loth 1989). Finally, the sternal rib ends of the third, fourth and fifth ribs are also suitable for estimation of age. The ribs were scored in phases from 0 to 8, with the lowest scores representing the youngest age, based on the shape and surface of the rib end (İşcan and Loth 1989). This method was applied to the Windeby I, Kühsen and Dätgen bodies.

It has recently been suggested that the greater sciatic notch depth, the greater sciatic notch angle and the mandibular arcade shape may be considered accurate for determining the sex of sub-adults from 6 to 15 years of age (Sutter 2003). This may be an appropriate approach for the sex assessment of the Windeby adolescent. Sutter (2003) tested the accuracy of nine previously identified non-metrics traits used for the sexing of subadults on a collection of 85 subadult mummies from the Atacama Desert in northern Chile. All of the subjects were of known sex, determined on the basis of the observation of external and internal genitalia during autopsies conducted in the 1980s by a team of qualified pathologists; all subjects had a skeletal age "between newborn and 15 skeletal years" (Sutter 2003:928). During the study, 8 skeletal traits of the pelvis and mandible were identified and each scored "from weakest to strongest expression" (Sutter 2003:928) on a scale of 1 to 5. Traits scoring one or two were classed as "very male" and "male",

respectively. Traits scoring five and four were classed as "very female" and "female" respectively. Scores of three were indeterminate (Sutter 2003:929). Results indicated that "...sex-related character states are more often associated among subadults older than 1 year of skeletal age and more commonly among traits of the ilia than the mandible (Sutter 2003:929). Three skeletal features that met minimum criteria (75% accuracy) for sex determination were: greater sciatic notch depth, the greater sciatic notch angle and the mandibular arcade shape. These traits were specifically assessed on the Windeby I skeleton, using the methodology of Sutter (2003), in an attempt to clarify the determination of sex. Using this method, when the angle of the sciatic notch is greater than 90°, the individual is classed as female; an angle around 90° is classed as male (Sutter 2003). The interval scale of 1 through 5 is used to score the angle, as discussed above. For the second criterion, when the sciatic notch is deeper, the individual is classed as male. When evaluating the mandibular arcade, females will have a more rounded shape, while the male mandibular arcade is more rectangular (Sutter 2003:929).

IMAGING

Digital X-ray

The Schloss Gottorf in-house digital X-ray system was used to examine several items to determine whether further analyses were necessary. Approximately 2 m of intestines from the Dätgen body were surveyed to see if there were any remaining contents. The sternum and manubrium from the same body, which are stored with the intestines, were also briefly examined. A large piece of skin measuring approximately 20 cm by 10 cm was examined to determine whether or not there was skeletal material within, since several pieces of leather that had obviously been used as textiles were also found with this

item. A single horse bone, the only animal bone recovered from a peat bog that could be located in the museum storage unit, was X-rayed for general comparison with the human skeletal material. Since these images were purely for "exploratory" purposes, none of these images were transferred to plain film or electronic storage media for retention.

A brief examination of the bog skeleton from the Kühsen site indicated that this material was well preserved and warranted detailed digital X-rays, particularly of long bones, that could not be taken in-house. The decision was made to transport this skeleton to the Institute for Diagnostic Radiology at the Kiel University Clinic for further imaging. At Kiel the skeleton was imaged using the Kodak Directview DR 9000 digital radiology system.

The entire Rendswühren male and Damendorf male, as well as the pelvis and femora of the Dätgen male, were imaged using digital X-ray. The images were also taken using the Kodak Directview DR 9000 at Institute for Diagnostic Radiology in Kiel.

No film is used in digital radiographs; the images are saved electronically and can be printed onto film, producing images that are similar to those of plain film radiography. There are several advantages to digital radiography. One key benefit is the ability to adjust the contrast and density of the image on the computer monitor while viewing the images in order to achieve the best possible picture for analysis. In the case of the bog bodies, it is not always easy to distinguish structures that may be obvious on radiographs of ordinary skeletal material. The high degree of demineralization of bog body bone and the occasional mineralisation of soft tissue structures necessitates careful manipulation of

contrast and density to ensure accuracy in recognition and interpretation. Other benefits of digital radiology for imaging bog bodies include the ability to store large quantities of images on CD or DVD for long-term archiving purposes, the opportunity to view images immediately and re-take substandard images, the ability to selectively print specific relevant images for publication or further analyses and the portability of the images for consultation with other physical anthropologists or radiologists.

CT scanning

The entire bodies of the Rendswühren male, the Damendorf male and the Dätgen male, as well as the Osterby cranium and mandible, the Windeby I cranium, mandible and pelvis and the Kühsen cranium, mandible and pelvis were imaged using Multislice Computed Tomography (MSCT) for this research. All bodies were scanned using the Siemens Somatom Sensation 16 MSCT unit at the Institute for Diagnostic Radiology at the Kiel University Clinic.

Although MSCT scanners, also known as multislice helical computed tomographic scanners, were first used in 1998 (Cody et al. 2002), their application to bog bodies is very recent. MSCT scanners are designed to "...allow simultaneous acquisition of multiple images in the scan plane with one rotation of the X-ray tube about the patient" (Cody 2002:1). The bog bodies were placed on the standard bed and slid into the gantry during the scan. The data acquired by MSCT are three-dimensional and, therefore, allow easy three-dimensional reconstruction of the images. The data are scanned into "raw data" files, in the case of the bog bodies as DICOM (Digital Imaging and Communications in Medicine) files, and must then be processed to three-dimensional in

an appropriate computer software program. Two sets of data files were recorded for the bog bodies – hard kernel and soft kernel. Both represent different levels of algorithms used to refine the images. The soft kernel data were recommended by the radiologist who conducted the scan, Dr. Hendrick Bolte, for smooth and even three-dimensional reconstruction, while the hard kernel data would allow for more detailed investigation of specific individual structures.

The entire Rendswühren body was scanned feet first at 0.75 mm intervals, resulting in over 2500 images (slices). During conservation the head had been partially remodelled with iron wires and bars and these caused substantial artifacts during imaging. As a result, the head was scanned separately at a different intensity in order to maximise the quality of the image obtained. This scan produced approximately 430 slices. Although the body was scanned on its display base, there were few imaging artifacts derived from the base.

The Damendorf body was scanned feet first at 0.75 mm intervals, resulting in 2218 slices. This body is very flat and has been partially mounted to its base. There were numerous metal pins, tacks, nails and screws holding the body in place. There were, however, few artifacts caused by these small objects during the imaging.

The Dätgen body is partially disarticulated and was scanned in two parts, resting on the wooden bases used to transport the body. The first scan included the scant remains of the head, as well as the thorax, left arm including the hand and right shoulder and humerus. The second scan included the pelvis, legs and feet. The data from the pelvis and femora

were saved as a separate data file from those of the lower legs and feet. In total, the scan resulted in approximately 1860 slices.

The Osterby cranium and mandible are fixed and were scanned as a single unit, resting in the head cradle of the scanner. The scan generated approximately 400 slices in total. The entire cranium was filled with plaster during the reconstruction of the skull and this caused substantial problems during the imaging. The plaster resulted in a halo-effect around the skull in the images, which needed to be eliminated during the post-processing.

The cranium and mandible of Windeby I were also scanned resting in the head cradle of the scanner. This skull is intact and well-preserved and provided excellent quality images with no artifacts. Approximately 400 slices were generated. The pelvis of Windeby I was also scanned to allow physical three-dimensional reconstruction of the pelvis for later examinations.

The skull of the Kühsen bog skeleton was also MSCT scanned as approximately 420 slices for both archive purposes and for future facial reconstruction projects. The pelvis was also scanned.

Three-dimensional reconstruction

The MSCT scans were used for three-dimensional reconstruction of selected areas. For example, in order to determine if the reported fractures on several of the long bones on the right side of the Dätgen body were antemortem or the result of taphonomic change, these long bones were reconstructed and examined.

The raw data in the form of TIFF files were converted to DICOM files at the point of imaging in Kiel. All files used for three-dimensional virtual and physical reconstruction were DICOM files. The images were imported into Mimics medical imaging software from Materialise Software. Mimics allowed the examination and editing of CT slices to remove visual artifacts caused by metal and other elements of interference during the scans. Once the visual artifacts were removed, the bodies could be reconstructed in three dimensions. Use of the "pseudocolors" feature in Mimics allowed easier distinction of bone from soft tissue and enabled easier visualization of artifacts to be removed. The editing and reconstruction process is both laborious and highly time intensive. Hundreds of hours of editing may be needed to remove artifacts or soft tissue in order to provide a clear three-dimensional reconstruction. For example, before reconstruction of any part of the Rendswühren body could be undertaken, it was necessary to remove, from each individual CT slice, the display board on which the body had been imaged. Although this is not a difficult process, it is time consuming. Approximately 10 hours of editing was necessary for this first step. Although a segmentation algorithm exists within the Mimics software, this algorithm was designed to work with medical imaging of living humans. The skeletal material of the bog bodies displayed varying degrees of demineralization and the soft tissue had become desiccated. It was, at times, very difficult to identify differences in density between some soft tissues, areas of bone and other structures, including the wood on which the body rested for imaging. The use of RapidForm reverse engineering software enabled the removal of some artifacts, for example the bases on which the bodies rested, to be edited out in layers, thus allowing areas with which the body did not have direct contact to be removed quickly and efficiently. Where the body

touched the board, more cautious editing was required. RapidForm also allowed the virtual three-dimensional models created in Mimics to be viewed in cross-section, at any angle, making aspects of the body more visible and permitting more accurate interpretation.

Specific parts, such as the individual bones of the Dätgen body discussed above or the pelvis of the Windeby I body, were of sufficient interest to warrant additional physical examination after leaving the museum. Images from the MSCT scans could then be rendered into 3D models and exported in stereolithography (STL) file format to allow for rapid prototyping of the object. The object, such as a bone, was created in three dimensions using Mimics. Soft tissue was then removed or otherwise edited using RapidForm and the virtual model exported to proprietary software for the physical model to be created using a binder-jet system. The three-dimensional printer that was used in this research, a Z-Corporation Z406 3D printer, had the ability to produce models in either monochrome or multicolour, although none of the models in this research were reproduced in colour. Following creation and editing, the object was sent from the computer to the printer. To generate the model, a layer of plaster was laid down, followed by a layer of binder. This process was repeated until the entire three-dimensional object was created. The object was then removed from the printer chamber and loose plaster removed from the model. The model could then be infiltrated with a resin for stability and coated with a wax for a shiny appearance, particular when intended for extensive handling or display. When the model was created to scale, it was an exact replica of the original bone and could accurately be used for osteometric and morphological assessment without the need to refer to the original.

Holography

To provide an additional aspect of three-dimensional reconstruction, a white-light hologram of the Windeby I skull was created at the Centre of Advanced European Studies and Research (CAESAR) in Bonn. In the summer of 2002 CAESAR created the first hologram of a bog body from the Landesmuseum Natur und Mensch in Oldenburg, Germany. This was the first use of this holographic system in archaeology (Frey et al. 2003). The Windeby skull was an appropriate choice for this procedure since it was easily transported to CAESAR and when displayed at the museum beside the soft tissue bog body it would provide an additional aspect of the body for visitors, as well as providing a high-quality three-dimensional reproduction suitable for permanent documentation or display of the skull.

A hologram is a "...high resolution optical reproduction of a recorded light field in three dimension" (Frey et al. 2003:194). In the case of the Windeby child, the skull was placed on a platform draped in black cloth, approximately 50 cm from the holographic camera. The camera, a Geola GP-2J, uses a single laser pulse of 30 nanoseconds with maximum pulse energy of 2 joules. The laser beam is in three segments; two illuminate the object being recorded evenly, while the third is routed over ceiling-mounted mirrors to record the object. The hologram is recorded on a plate coated with a Slavich VRP-M photographic emulsion, similar to that on photographic papers, which is chemically developed and bleached (Frey et al. 2003). The final holographic image is approximately 30 cm by 40 cm with 10 micrometer resolution. When illuminated the object is reproduced at full-scale. The image is illuminated with a standard white light. The

hologram process not only produces an impressive image for display, it records a substantial amount of visual data in an accurate, three-dimensional full-scale format (Frey et al. 2003).

Photography

All of the bodies were photographed using basic digital photography and standard 35 mm colour negative film photography. Digital photography was done with a Hewlett-Packard HP Photosmart 812, with mini-tripod as required. All 35 mm photographs were taken with a Nikon F60 camera with a Vivitar flash unit and Cullman tripod using Agfa or Fuji colour film. The 35 mm photos were also recorded in digital form as jpeg files during processing. Copies of all photographs were given to the Archaeologisches Landesmuseum for archive purposes. Both digital and 35 mm photographs were provided both on CD and as hard copies.

INVASIVE ANALYSES

Stable isotope analysis (hair)

Dr. Andrew Wilson of the Department of Archaeological Sciences at Bradford University, United Kingdom, requested hair samples from the Schloss Gottorf bog bodies as part of a larger programme of stable isotope analysis of bog body hair. Approximately 12 hairs each from the Windeby I, Damendorf, Osterby and Dätgen bodies were extracted from the scalp. These hairs were placed in glass vials provided by Dr. Wilson and sent to Bradford by courier for analysis.

Trace element analysis (hair)

Dr. Norman Halden of the Department of Geological Sciences at the University of Manitoba performed trace element analysis of the hair using a laser ablation technique. A single hair from the Windeby I, Damendorf, Osterby and Dätgen bodies was cut into three or four pieces, depending on the length of the hair, and mounted using 100 parts Buehler Epo-Thin Low Viscosity Epoxy Resin (No. 20-8140-032) and 36 parts Buehler Epo-Thin Low Viscosity Epoxy hardener (No. 20-8142-064) on a microscope slide for insertion into the laser unit.

Laser ablation, formally known as "Laser Ablation – Inductively Coupled Plasma – Mass Spectrometry" or LA-ICP-MS, "introduces the sample to a high-temperature plasma … which dissociates molecules and ionizes atoms" (Neal et al. 1995:28). Argon gas was used with these hair samples. Once the ions have been scattered they pass through a vacuum and are sorted by the ion beam of a mass spectrometer. It is then possible to identify the specific elements once they have been sorted (Neal et al.1995).

The bog body hair samples were put through a Merchantek LUV 213 Laser Ablation Micrcoprobe (LAM) unit with an Element 2 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). Each scan was approximately 1.098 seconds with 5 nanosecond pulses. The total data acquisition consisted of approximately 10 to 20 seconds for gas blank followed by a 20 to 60 second ablation of the sample with a concluding gas blank. The following isotopes were tested for their possible presence in one of more of the bog body hair samples: ^{44}Ca, ^{63}Cu, ^{64}Zn, ^{75}As, ^{112}Cd, ^{202}Hg and ^{208}Pb. Unfortunately, samples of the peat excavation sites are not available to provide a baseline comparison to the

composition of the surrounding environment. There is some level of comparison possible between the samples from the four bodies.

DNA analysis

A single finger phalange of the Windeby child had been selected for DNA analysis at a specific institution approximately two years ago. This study was not done and the sample was returned to the museum at the request of Dr. Ingrid Ullbricht, who is responsible for the organic storage area of the Archaeologiches Landesmuseum. When the sample was originally selected it was placed in a sealed plastic bag. At the decision to send this sample to Canada for DNA analysis, the plastic bag containing the sample was then packed into a film canister and shipped by courier.

The sample was sent to Dr. Carney Matheson of the Paleo-DNA Laboratory at Lakehead University for polymerase chain reaction (PCR) analysis in an attempt to determine the sex of the individual. Using the PCR method a small amount of genetic material can be amplified using enzymes to obtain additional information. First, the DNA is separated into single strands through denaturation. In the second phase, annealing, the selected primers bond at the appropriate recognition sites on the DNA strands. In the final phase, elongation, the DNA polymerase constructs nucleotide base connections. This cycle is then repeated to further amplify the DNA (Hummel 2003). As discussed in Chapter 3, the ability to successfully amplify DNA from a peat bog body is a recent innovation. The acidity of the bog causes substantial inhibition during the PCR process and special protocols to address the issue of inhibition were developed at the Palaeo-DNA Laboratory.

The purpose of the DNA test in this research was to attempt to confirm the sex of the Windeby I adolescent. Specific DNA sections with known sex-specific markers were targeted for amplification in order to identify the XX (female) or XY (male). A very high level of sensitivity was required to determine the presence of a second X or a Y. In these tests the absence of a Y in initial runs would not conclusively indicate female. Only the presence of XX or XY would allow a definitive sex to be assigned.

Palaeoparasitology

Samples of the scalp hair from four bodies were sent to Dr. Patrick Horne of the University of Toronto for palaeoparasitological examination. The hair was plucked from the scalp of each of the bodies at the same time as samples for stable isotope and trace element analyses were extracted. No more than 20 single hairs were extracted from any one individual body and approximately five to eight hairs from each body were sent to Dr. Horne. All of the hairs sent to Dr. Horne were examined using a Leica DMLS microscope at 40x magnification using normal transmitted light.

SUMMARY

Through analysis of both the relevant documentation stored in the museum archives and the physical remains of the bog bodies, it will be possible to draw conclusions about the seven individuals in this research. Several supplementary analyses were arranged, as is common in mummy studies, to provide additional specialist data about each individual. This chapter presented an overview of the methods used to analyze and interpret the Schloss Gottorf bog bodies, both in the library and in the laboratory.

CHAPTER 7
RENDSWÜHREN

INTRODUCTION

The first bog body in the Archaeologisches Landesmuseum collection to be excavated is known as "Rendswühren Man". Although discovered and examined in 1871, no further analyses had been undertaken on this body prior to this research. This chapter is a complete overview of the Rendswühren Man from the time of his discovery to the present, including the results of analyses undertaken on this body during this research.

PREVIOUSLY PUBLISHED ANALYSES

There are very few publications that present the results of previous analyses on the Rendswühren Man. A single journal publication from 1871, the year the body was found, exists (Virchow 1871). This report is the only academic publication detailing the discovery, excavation and early examinations of the body. The article is not well known; it has not been cited in any other published or unpublished work related to bog bodies, including a recent German Master's thesis that thoroughly documents the bog bodies of Schleswig-Holstein (von Haugwitz 1993). The reference was located during the author's recent search of the archival material for this body; a copy of the article was found buried within other documents.

The results of radiocarbon dating of textiles associated with this body were presented, along with the dates for several other bog bodies or associated artifacts, as part of a 1995 article by van der Sanden (van der Sanden 1995b). The textile was dated at the Groningen

C14 Laboratory in the Netherlands in 1995. The resulting date was for the sample (GrA-1346 Rendswühren) was 1960 ± 50 BP (van der Sanden 1995b), the Early Roman Iron Age in northern Europe. Recently, several other dates from additional samples were published. Calibrated radiocarbon dates were provided for three skin samples. It is not clear where those samples were taken from. The dates were: A.D. 425-535 (GrA-10195), A.D. 360-365 and A.D. 385-430 (GrA-14306) and A.D. 135-255 and A.D. 305-315 (GrA-14313) (van der Plicht et al. 2004:478). All dates were calibrated to 1σ. Additional information on sample preparation was also provided for the three skin samples and the earlier textile sample. The textile sample GrA-1346 was reported as A.D. 20-120 in the most recent publication (van der Plicht et al. 2004:478). These dates, and their interpretation, will be discussed in more detail in Chapter 13.

One unpublished Master's thesis from Hamburg University documents all of the bog bodies from Schleswig-Holstein in a catalogue, including the Rendswühren body (von Haugwitz 1993). Several general bog body publications include brief reports of the Rendswühren body (eg. Glob 1969, Lund 2002, van der Sanden 1996 and see Appendix C for a complete list). These reports seldom include more than a basic description of the body and the circumstances of its discovery.

THE 2003-2004 RESEARCH

Data obtained from the archives

Discovery and excavation

On June 1, 1871, a human corpse was discovered face down (Möller 1871) in the peat of the "Renswührener Moor" (sic), Kreis Kiel at a depth of three feet[1] (Handelmann 1871a). The peat had a total depth of between four (Handelmann 1871b) and six feet (Möller 1871). The body was identified as a male, five foot, ten inches long (Anonymous 1871, Handelmann 1871a). The body was found with the head about one foot deeper than the feet and with the head to the east and the feet to the west (Handelmann 1871b). Another report stated that the head was to the south (Handelmann 1871a). A third report indicated that the head was oriented southeast and the feet northwest (Möller 1871). It is, therefore, unclear in which direction the body laid. The orientation of bog bodies is inconsistent so confirmation of the actual direction of the body is not relevant to the interpretation of this corpse. The right foot was crossed over the left. The arms and hands were outstretched directly under the chest and abdomen (Möller 1871).

When first seen by museum personnel the body had been removed from the peat and was lying on a cart in a barn near the village (Anonymous 1871, Handelmann 1871a). Fragments of animal skin and wool clothing were next to the body (Handelmann 1871a),

[1] Although the measurements from the archives are provided in feet and inches, these are old forms of the measurements and do not correspond to modern use of imperial measurement. According to the research librarian at the Main Library at the University of Kiel, Frauke Michel-Grohmann, there have been more than 100 different lengths for "*fuss*" (foot). It is unknown exactly what the conversion is between the old system and modern systems of measurement since the measurements were regionally based and not standardized between different areas until the end of the 19th century, after the discovery of Rendswühren Man. The equivalencies for "*fuss*" (foot) seem to have varied from 25 cm to 34 cm, although it is possible that other measurements also existed.

but there were no worms or maggots present on or around the body (Anonymous 1871). Peat clung to the skin all over the body and it was somewhat difficult to remove the plant matter from the skin (Anonymous 1871). It is also reported that an upper limb bone from a horse was found nearby (Handelmann 1871b).

External examination

Dr. Hansen of Neumünster and Dr. Kaestner from Bordesholm conducted a physical examination and autopsy (Handelmann 1871d). The skin of the body was dark black-brown, like tanned leather and without clothing. One report says that the skin was like "parchment" (Anonymous 1871) while the muscles of the entire body were described as "wasted" (Anonymous 1871). It was reported that the skin had been blackened by "bitumen" acid (Anonymous 1871). The body, as a whole, was described as being of medium build with a delicate frame (Handelmann 1871a).

On the back of both upper arms were large pieces of peat with felt-like material from plant remains that could not be separated from the skin. The plant remains had penetrated the skin in the area of the lumbar vertebrae and into the abdominal cavity (Handelmann 1871a).

Some hair, cut to about two inches in length (Möller 1871), remained on the scalp; it was brown in colour from immersion in the peat (Handelmann 1871c). An injury to the right temporal bone was identified (Handelmann 1871a, Plessen 1871). The excavation and movement of the body caused the detachment of the mandible, which was found in two pieces (Anonymous 1871), and the nasal spine. Both eyelids were closed (Möller 1871).

The eyelid, sclera and cornea of the right eye were all present but only the eyelid was present in the left eye (Anonymous 1871). There was a delicate perforation in the middle of the eye (Handelmann 1871a). Both ears were present (Möller 1871). All 32 teeth were recorded as being present (Anonymous 1871), but were dark in colour and rubbery (Handelmann 1871a). The teeth were used to determine the man had been around 30 years of age at the time of his death (Mielck 1871). The tongue was preserved and lay in the area where the maxilla would have been in the middle of both maxillary joints (Handelmann 1871a).

The muscles from the clavicles and sternum to the larynx were gone. The skin from the sternum and clavicles had moved and was a thin layer over the windpipe (Handelmann 1871a). The clavicles had moved towards the sternum and rose out of the chest slightly. Both the detached sternum (Anonymous 1871) and windpipe were in an area of open skin and it was possible to see into thoracic area (Handelmann 1871a). Several ribs were loose or detached (Anonymous 1871). The chest and abdomen were both sunken but covered with the leather-like skin and the curve of the ribs was visible (Handelmann 1871a). There were no noticeable abnormalities observed during external examination of the abdomen (Anonymous 1871). The genitals were preserved. The right testicle was visible but the left was not identified (Handelmann 1871a).

The extremities were flexible and mainly covered with the dark brown skin. The skin over the hand and finger phalanges was broken and neither the radius nor the ulna was encased in skin (Handelmann 1871a). Although the left metatarsals and phalanges were missing, both of the hands and both feet were well proportioned (Handelmann 1871a). It

is unknown whether the left metatarsals and phalanges were in the peat but not recovered (Handelmann 1871a), but it has been reported the peat spade caused the damage to the left foot (Anonymous 1871).

Internal examination

A triangle-shaped injury measuring about 1 inch was identified over the nasal bone. Pieces of the frontal bone were loose. There was also a star-shaped fracture with radiating fissures on the under side of the right orbit through to the temporal bone, which may have been caused by a blow to the face (Handelmann 1871a, Plessen 1871). The right parietal bone was completely shattered (Plessen 1871). The temporal and parietal bones were damaged by a blow to the head which seems to have come from the right side of the head towards the left side and would have caused the other injuries to skull (Handelmann 1871a).

All of the skull bones were dark black-brown in colour, thin and brittle (Handelmann 1871a). An attempt was made to restore the skull to its original shape, including the brain and skin. Although the reconstruction was believed to be good, the researchers thought that it was likely that the original skull shape was more rounded than the reconstruction, that the man had a shorter forehead and that the back of the head should have been slightly flatter (Handelmann 1871a).

The *dura mater* was hard, but otherwise well preserved, with no fluid apparent. There was a noticeable yellow mass about the size of a pea. Although hard and solid, the *dura mater* was even and smooth; there were no other masses visible (Handelmann 1871a,

Plessen 1871). At the division between the *dura mater* and the arachnoid layer the hardened *dura mater* showed evidence of a possible haematoma. The brain itself was coffee-brown in colour and with the consistency of ordinary pottery clay (Handelmann 1871a). After examination the brain was preserved as a sample for the anatomical museum (Handelmann 1871a). The name and location of the museum to which the brain was sent is not listed in the archive records.

The chest cavity was examined through a long cut down to the diaphragm. The spinal column had formed an arch in the chest cavity, causing the vertebrae to separate (Handelmann 1871a). Within the rib cage were two flattened black spongy masses about the size of a hand, identified as the lungs (Anonymous 1871). On the left side, near the middle, was a sack-like bit of skin. This piece of skin was identified as the heart sac. Within the heart sac, the heart muscle was preserved; the ventricular openings to the veins (*ostium ventriculi venosum*) and arteries (*arteriosum*) were clearly visible and the *Chordae tendinae* (connective tissue between the valves and the muscle of the heart ventricles) were also preserved (Handelmann 1871a). All of the organs had been coloured dark brown by the peat (Anonymous 1871). Further investigations of these internal structures were not conducted and the organs were left *in situ* (Handelmann 1871a).

The examination of the abdominal cavity was conducted through the same incision as the examination of the chest cavity, although the incision was lengthened at that stage. It was determined where the liver lay within the abdomen and that the diaphragm was thickened and shrunken to about the size of a child's hand (Handelmann 1871a). The intestines and

stomach were located to the right of the vertebral column in the abdominal area. The pelvis was empty except for the bladder (Handelmann 1871a).

The clothing and textiles

Pieces of a vest and tunic lay beside the body. The clothes were made from wool and had become dark brown during their immersion in the peat. The fabric was hemmed with a long thread and was similar to fabric recovered from another bog in the area – the Süderbaruper Moor, near Schleswig. The fabric was believed to be "very old" (Handelmann 1871a). The tunic was sleeveless but had armholes. The woolen fabric was coarse. Originally the textile had been 4.5 feet long by 3 feet wide (Möller 1871).

The animal pelt seemed to be from sheep, calf and wild animal skins stitched together to form a fine strap. The tunic was fragmented. Both the animal skins and wool clothing were patched and repaired, which was common at the time (Handelmann 1871a).

The investigators noted that no buttons, hat, stockings or shoes were discovered (Möller 1871). The left ankle from the heel to the malleolus was wrapped in a cuff made from cowhide, the rough side of which was turned inwards, as if it were a stirrup (Handelmann 1871a). The width of the leather piece from malleolus tibiae to malleolus fibulae was 20 cm (Handelmann 1871a, Möller 1871). An additional note in the archives, lists the acquisition of a piece of brown textile, 18 cm long by 4 cm wide. The textile piece was purchased from an individual in Berlin on 6.3.1961. It appears that the textile was originally found with the bog body, but the lack of specific provenience prevents interpretation of the original function of the fabric (Anonymous 1973).

Additional information

It was the opinion of the medical experts that conducted the autopsy in 1871 that clearly that there was a connection between the head injury and the sequence of events that lead to the deposition of the man in the bog (Handelmann 1871a). It was also concluded that they could not determine when the man had been deposited in the bog since the normal rate of decomposition had clearly been affected by the influence of the peat (Handelmann 1871a). Speculations by the experts at the time concluded that the body could have lain there for "a thousand years" (Mielck 1871). It was suggested the man had been the victim of a murder since his feet had been bound and he was hidden in the bog. It was also believed that a pole had been put across the back of the man (Möller 1871), although there is no report of a pole found with the body. The man was described as something of "exceptional beauty and great value" (Möller 1871) by one investigator.

The body from Rendswühren was the first bog body in northern Europe to be photographed, shortly after his discovery. A single photograph of the body standing upright, with the assistance of supports, was taken (see Figure 16). The body position in the photograph has been referred to as a "ballerina pose" because the man appears to be standing on his toes (Lund 2002, van der Sanden 1996).

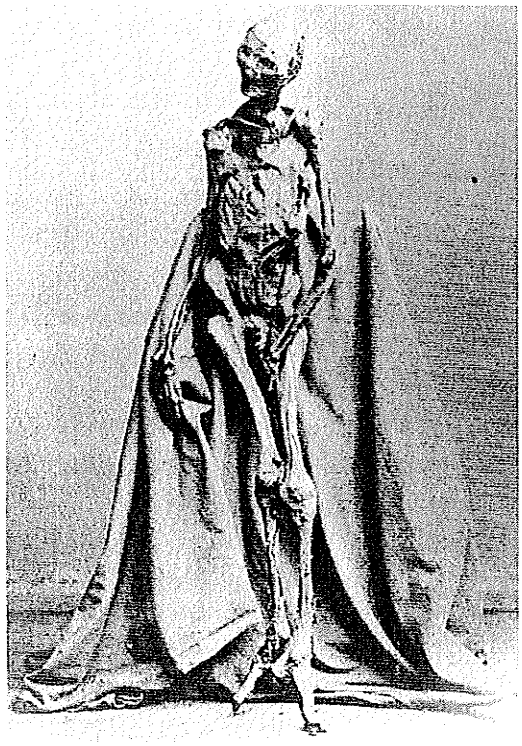


Figure 16: Rendswühren Man in "ballerina pose" (Source Lund 2002:77; original photograph property of Archaeologisches Landesmuseum, Schloss Gottorf)

Results of the Physical and Anthropological Analyses

Visual assessment

Figure 17 shows the whole body from Rendswühren. The body is smaller than might be surmised from photographs. Although two people are required to move the body, to ensure the safe transfer of the body from the display to the work area, the body is very light. It was not possible to weigh the body. The entire body varies from dark brown to black in colour and areas of the surface are shiny. The skin texture is generally smooth.

The head of Rendswühren is somewhat rounded and the shape of the nose is quite pointed with large nostrils (see Figure 18); this may be evidence of remodelling during

conservation. There are two eye sockets, but it is not possible to determine the presence of eyelids or eyeballs. The mouth is partially open but although it was possible to feel something similar to dentition through the open mouth, examination of the oral cavity was not possible. Further visual examination of the head shows a small opening on the left parietal through which a tiny amount of some type of white cotton-like wadding and string is visible. It does not appear that either ear had been preserved. It was reported, however, that souvenirs were taken from the body by curious visitors in the first few days after the body's discovery (Glob 1969) and it is possible that the ears were removed at that time. There are a few strands of short, fine hair on the crown of the head that were too delicate to measure without damage. It was not possible to accurately determine the colour of the few remaining strands of hair.

The neck seems unnaturally elongated (see Figure 18). The area of the sternum is sunken into the chest and both clavicles are slightly loose. Due to the overlying skin it is not possible to remove the right clavicle although it is disarticulated and loose within the shoulder area. Wadding and string visible through the chest cavity (See Figure 19) is similar to that observed in the skull. There is a clearly visible sutured incision running the length of the thorax and into the pelvic area (see Figure 20); this is the result of the original autopsy held in 1871. The pelvis is slightly distorted and the penis is visible. The lower half of the body is in good condition, although the left femur is slightly bowed. A section of the left foot that had been inadvertently severed at the time of discovery is



Figure 17: Rendswühren Man (Photo: Heather Gill-Robinson)

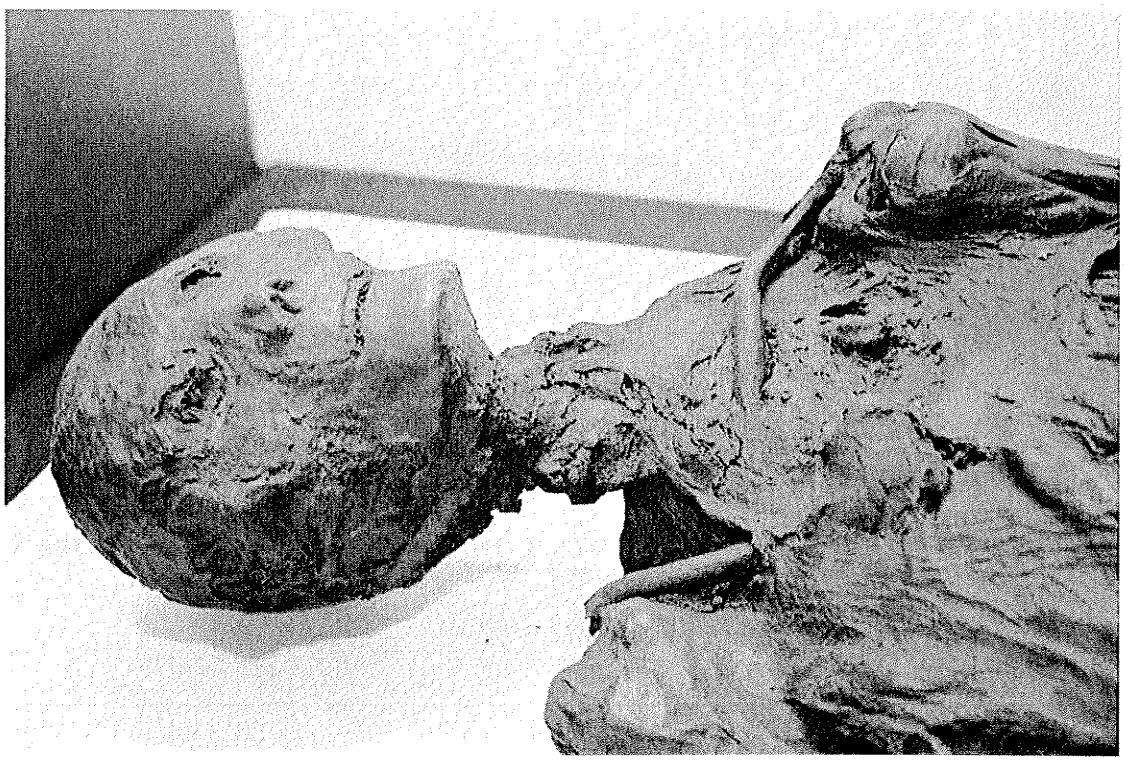


Figure 18: Rendswühren Man – neck and head (Photo: Heather Gill-Robinson)

wired to the rest of the foot (see Figure 21). A leather cuff with leather binding straps is on the right leg at the ankle.

On the underside of the right foot there is a tear to the skin (Figure 22), which is not visible when the body is on display. The margins of the tear are smooth. There appears to some involvement of the muscle underneath the skin. It is suggested that the wound is possibly perimortem, since taphonomic skin tears usually have more jagged margins and often affect only the surface, not underlying structures.

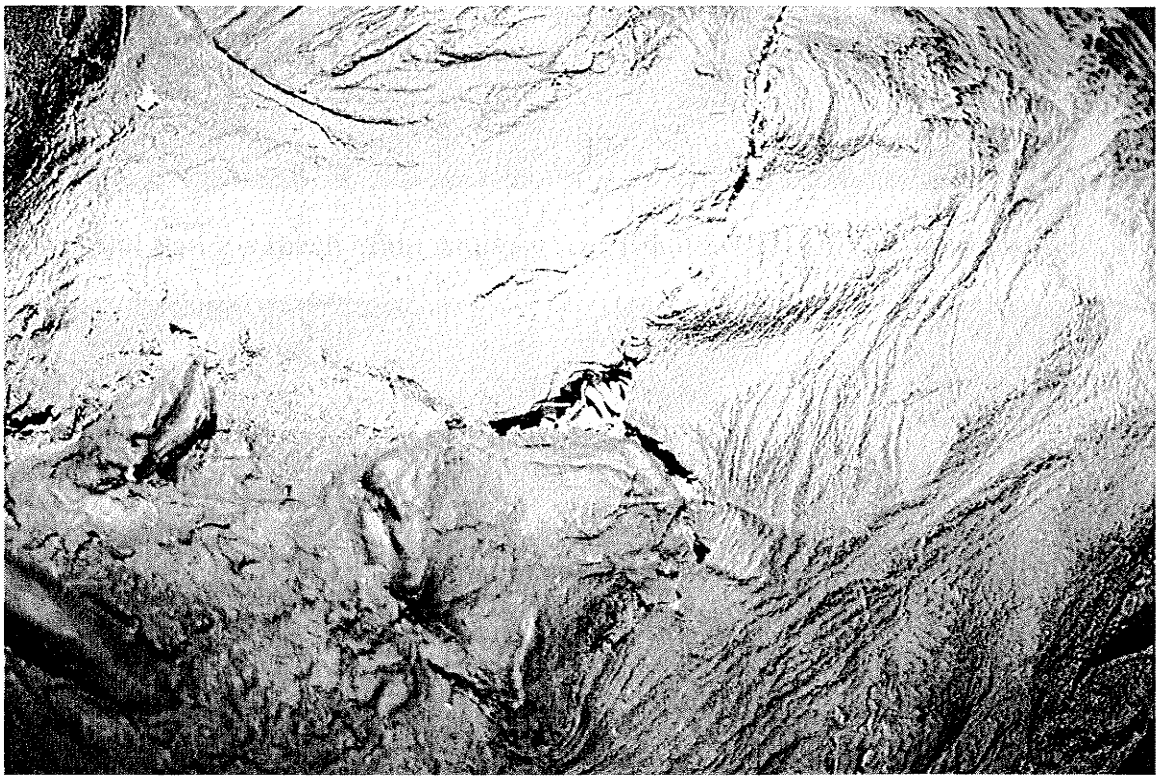


Figure 19: Rendswühren Man: Chest packing (Photo: Heather Gill-Robinson)

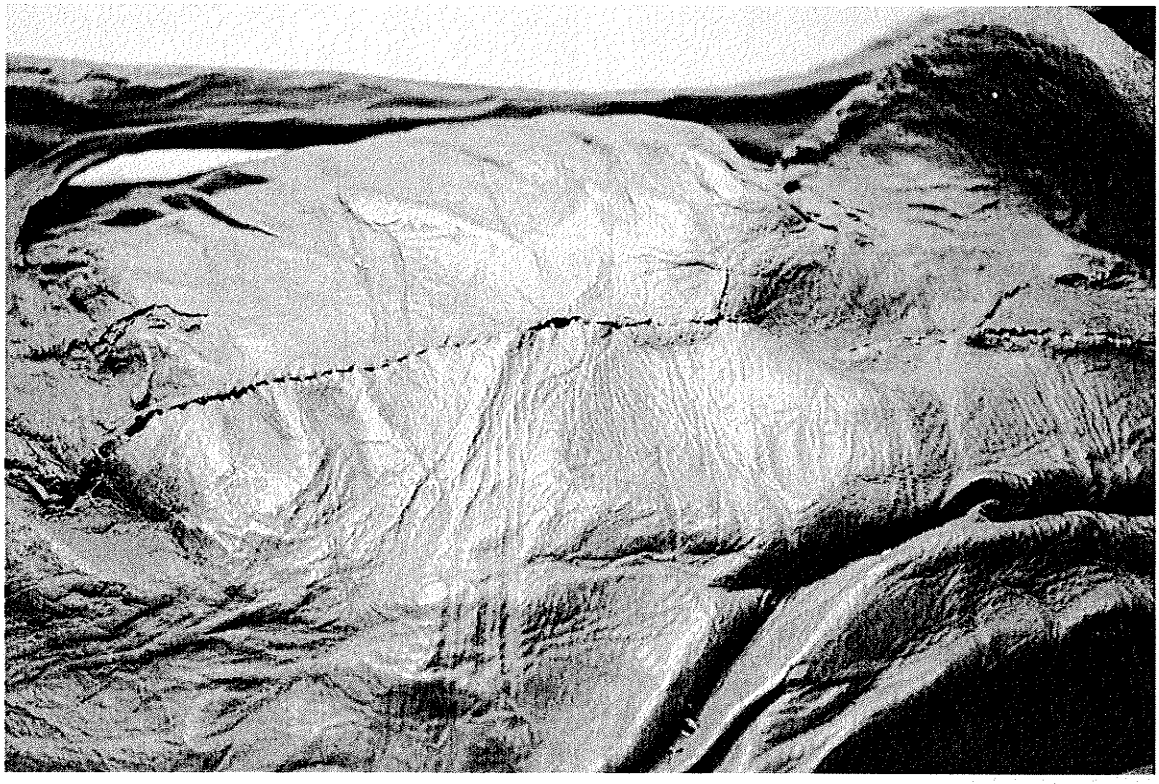


Figure 20: Rendswühren Man: Autopsy scar (Photo: Heather Gill-Robinson)

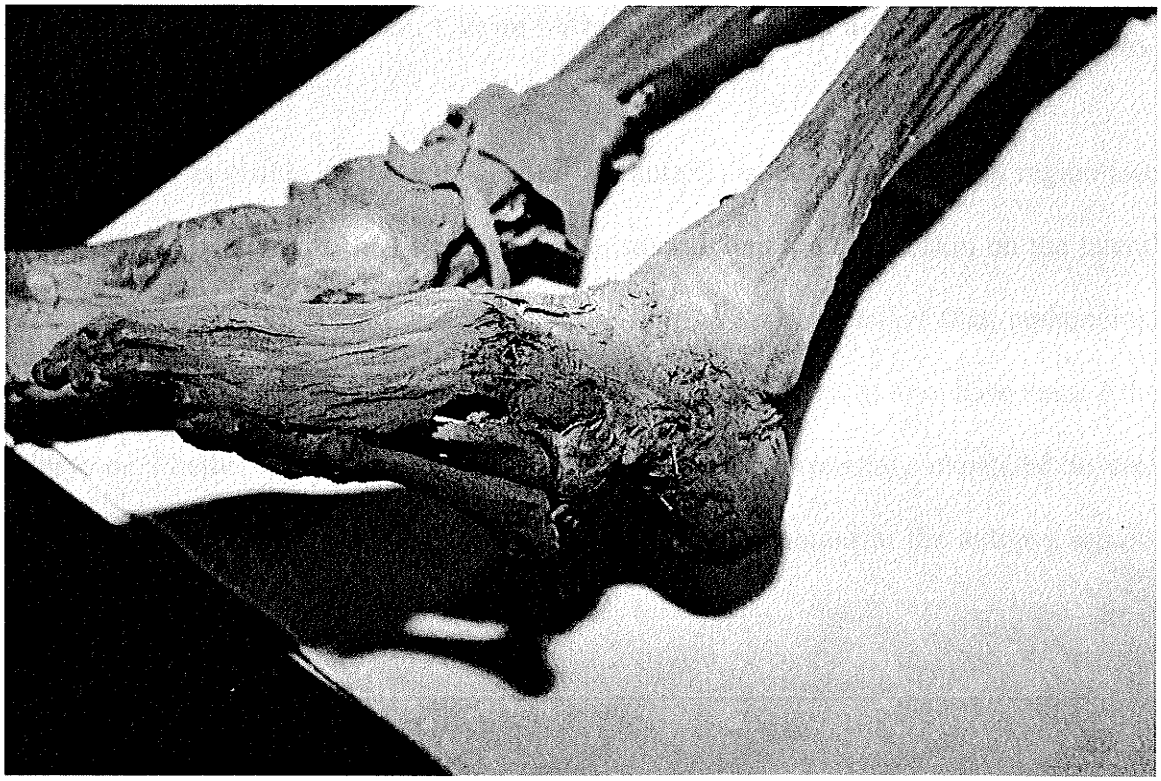


Figure 21: Rendswühren Man: Wiring of left foot (Photo: Heather Gill-Robinson)



Figure 22: Rendswühren Man: Cut on bottom of right foot (Photo: Heather Gill-Robinson)

A second tear is visible on the right side of the thorax, just below the axillary region (see Figure 23). The edges of this wound are also smooth and the curled skin on the lateral margin of the wound is more suggestive of an *intra-vitam* cut, rather than taphonomic damage. This wound, although large, is not deep. It is unclear what may have caused the injury, or whether the injury was caused perimortem but possibly expanded in size following death. There appears to be no mention of this wound in the autopsy reports found in the archives.

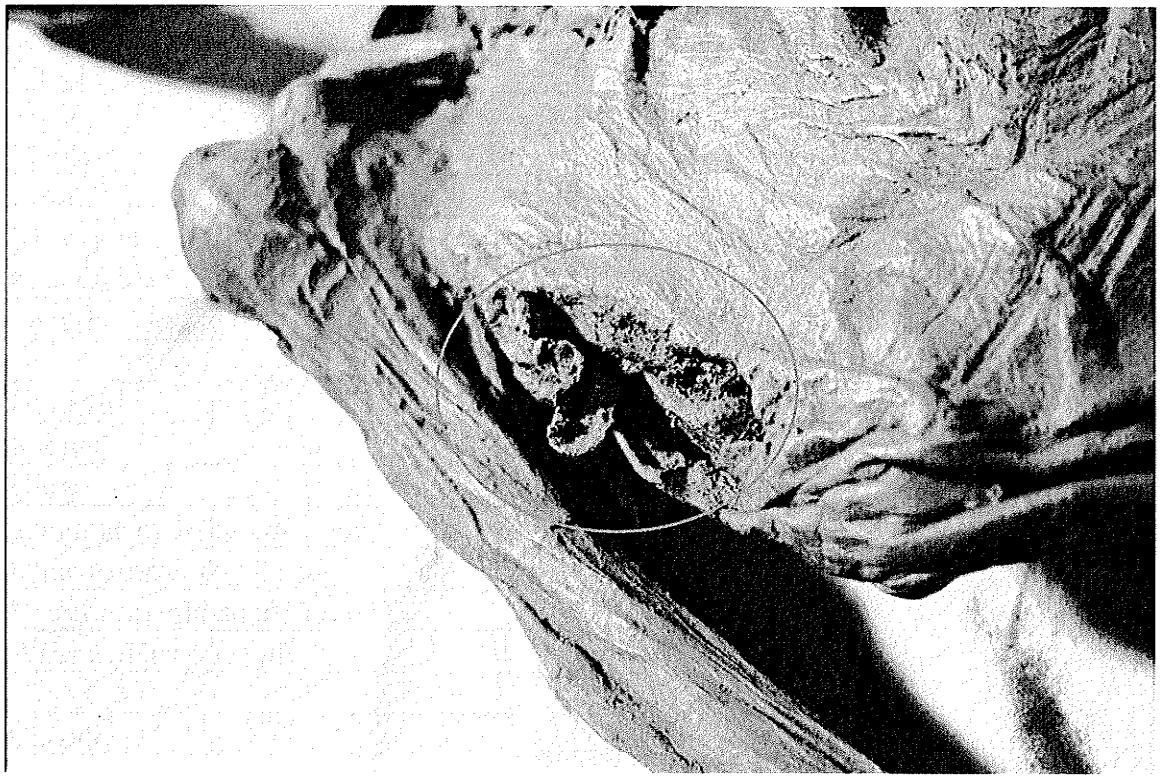


Figure 23: Rendswühren Man: Cut to area below right axilla region (Photo: Heather Gill-Robinson)

Metrics

The entire body is currently approximately 161 cm maximum length from the top of the skull to the tip of the partially-extended right foot. It is not possible to compare this current measurement with original length at excavation, since the "foot" and "inch" measurements cannot be accurately converted, so no assessment of shrinkage since excavation was estimated. Individual osteometric measurement was not possible since all of the skeletal material was encased within skin. Some approximate measurements were taken on the surface of the body but due to the distortion of the body, specific landmarks could not be clearly identified for the standardization of measurements. Tables 5 and 6 show a list of the approximate measurements taken on the Rendswühren body.

	Left	Right
Thigh	40.3	42
Tibia	36.8	34.7
Fibula	35	30.3
Lower leg diameter (approx. mid-shaft)	12.6	11.3
Knee area diameter	25.4	25.9
Foot (ankle to big toe)	18.5	18.5
Foot (heel to big toe)	20.5	22.8
Humerus	33.1	31
Radius	24	24
Ulna	25	24
Humerus mid-shaft diameter	8.2	11.4
Ulna diameter distal end		3.8
Lower arm mid-shaft diameter		9.7
Wrist and hand length	15.8	11
Clavicle	12.7	

Table 5: Rendswühren: Paired measurements

Measurement	cm
Total length	161
Across pelvis - outside	20
Across pelvis - inside	15.5
Shoulder to shoulder maximum	28.7
Shoulder to shoulder inside	16.5
Maximum chest width	26
Neck length	8.2
Neck diameter	19
Cranium - crown to chin	23
Cranium diameter	44.5
Length of first autopsy incision	20
Length of second autopsy incision	10

Table 6: Rendswühren: Non-paired measurements

The measurements taken do, however, provide rough data for an estimation of stature. Again, it must be emphasized the estimation of living stature based on this measurement

is not exact, but provides a basis for general comparison with other Iron Age populations (see Chapter 13). When stature was calculated using just the right femur and the formula in Trotter and Gleser (1958), the estimated range was 158.1 to 164.64 cm. The right humerus provided an estimate of 161.88 to 169.98 cm. A combined formula using the right femur and tibia provided an estimate of 160.01 to 165.99 cm. The overall average living height estimation for Rendswühren Man is 163.43 cm, with an approximate range of 160 to 170 cm.

Sex and age determination

Sex determination of male was made through the presence of visible external genitalia. Estimation of age is less specific. There are no soft tissue indicators for age estimation but it is clear that this is an adult on the basis of his size. The body lacks dentition so age could not be determined through the teeth; it is not clear if teeth were lost antemortem or post-mortem, for reasons that will be explained in the "Image analysis" section below. The digital radiographs, which are discussed in more detail below, are inconclusive. Owing to partial demineralization of the bone and a potential high risk of misinterpretation due to the image angle from the restricted positioning of the body during imaging, it was not possible to provide more specific age determination. Although epiphyses appeared fused and there was little evidence of degenerative change to the bone, unambiguous aging was not possible from the radiographs. This body can only be conclusively identified as an adult male.

Image analysis

The Rendswühren male was subjected to complete digital X-ray and multislice computed tomography (MSCT). Figure 24 shows the body in the MSCT scanning unit, while Figure 25 shows the body positioned for digital radiography. From the radiographs it was immediately apparent that at least partial reconstruction of the head and skull had taken place, since numerous metal rods were visible (see Figure 26).

These rods extended down through the neck to the upper thorax, likely to keep the head attached to the body. The presence of the rods explained the unusually elongated neck. It is also clear that although something resembling dentition in appearance and texture was used during the reconstruction, there are no actual teeth present in the head of Rendswühren Man. This meant that it was not possible to use dentition for estimating the age of this individual or to assess oral health.

No additional evidence of trauma or pathology was identified through the imaging of the post-cranial skeleton; only the skin tears indicated above were noted. The pelvic distortion that was noted in the visual assessment was confirmed on the imaging and is taphonomic in origin. The demineralization of the pelvis caused part of the left innominate to deform and bend inwards. No internal organs were visible within the body cavity, although there was no indication in the archives that organs had been removed during the autopsy; one report specifically notes that organs had been left in the body (Handelmann 1871a). It is possible that organs were removed after the initial autopsy,

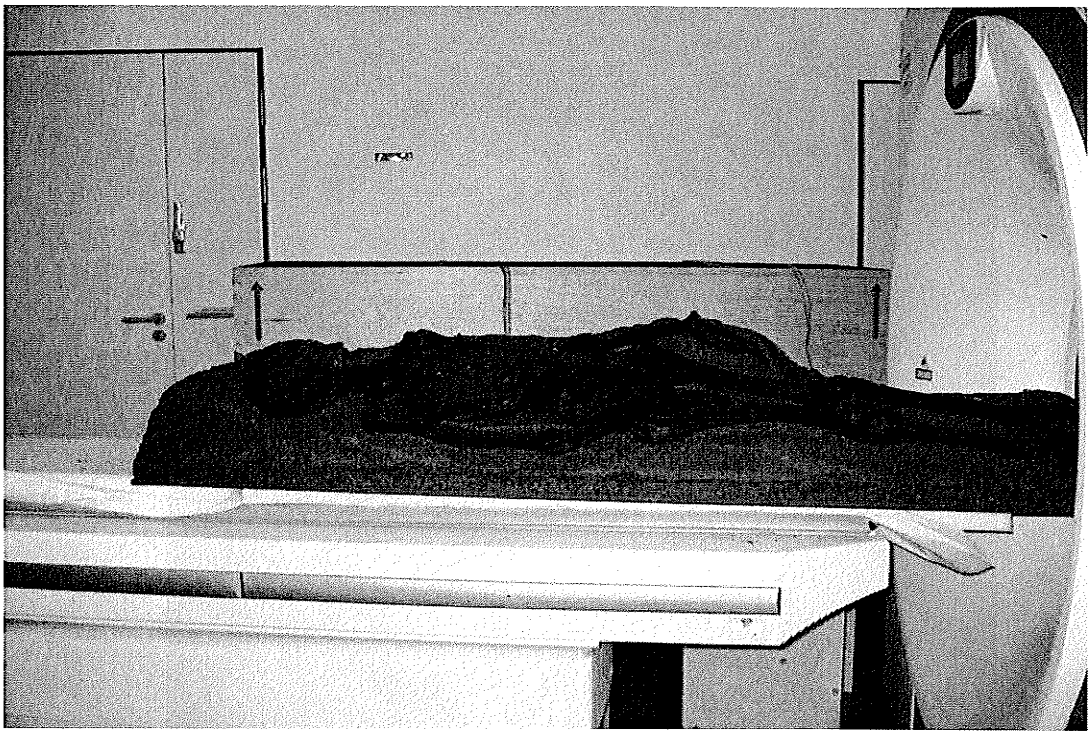


Figure 24: Rendswühren Man during the MSCT scanning process (Photo: Heather Gill-Robinson)

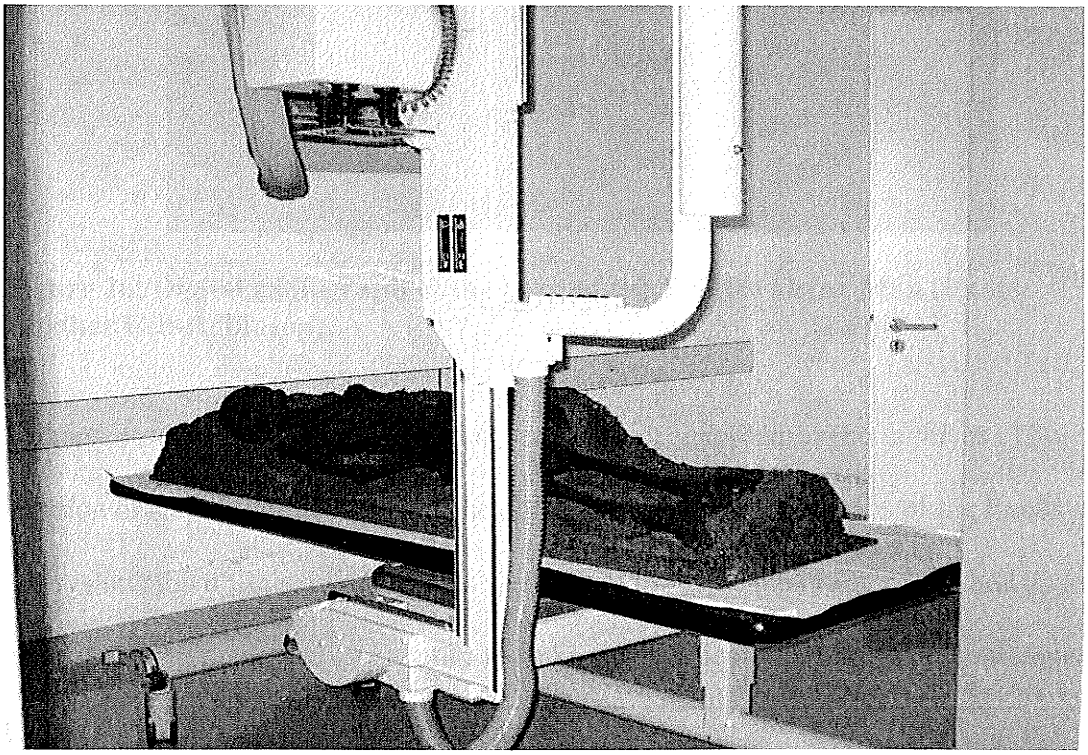


Figure 25: Rendswühren Man during digital radiography (Photo: Heather Gill-Robinson)

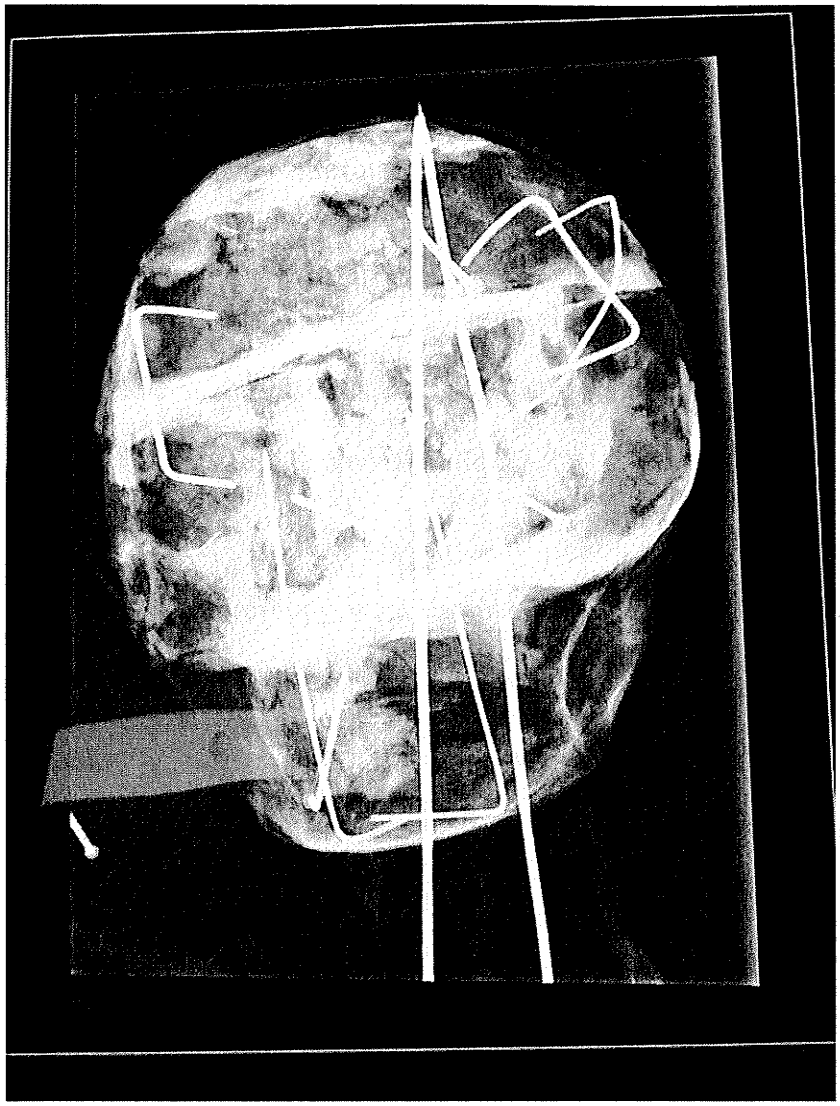


Figure 26: Digital radiograph of the head of the Rendswühren Man (Photo: Heather Gill-Robinson)

perhaps during conservation, and this removal not recorded in the archives. The current location or state of preservation of the abdominal and thoracic organs of the Rendswühren Man is unknown. Recently, attempts were made to locate the brain, which had apparently been removed, preserved and sent to an unknown medical museum. These attempts have, to date, been unsuccessful (Gebühr, pers. comm.).

The head of the Rendswühren body was reconstructed from the MSCT scans. This provided a visual representation of the head as it looks at present. Although this image did not contribute significant new information to the knowledge and interpretation of this body, it did allow the head to be viewed from all directions and clearly showed the two rods protruding from the head into the neck area. The first rough three-dimensional reconstruction was made at the Institute for Diagnostic Radiology in Kiel, to provide a quick assessment of the reconstruction possibilities.

The MSCT scans of the entire body were examined at the Bioanthropological Digital Imaging Analysis Laboratory (BDIAL), based in the Department of Anthropology at the University of Manitoba. Since the digital radiographs had provided substantial evidence of reconstruction of the head, further investigation of the MSCT scans of the head was identified as a priority. The scans revealed that there was no skeletal material remaining in the head, which was unexpected. Although it was known that the head was opened during the autopsy it was also reported that it was put back together before display. Apparently no bone from the skull was returned to the head. The scans show several metal rods and a dense substance, possibly clay, was wrapped around the rods to form the shape of the head. There is also a loosely packed material that appears to be wadding, although the specific nature of this material cannot be determined without invasive examination. Prior to the MSCT imaging, it was not known that the head had been completely reconstructed, without the skull as a frame. As noted from the archival material, the body was reported to have at least two fractures to the skull. This information, however, could not be confirmed since the skull is no longer available for examination.

The head was reconstructed as a three-dimensional model. Through the use of RapidForm reverse engineering software, it was possible to section the head of Rendswühren Man from any angle. By cutting head through the sagittal plane (Figure 27), the interior of the head was visible, allowing confirmation that no skeletal structure remained. Furthermore, the wires, wadding and solid material used in the reconstruction were visible (Figure 28). In a third image, the cut and angle of the head provided confirmation that the material that looked and felt like dentition, was indeed an unknown material with no evidence of teeth remaining (Figure 29). Finally, although visual examination failed to locate any external evidence of ears, there is a structure that resembles ear cartilage (Figure 30). It is not possible to determine if this is definitely ear cartilage or part of the reconstruction of the head.

SUMMARY

The bog body from Rendswühren had received little analysis since the original autopsy at the time of excavation in 1871. This research indicated that the body is that of an adult male, although it is not possible to be more specific about an age range. The body shows little sign of trauma or disease. The head has been completely reconstructed; none of the original skull remains and analysis of previously-reported skull fractures was not possible. The body was imaged using digital radiography and MSCT scanning. The MSCT scans were used to further examine the skeletal material of the body and allowed three-dimensional reconstruction of the head of Rendswühren Man.

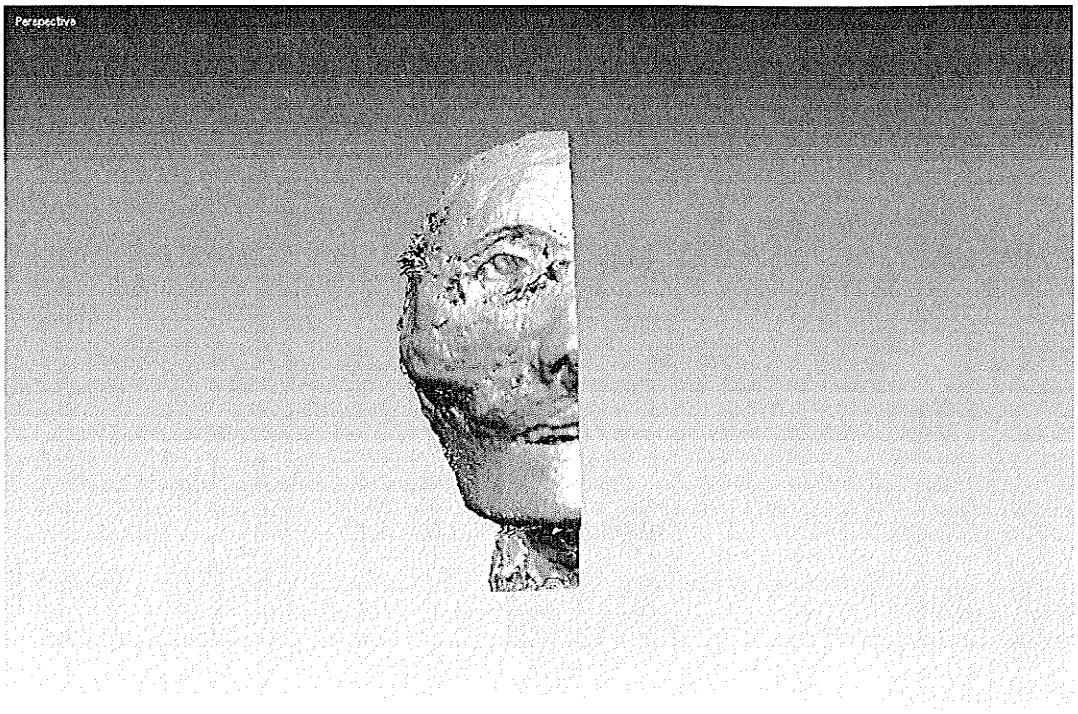


Figure 27: Rendswühren Man – head with sagittal cut

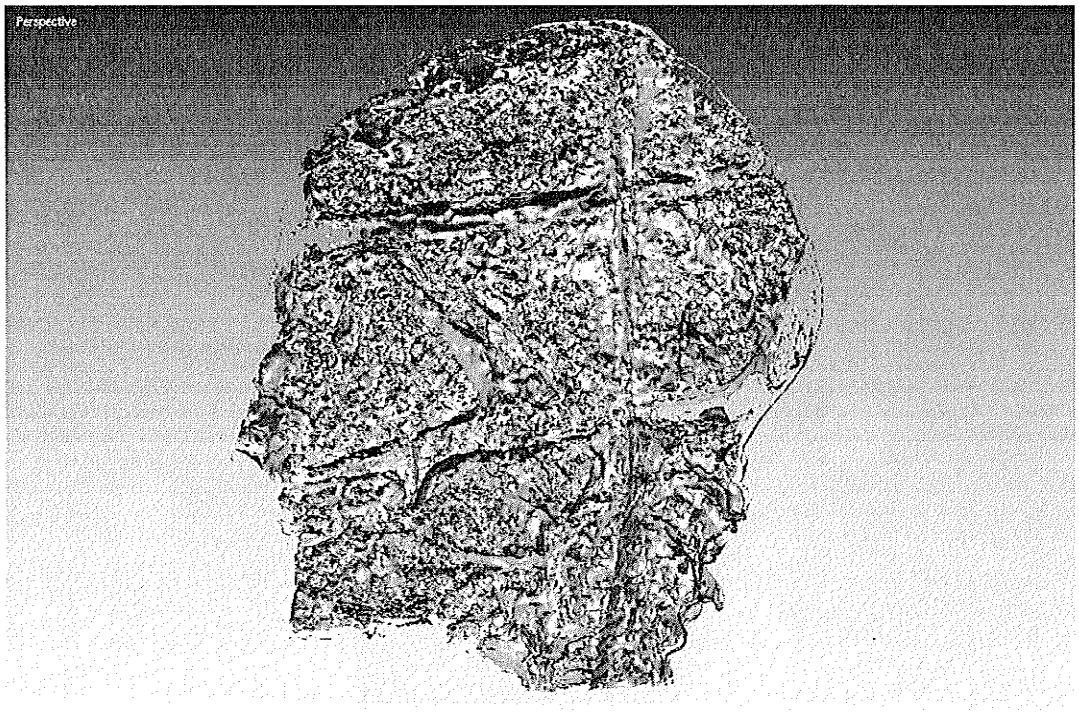


Figure 28: Rendswühren Man – Interior of right side of head

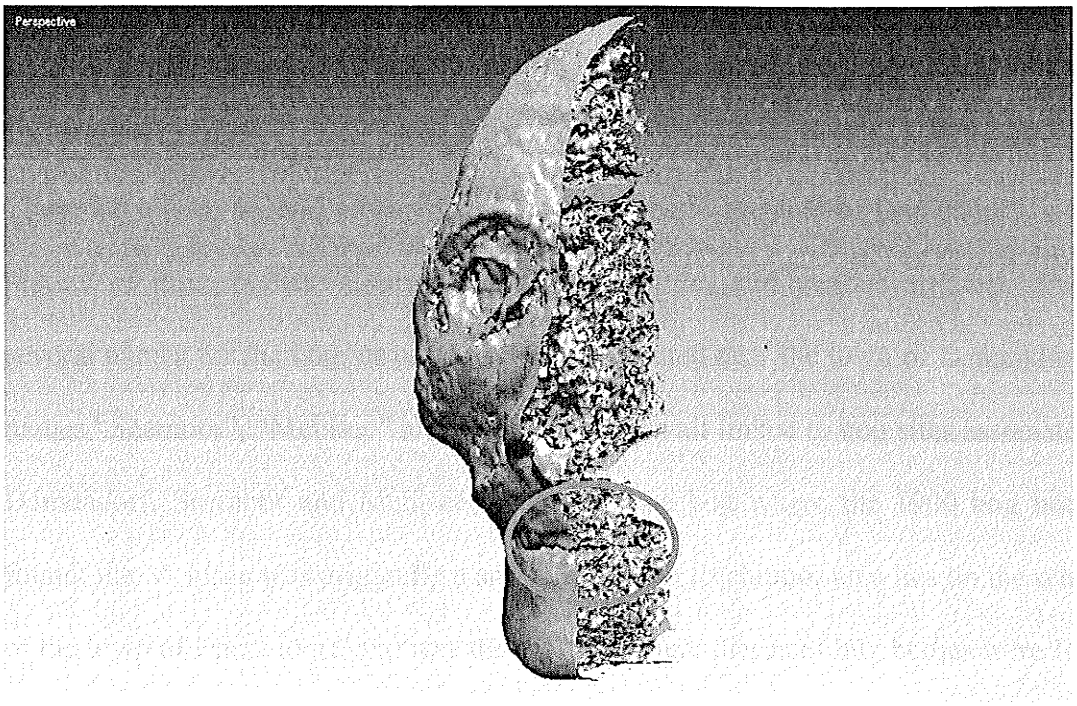


Figure 29: Rendswühren Man – Interior of right side of head, showing the region of the mouth. Although it appears teeth are visible from the exterior, examination of the interior shows that an unknown modelling material was used to replicate the teeth

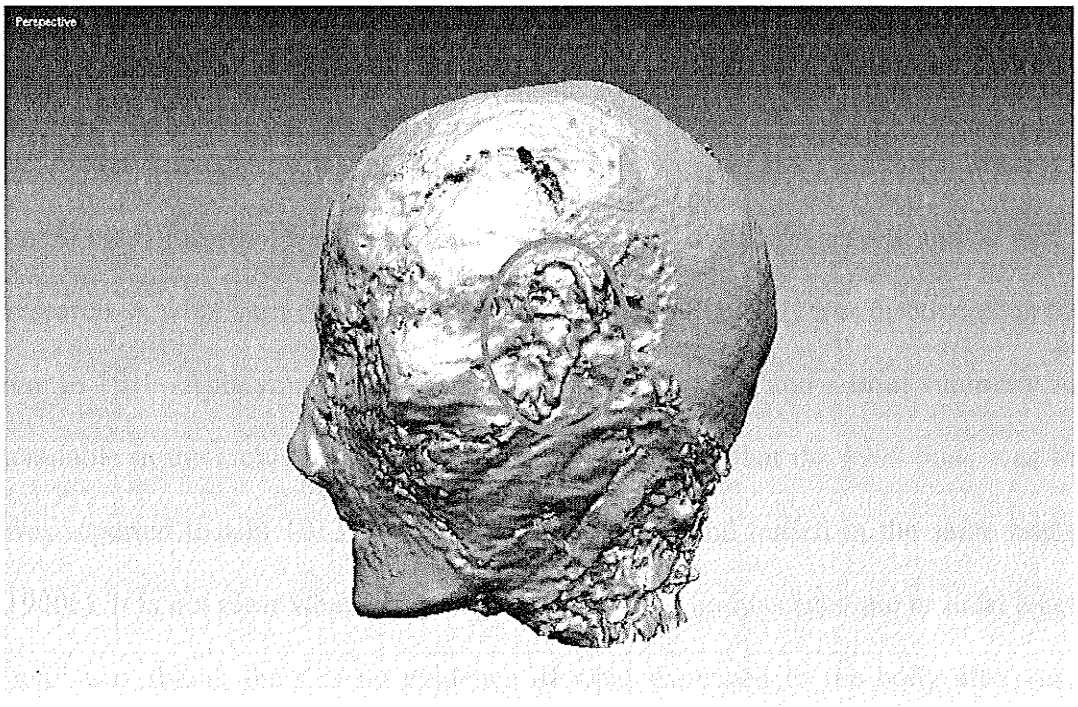


Figure 30: Rendswühren Man – Possible left ear

CHAPTER 8
DAMENDORF

INTRODUCTION

There have been several archaeological discoveries in the area of Damendorf, including reports of three bodies, assorted clothing or textiles and various artifacts. There are several names for the bog, or parts of the bog, located near the town of Damendorf. The names "Seemoor", "Mehlsee" and "Ruchmoor" are all linked to bog sites associated with Damendorf. Seemoor and Mehlsee are part of the bog where the 1900 bog body was found; the Mehlsee was originally a small lake. The Ruchmoor area lies on the other side of the town of Damendorf, and was the location where pieces of bog bodies were found in 1934 and 1947. All relevant finds attributed to the bogs and the area surrounding the town of Damendorf have been identified in this section. Where accession numbers were included with reports, the numbers have been provided.

The first find reported in the archives of the Archaeologisches Landesmuseum consisted of textiles, including a leather belt, found in the bog in 1884 (Sandberg 1884). Only 16 years later, the first body was found. This body is still preserved and is part of this research. A wool skirt (museum accession number KS 12313) was discovered at the same site in 1918 (Anonymous 1918). The skirt was examined and a brief summary report is available in the archives (Wilczek 1958). At the time that the 1900 body was found, it was reported that in 1813 a "Cossack" had been found buried in the same bog (Jessen 1900c). It is not clear whether the report of the 1813 body is accurate or local legend; if a body was found, there is no evidence of what happened to the body after discovery. Numerous finds of "hand-sized" stones and wooden poles, as well as a small back clay

vessel, were found in the area of the Mehlsee, which lay to the east of the find site for the 1900 bog body (Jessen 1900c).

A second body was reported in 1934 and a third in 1947 (Kersten 1947). The human remains from 1934 consisted of a skull (no preserved soft tissue) found in peat at Gross Wittensee, a lake in the Ruchmoor region, as well as a piece of woolen textile, a wooden stake and a leather drinking vessel (Bauermeister 1938; Jankuhn 1938, 1958; Schlabow 1938; Tidelski 1938). The emphasis for this research was the Iron Age bog bodies so the 1934 skull was not examined; there was no soft tissue present at discovery and the skull had not been conclusively dated to the Iron Age. A cow horn drinking vessel was found at the same site in 1941 (Anonymous 1941). Rothmann (1942) recorded that Johan Sohrt reported finding a rider on a horse in the bog, but this report was not believed (Rothmann 1942). Hair from the 1947 body is preserved in the organic storage unit at the Archaeologisches Landesmuseum but since it has been conserved and mounted for display, it was excluded from this research. The current location and condition of the reported 1947 body are unknown. In May of 1951 a small grave with a cremation urn, buried under several wooden poles or branches, was found in the peat of Ruchmoor (Schlabow 1951). A small Iron Age site with pottery, possibly cremation urns, was also located near the place where the Ruchmoor bodies were found (Jockisch 1961). Only the bog body found in 1900 was studied for this research.

PREVIOUSLY PUBLISHED ANALYSES

There are no publications specific to the 1900 bog body find. There were no analyses undertaken, possibly because the body is so flat, and little information published. The clothing and textiles associated with the 1900 bog body were discussed and compared to other textiles recovered from Dätgen and Thorsberg (Stettiner 1911).

In 1995 a sample of textile associated with the Damendorf (1900) body was radiocarbon dated at the Groningen C-14 Laboratory (GrA-507 Damendorf 1900). The results provided a date of 1780 ± 45 B.P., the Late Roman Iron Age (van der Sanden 1995a). This data is discussed in more detail in Chapter 13.

THE 2003-2004 RESEARCH

Data obtained from the archives

Discovery, excavation and preliminary physical examinations of the 1900 bog body

On the morning of May 29th, 1900 a body was found in the Damendorfer Moor by a peat-cutter (Sye 1900a). The bog site is also known as the "Seemoor" (Jessen 1900c) (See Figure 31). The body was found about 200 paces from an area where several pieces of wood had been found in the peat over the years (Jessen 1900c). Within two months of the excavation, the hole had filled with three to four feet[2] of water and further investigation of the site was not possible (Sye 1900c). At a depth of six feet from the peat surface (Sye 1900a), the peat spade struck a bundle, later identified as shoes and clothing, and excavation of the area located a body.

[2] As with the Rendswühren Man, the modern equivalencies of the unit "feet" used here is unavailable. See footnote 1 in Chapter 7.

The head of the body lay to the southwest and the legs to the northeast (Jessen 1900c). The naked body was completely flat, about 1 cm thick, and it was reported that all of the bones were "missing" (Robbert 1900). Another report noted that although it was not unusual for bone and horn to preserve in the bog, the bones in this body had "dissolved" (Anonymous 1900). Another report describes the body as "a flat silhouette" and "peacefully asleep" (Mestorf 1900a). No teeth were visible (Mestorf 1900a, 1900b). More specifically, it was noted that the skin was preserved, while the bones, muscle and teeth were gone (Mestorf 1900a). The skin was shiny and there was a substantial amount of reddish hair remaining on the head (Gebühr 2002). Even at the time of discovery it was noted that the body was "many centuries old" (Robbert 1900). One report identified the body as a 30-year-old male with between 15 and 20 stab wounds (Sye 1900b). It was reported that the peat spade had damaged one of the hands and that pieces of the hand and the fingernails were found (Jessen 1900a). Although the body was naked, a cloak covered the entire body (Jessen 1900c). Two long leggings, a pair of trousers, a leather belt and a pair of shoes with fine diamond-shaped cut-outs across the top, were found by the feet of the body (Jessen 1900c; Robbert 1900; Sye 1900c).

At the time of discovery, curious locals went to the find site and took mementos, leaving the cloak that had covered the body in tatters (Jessen 1900c; Sye 1900c). Dr. Sye offered arrangements to Professor Mestorf for the conservation of the body (Sye 1900c), although details of the conservation process were not provided. In August of 1900 the

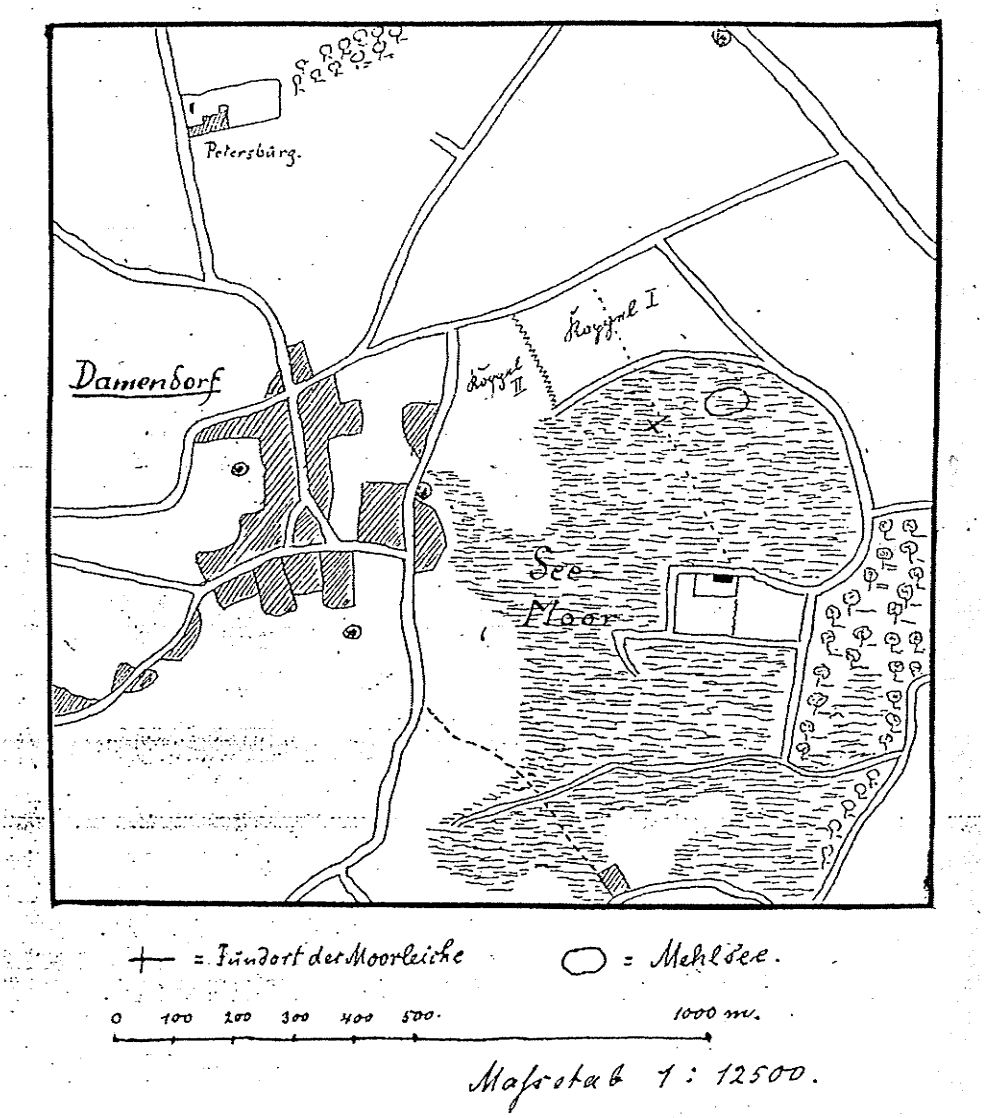


Figure 31: Map of the find site for the Damendorf 1900 body. The body was found where the cross was marked. The small circle represents the "Mehlsee", the site of a former lake (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

body was reported to be "lying in his glass bed" (Sye 1900c). It appears that hair samples were taken from this body for forensic analysis, but the type of analyses planned and the results are not recorded in the archives (Röttger 1911).

The body was found laying its left side, with the left arm extended over the head. Both knees were bent. The head hair measured between 2 cm and 15 cm in length and was reddish in colour. The adult male appears to have had a short moustache. There is a reported 2 cm tear in the skin in the area of the heart and this has been identified as a possible stab wound (Gebühr 2002).

Clothing and textiles

The clothing and textiles associated with the 1900 body were not examined during the course of this research; they have been studied in great detail by other researchers Stettiner 1911) and some pieces have been reproduced for museum exhibition (Gebühr 2002). As a general summary, it is reported in archive documents that some of the textiles were made of flax (Benzon 1900) or hemp (Mestorf 1900a). Several pieces were patched (Benzon 1900).

Additional Information

According to museum archives, "a couple of" bones from one of the hands and "miscellaneous" fingernails were sent to Kiel. Neither the specific destination of the specimens sent, nor the purpose for sending them to Kiel was recorded (Jessen 1900b). It is most likely that the bones and fingernails were sent to the Museum für Vaterland Alterthümer. According to one of the excavators, it is possible that these specimens were lost in transit by a worker or it may be that they were not completely recovered during the excavation and may still be in the peat in the area where the body was found (Jessen 1900b). Given the clear reports of bones and fingernails from the hand, it suggests that these items were observed and excavated, and that the possibility that they remained in

the peat is unlikely. A total of six other "scraps" (Jessen 1900b) were located in the towns of Damendorf, Eckernförde and Ascheffel, in the hands of individuals unrelated to the excavation and analysis of the body. These appear from the records to be pieces of the body, although exactly which parts of the body were located is unknown. The pieces were to be sent to the museum by post or in the care of a Dr. Spleidt, although Dr. Spleidt's association with the bog body is unclear (Jessen 1900b). It is unknown whether these individual pieces did arrive at the museum and, if they did arrive, whether they were reunited with the body during conservation or stored separately.

Results of the Physical and Anthropological Analyses

Visual assessment

In appearance this individual is nearly intact, but completely flat (see Figure 32). The body is attached, in several places, to a mounting board that is covered with mock peat and was not removed from the board during this examination. The skin is desiccated and there are several skin tears evident. The skin damage is clearly caused by the skin drying out and was not inflicted perimortem (eg. Figure 33). There is one area of open skin on the thorax, approximately 2.5 cm long, that may be a deliberate cut mark. The edges of the wound are clearly defined, unlike the other skin tears; it is possible that this is an intentional cut to the skin, rather than an artifact of taphonomy. The high rate of pseudopathology of bog bodies, discussed previously in Chapter 3, leads to caution in the interpretation of this apparent cut.

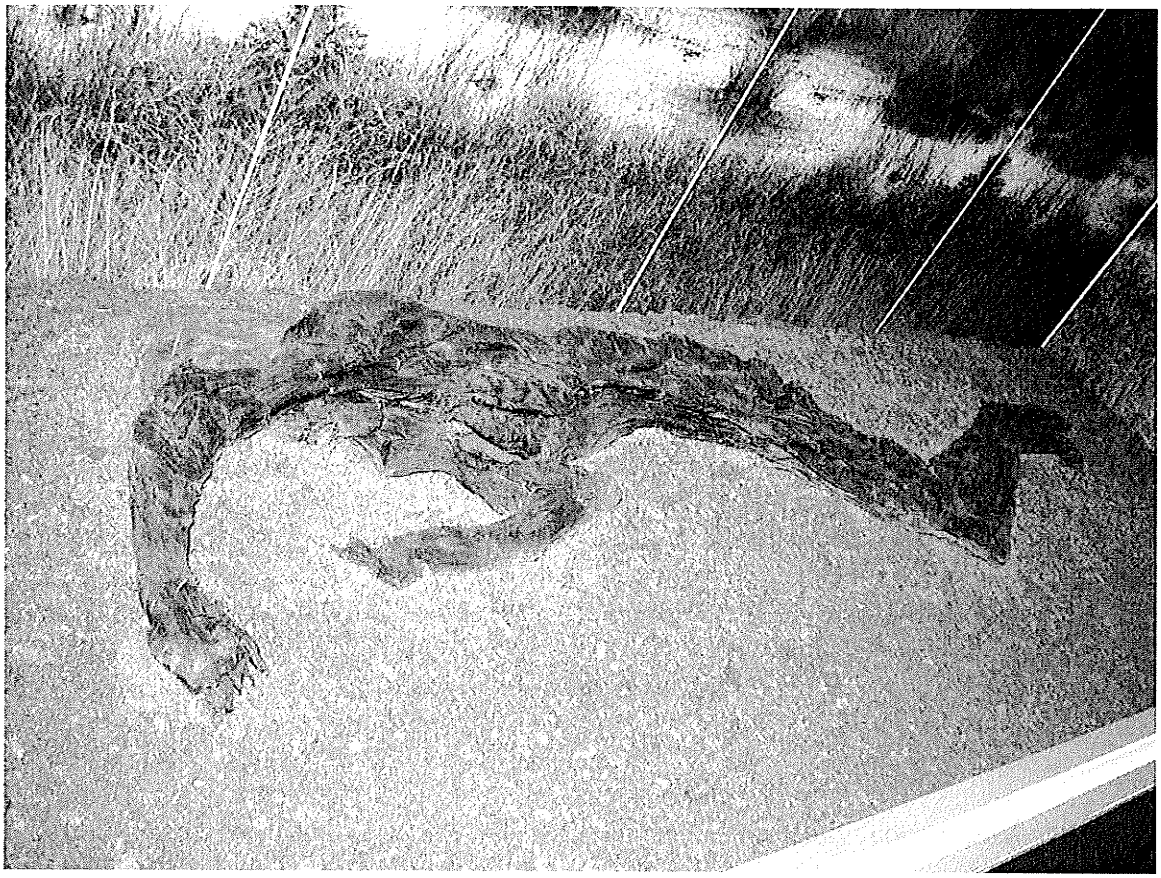


Figure 32: Damendorf Man (Photo: Heather Gill-Robinson)

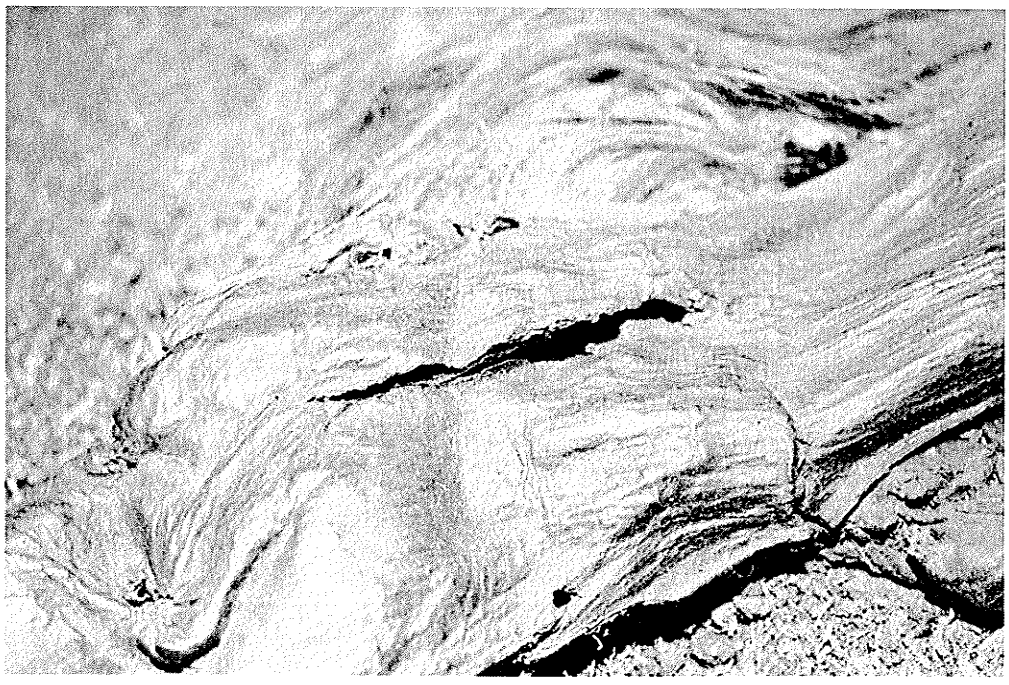


Figure 33: Damendorf Man: Skin tear- left arm (Photo: Heather Gill-Robinson)

The right arm is flexed while the left arm is extended across the upper part of the head. On the right hand there are only traces of fingers. It is possible that this is the hand that was damaged by a peat spade during excavation. Although it was reported that pieces of the hand and the fingernails were observed (Jessen 1900a), it is not clear whether those pieces were collected during excavation and, if so, where they can be found today. On the left hand the thumb is visible and quite well preserved. There appear to be parts of the other fingers present, but these are flat and not fully identifiable. The head rests on the right shoulder. The head has a substantial amount of reddish hair. On the flattened face the nose and mouth are visible; the mouth is opened slightly.

All other aspects of the post-cranial skeleton are completely compressed, with the exception of the toes of the left foot, which are all still three-dimensional (see Figure 34). The toes of the right foot are flattened to the point of absence (Figure 35).

Metrics

Tables 7 and 8 list the measurements taken for the Damendorf body. Figures 36 and 37 show a photograph of the body with the measurement points indicated. The entire body measures approximately 153 cm in length from the elbow of the extended arm to the end of the right foot (marked as "A" on the photograph). Thickness measurements taken along the length of the body ranged from approximately 0.75 cm to 1.35 cm.



Figure 34: Damendorf Man: Toes of left foot (Photo: Heather Gill-Robinson)



Figure 35: Damendorf Man: Feet (Photo: Heather Gill-Robinson)

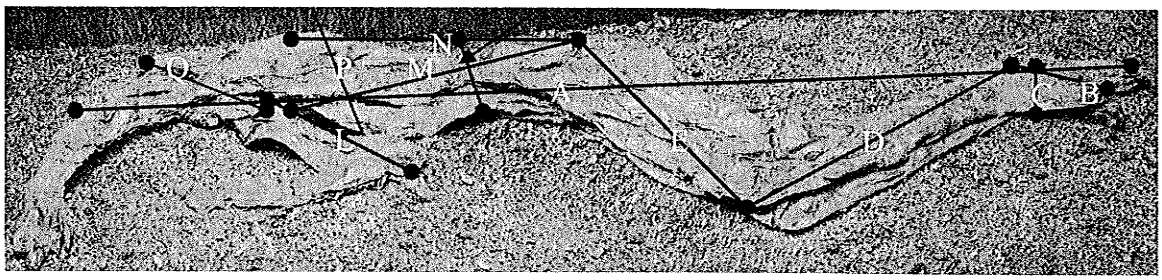


Figure 36: Damendorf Man – showing measurements A through E and O through Q (Source: Gebühr 2002:24)

Photo marker	Measurement	Left	Right
B	Foot - heel to tip of toe maximum	9.1	20.5
C	Foot - maximum width	9.1	6.2
D	Leg - ankle to knee	35.4	39
E	Leg - knee to approximate hip	45	N/A

Table 7: Damendorf: Paired measurements

Photo Marker	Measurement	cm
A	Total length	153
F	Left arm (over head) - fingertip to shoulder	52
G	Left arm - fingertip to elbow	26.5
H	Left hand - middle finger to wrist	11.5
I	Left hand - thumb to wrist	8.2
J	Left hand - little finger to wrist	7.3
K	Left hand - maximum width	8.5
L	Right arm - elbow to under chin	26
M	Right side - under armpit to hip	39.4
N	Left shoulder - shoulder to hip	54
O	Width of body at approximate waist	18
P	Width of body at chest/back	22.3
N/A	Face - under arm area to chin	9
Q	Width of head - hair to chin - across arm	22.5

Table 8: Damendorf: Non-paired measurements

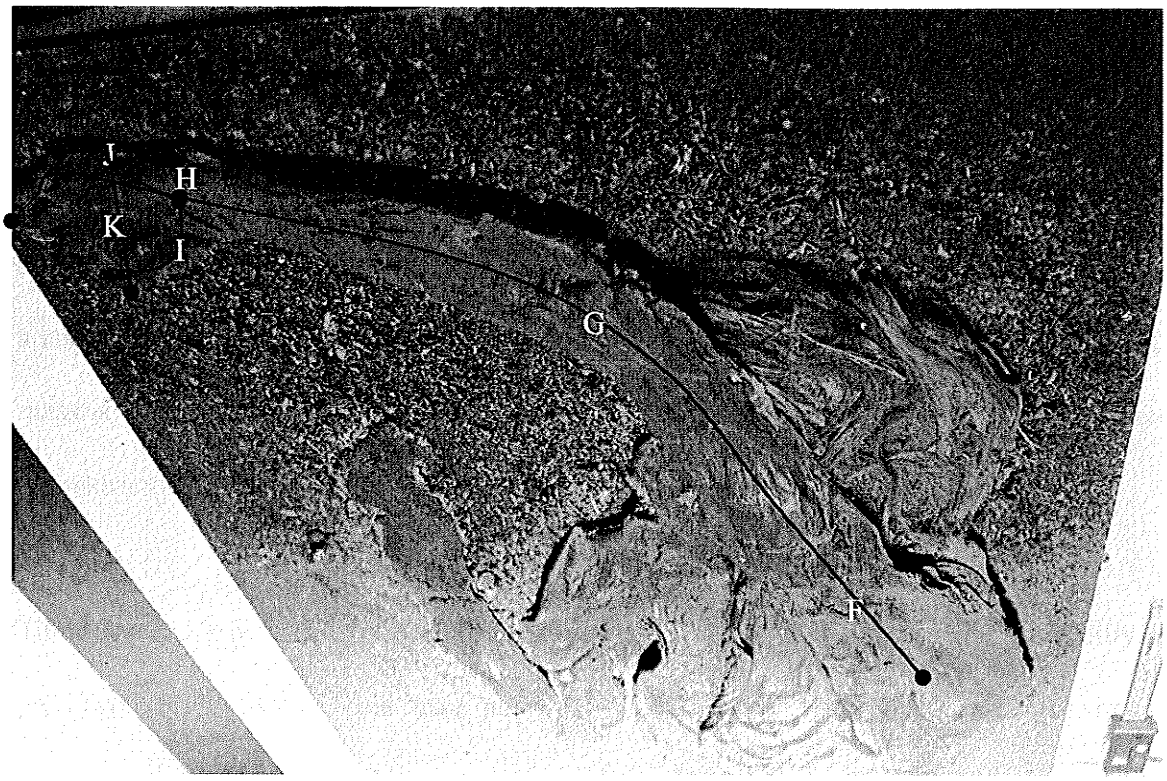


Figure 37: Damendorf Man – showing measurements F through K (Photo: Heather Gill-Robinson)

Sex and age determination

Since there is only limited skeletal material remaining in the body, sex and age determination were dependent upon soft tissue examination. A penis was identifiable, confirming the sex as male. Although the size of the body suggests it is an adult, it is impossible to be more specific about the age determination.

Image analysis

The entire body was imaged using digital X-ray and MSCT. The presence of metal pins, tacks and small nails to mount the body to the board was obvious in all images. Both imaging methods revealed that, contrary to the appearance of the body, there is a small

amount of skeletal material remaining in the body. There are traces of bone in the area of the pelvis and the cranium. A single tooth was recognized, although the specific tooth could not be identified. Five articulated vertebrae, possibly lumbar, are visible on the CT images through a special pseudocolour feature in the Mimics imaging software (see Figure 38). These vertebrae were not visible when using other imaging software. There is a large mass in front near the vertebrae and it is suggested that this may be intestines. This mass is visible on both the X-rays and the CT scans, but the texture is more visible on the reconstruction and resembles coiled intestine.

There is a shadow visible on both the X-rays and CT scans that suggests the possibility of preserved brain tissue. This may possibly be confirmed with more extensive image editing and analysis using Mimics or a similar software to isolate out and examine the mass. In order to fully edit and model the possible preserved brain tissue, it is estimated that more than 100 hours of editing would be necessary. The reconstruction of this single element is not possible within the scope of this work, but provides an excellent basis for further research.

Trace element analysis

A single hair from the Damendorf body was divided into four samples and tested for trace elements using laser ablation. Although the results are not quantifiable using this method, both lead and mercury were detected in all of the hair samples from this body. While the levels of calcium, copper, zinc, arsenic and cadmium changed only slightly

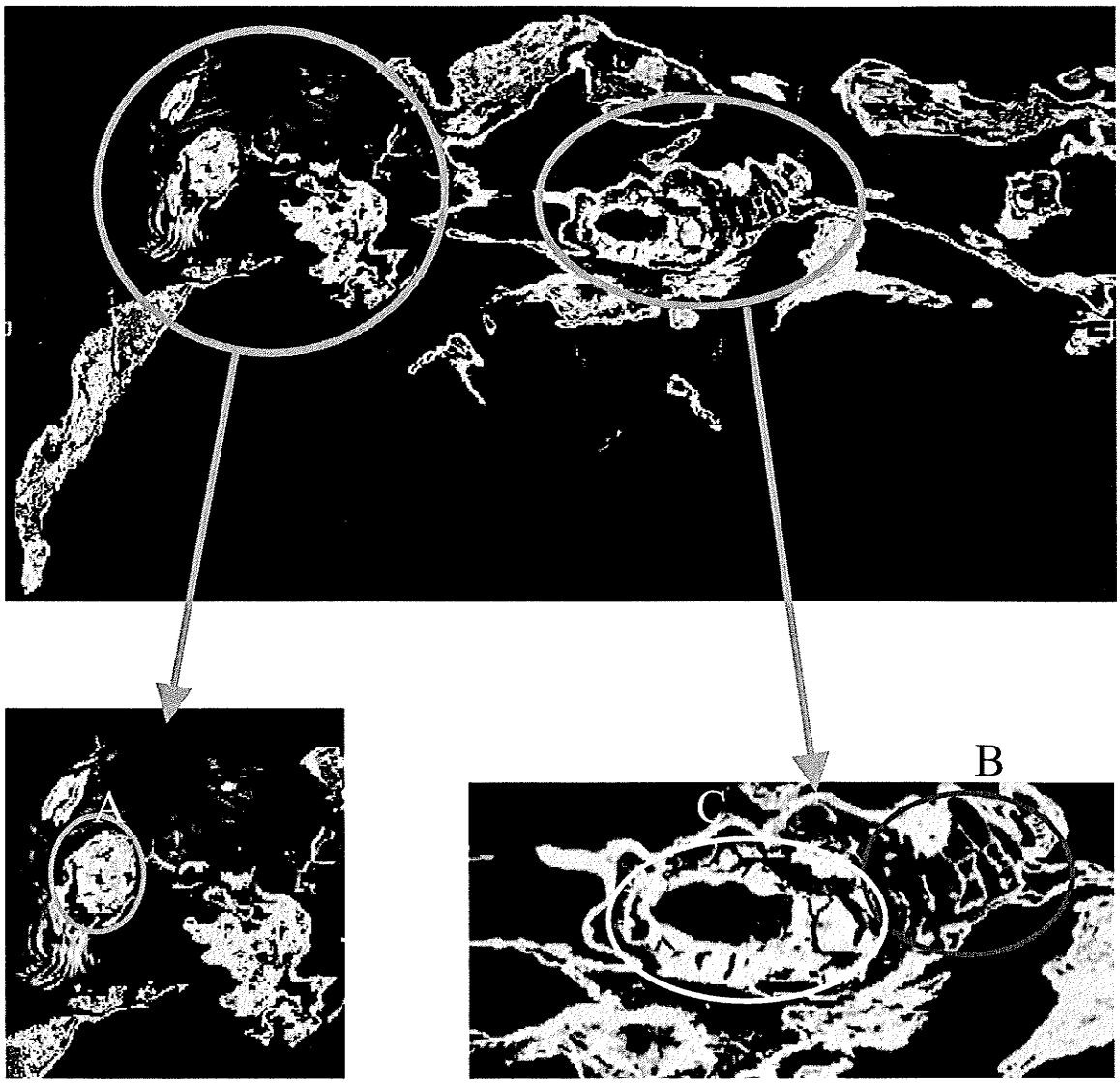


Figure 38: Edited images reconstructed from CT scans of the Damendorf Man, highlighting brain (pink circle "A"), vertebrae (dark blue circle "B") and possible intestines (light blue circle "C").

between the scanned area of the glass and the hair, the differences in the levels of both mercury and lead were obvious (see Figure 39). The mercury was consistently present at a high level, relative to all other elements, across all four samples from this body. Although the meaning of this cannot be clearly determined without further analyses to quantify the specific levels of mercury, the strong presence might be an indicator of exposure to metalsmithing, since mercury was used in the processing of gold (Oddy 1991). Lead was also present at a consistently high level, relative to other elements, in these hair samples. It has been suggested that the Damendorf Man may have been, specifically, involved in the gilding of gold and silver, since mercury would have been used during the gilding process and the man would have been exposed to substantial levels of these elements through inhalation (Oddy 1993). Gold and silver gilding of weapons, household items and jewellery was common during this time period, although it is not known whether the artisan would have been imported from the Roman regions to the south of Schleswig-Holstein or trained locally. Further analyses to quantify the specific levels of lead may allow more specific interpretation of its presence in the hair of this body. In order for those analyses to be conducted a very large sample of hair, a minimum of 100 mg, is required for analysis and replication. A sample of this quantity is currently not available, and therefore a more in-depth analysis of the trace element data is not possible at this time.

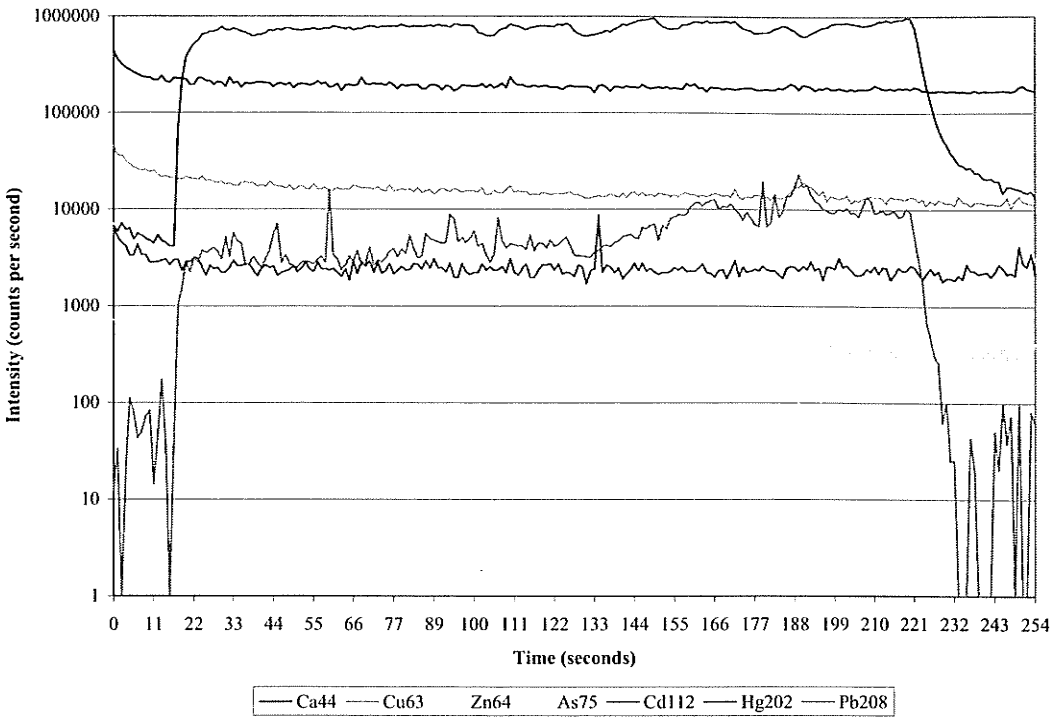


Figure 39: Damendorf Man – Presence of trace elements

Stable isotope analysis

Approximately 12 hairs were plucked from the scalp of the Damendorf body for stable isotope analysis. Two preliminary results have been obtained and additional samples will be tested in the future. The values were: δ13C -21.66/ δ15N 7.39 for the first sample and δ13C -21.79/δ15N 7.88 for the second sample. Both of these ratios suggest that the diet of Damendorf was primarily vegetarian. These results are discussed in more detail in Chapter 13.

SUMMARY

Although the Damendorf body had received little analysis in the century between its excavation and this research, it is clear that there was a great deal of information to be

obtained from the body. This research confirmed the sex of the individual as male, identified the presence of previously unknown skeletal material and internal organs and was able to suggest a possible occupation for the individual. These results will be discussed in more detail in Chapter 13.

CHAPTER 9
OSTERBY

INTRODUCTION

In 1948, an isolated head wrapped in animal hide was recovered from the Köhlmoor, near the town of Osterby. The head was partially crushed, but a unique hair knot was well preserved. This chapter is an overview of the Osterby skull, from the time of discovery to the present, including the results of examinations and analyses undertaken during this research.

PREVIOUSLY PUBLISHED ANALYSES

In 1949, two brief articles were published in Offa providing details on the Osterby find. Kersten (1949) presented an overview of the discovery and excavation of head. The article specifically notes that the location of the find site is only 3 km from where the 1900 bog body was discovered at Damendorf, and only 5 km from the location of the Ruchmoor, where parts of the other bog bodies were discovered in 1934 and 1947 (see Figure 40).

The article reports that the skull was examined by H. Weinert, who identified the individual as a male between 50 and 60 years of age at the time of his death (Kersten 1949). The article also indicates that the first two vertebrae were found loose in the peat and that there was clear evidence of cut marks on the vertebrae. More specifically, it appeared that the head had been forcibly severed and that the left side of the skull had been struck with a blunt object that left a 12 cm indentation, caused the skull to splinter and drove pieces of the skull deep into the brain (Kersten 1949:2). Only small fragments

of skin remained on the skull, but the hair was well preserved. Kersten (1949) also includes photographs of the skull after conservation (see Figure 41).

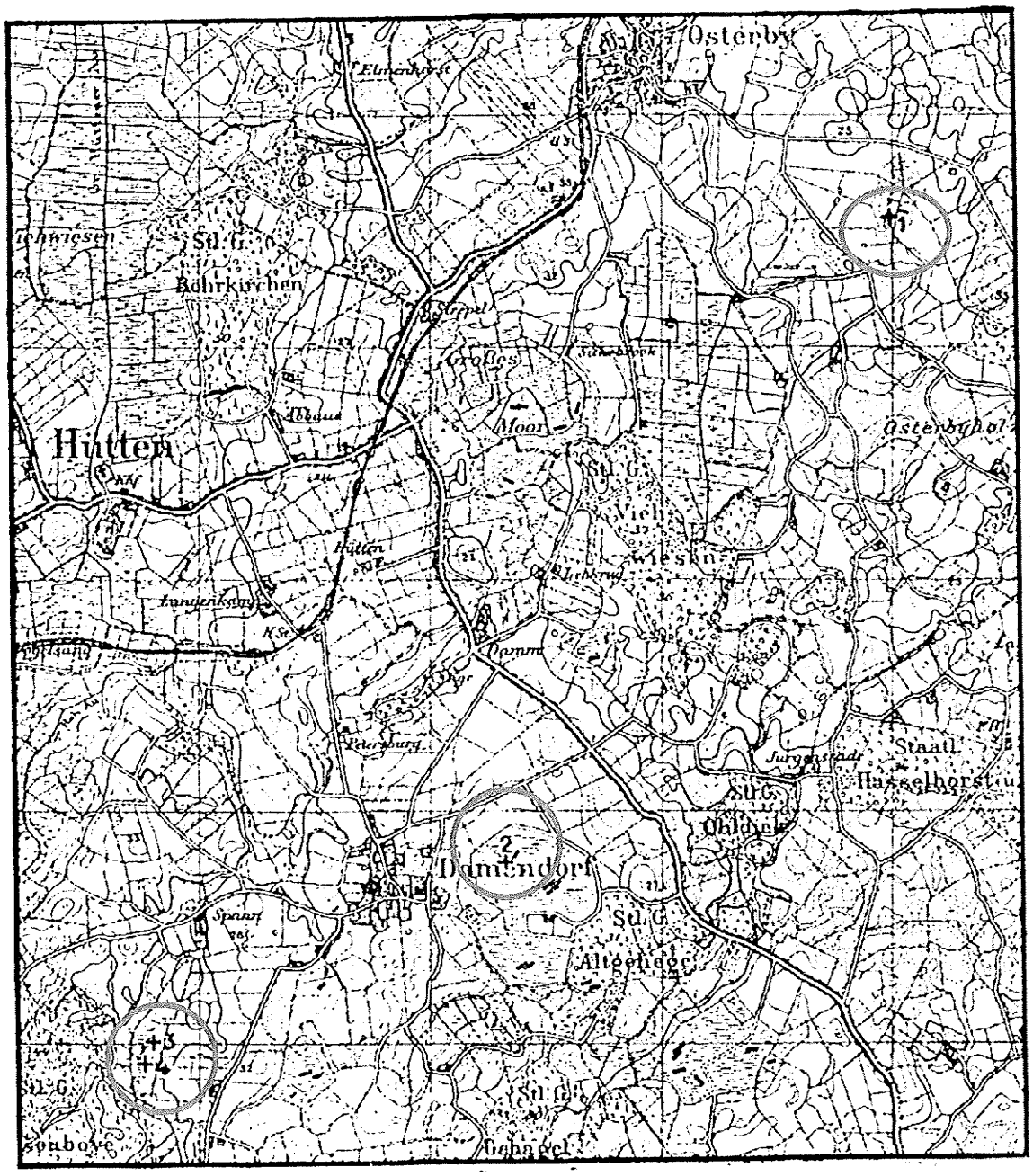


Figure 40: Map of the Osterby area, showing the location of the Osterby skull find (indicated on the map with a "1" – circled in red). The location of the 1900 Damendorf bog body discussed in Chapter 8 is identified by the number "2" and is also circled in red. The locations of the Ruchmoor bodies, also discussed in Chapter 8, are identified by the numbers "3" and "4", also circled in red (Source: Kersten 1949).

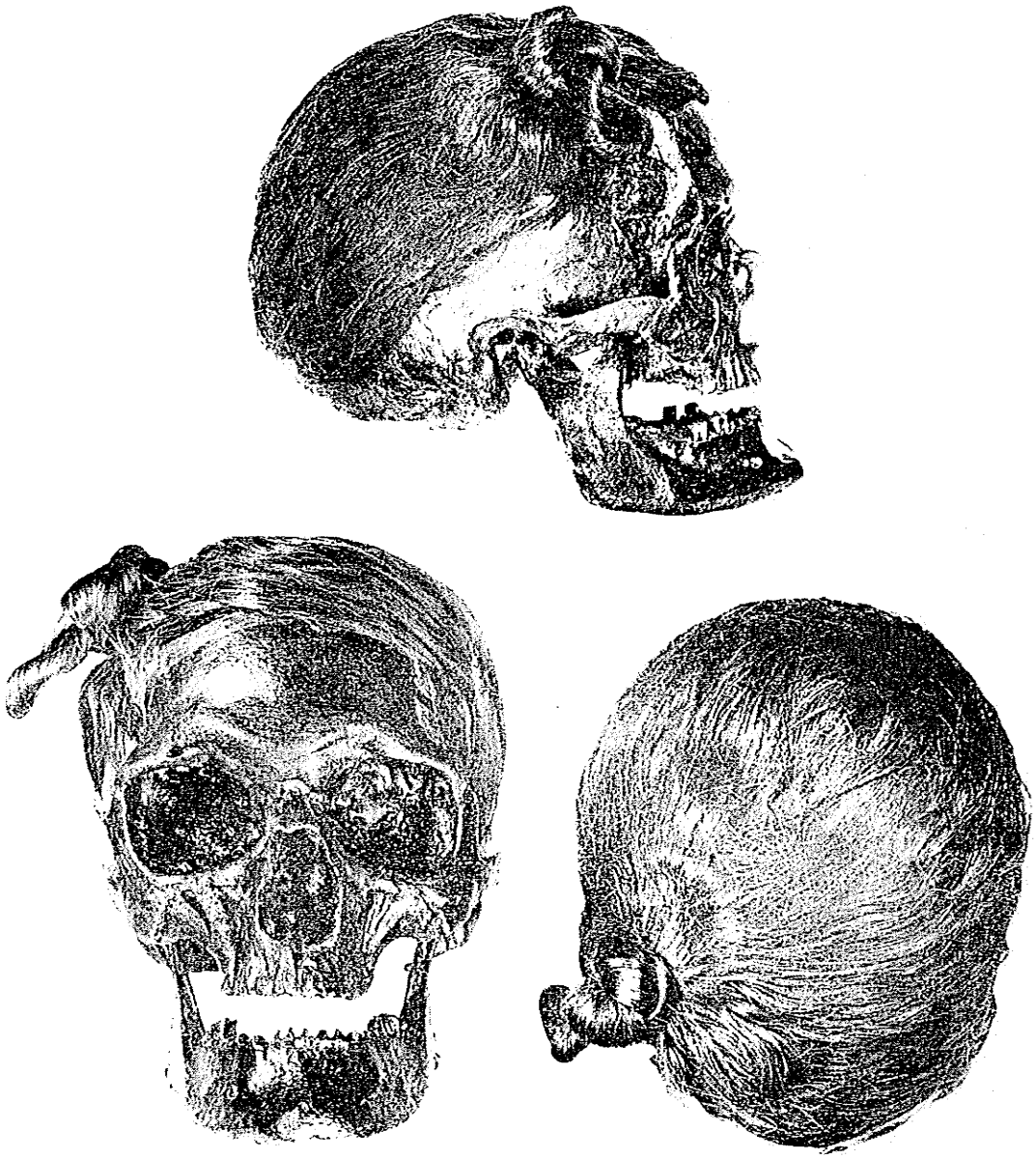


Figure 41: The Osterby skull after reconstruction (Source: Kersten 1949:Tafel 1)

A second article, published in the same volume as Kertsen (1949), provide detailed information on the hide in which the skull had been wrapped and on the unusual hair knot

(Schlabow 1949). This article even provided detailed directions for the replication of the hair knot and discussed its significance in Germanic society.

In 1958, as part of a publication discussing the analyses of the bodies from Windeby (see Chapter 10), the results of pollen analysis from samples taken near the site of the Osterby skull were presented (Schütrumpf 1958). One year after the discovery of the small samples of peat were collected from inside the skull and a larger sample was taken from a spot 2 to 3 m from the find spot of the skull. The samples consisted of both sphagnum and sedge peat and the depth of the skull in the peat suggested a date of the first century A.D. (Schütrumpf 1958).

In 1995, hair from the Osterby skull was dated at the Groningen C14 Laboratory. The results indicated that the skull dated to 1895 ± 30 B.P. (GrA-822 Osterby 1948) (van der Sanden 1995b), which is similar to the date suggested by the peat depth. Recently, the calibrated date of A.D. 75-130 (calibrated to 1σ) was published for the same hair sample, along with additional information related to sample, as part of a catalogue of bog body radiocarbon dates (van der Plicht et al. 2004). The radiocarbon dates will be discussed in more detail in Chapter 13.

THE 2003-2004 RESEARCH

Data obtained from the archives

Discovery and excavation

An isolated skull was discovered on May 26, 1948 by Max Müller, a peat cutter, in Köhlmoor, a bog southeast of the village of Osterby in the region of Kreis Eckernförde. The skull was found in dark brown peat at a depth of approximately 65 to 70 cm below the surface of the peat, about half way across the 3 m peat parcel being dug for fuel (Kersten 1948). Slightly below the peat layer where the skull was found is a layer of pine tree stumps that runs throughout the bog and was identified as the base of the peat (Kersten 1948).

The skull was partially crushed (see Figures 42 and 43). There were small pieces of skin clinging to the bone and a mass of reddish-brown hair, including an elaborate hair knot, was still attached. The head was taken back to the home of the peat cutter's brother, Otto. When the museum was notified the find site was examined and the last pieces of the skull and brain were recovered (Kersten 1948). Although the peat area was checked thoroughly, there was no evidence of any other skeletal material or soft tissue at the site (Kersten 1948). No pieces of wood, stone or sharpened poles were found near the head; it was also believed that the head was deposited without any other human remains (Kersten 1948).



Figure 42: Side view of Osterby skull before reconstruction (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).



Figure 43: Top view of Osterby skull before reconstruction (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

Examination and reconstruction

The skull was reconstructed and conserved by Karl Schlabow of the Schleswig-Holstein Museum Vorgeschichtliche Altertümer. Physical anthropological investigations were conducted at the time by Herrn Professor Hans Weinert of the Anthropologisches Institut der Universität Kiel (Schlabow 1948), who concluded that the skull belonged to a male who had been 50 to 60 years of age at the time of his death (Kersten 1949:2; Schlabow 1948). The specific methods used for age estimation and sexing were not identified in the archives. During the anthropological examination two specific points of trauma were identified. A sharp object had decapitated the man at the second [cervical] vertebra; the cut marks were clearly visible on the bone. Also, a 12 cm area of depressed bone on the left frontal bone was completely shattered with pieces of the skull driven deep into the braincase. This was attributed to a blow with a blunt object to the left side of the skull (Kersten 1949:2). Photographs, pencil, pen and ink (Figures 44 and 45) and pastel drawings (Figure 46) of the skull before and after reconstruction were placed in the archives of the Archäologisches Landesmuseum at Schloss Gottorf and are still available for consideration.

The hair was extremely well preserved and was subjected to microscopic analysis by Karl Schlabow. The microscopy showed that although reddish-brown when discovered, the hair was originally light blonde with strands of white. The hair had retained its elaborate style: divided in the middle of the head into two neat bundles that had been twisted

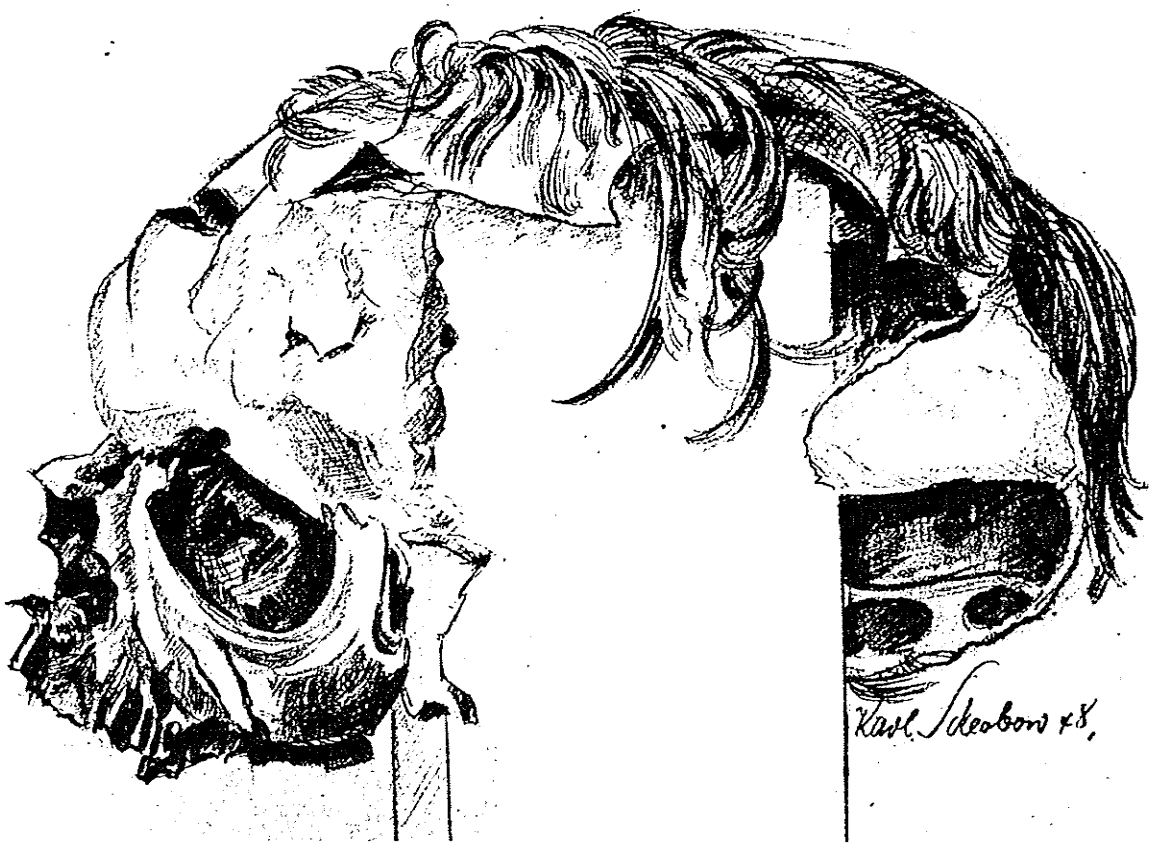


Figure 44: Pen and ink drawing of the partially-reconstructed skull from Osterby (left side), drawn by Karl Schlabow (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

around each other to form a complex vertical knot on the right side of the head at the temple (Kersten 1949:2; Schlabow 1949:3). Known as a "Suebian knot", the Osterby skull was the first time an original Suebian knot was identified on a body (Kersten 1949:2), although several images of the knot exist in Greek and Roman art from the second century A.D. and had been described in Roman texts of the time (Schlabow 1949, 3). In order for the Suebian knot to have been formed it is estimated that the hair was approximately 28 cm in length (Schlabow 1949:3). The knot was held without pins or



Figure 45: Pen and ink drawing of the partially-reconstructed skull from Osterby (front), drawn by Karl Schlabow (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).



Figure 46: Pastel Drawing of Osterby skull during reconstruction (highlighting the hair knot), drawn by Karl Schlabow (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

binding of any sort (Schlabow 1949:5). The specific meaning of the hair knot is unknown; it may have been a common style of the time for any male with long hair, or there may have been an inherent social meaning attached to the style (Schlabow 1949: 5). The hair knot will be discussed in more detail in Chapter 13.

The clothing

Over the Osterby skull was a poorly preserved covering made from pieces of tanned deerskin stitched together. The maximum dimensions of the skin fragment were 53 cm in length by approximately 40 cm in width and have been identified as part of a shoulder cape. Since one end of the fragment is clearly the neckline of the cape it was possible to estimate the maximum dimensions of the cape as approximately 1.5 m wide by 60 cm long and it is most likely that the cape was deposited whole but did not preserve well in the peat. The neckline area is double stitched with a hem approximately 1 cm in width. Two other pieces of hide are stitched to the main piece with a fine thread made of gut (Schlabow 1949:6). The deerskin was not examined during the course of this research.

Additional information

In December of 1953, two cremation urns and an area of burning (cremation pit) were discovered by a house contractor digging an area in preparation for construction. The second urn at this site contained an "object" made of iron (Thomsen 1953). Although these urns were not found in peat, they were within a short distance of the location where the skull was found. Two years later a cremation urn was found near the find site of the skull. The urn was believed to date to approximately 100 years B.C. and an iron belt clasp was found within the urn (Kersten 1955).

Results of the Physical and Anthropological Analyses

Visual assessment

Close examination of the bone surface shows traces of blue clay or plasticine; likely the remnants of the reconstruction effort on this skull. The small blue fragments can be found on both the left and right zygomatics, in both orbits, on the maxilla and the left frontal region. There are no teeth remaining in the maxilla, but the first and second molars of both sides are still present in the mandible. The entire skull was filled with plaster during the reconstruction process and weighs approximately 10 kg. There is a small, rectangular wooden block with a screw hole embedded in the plaster block to allow for easy mounting in the museum display case.

During the examination it became apparent that mandible is not related to the cranium (Figures 47 and 48). The mandible is somewhat more robust than the remaining cranial bones. Also, the bone of the mandible is black in colour, while the facial and frontal bones are dark brown with some lighter brown patches. While this could be the result of variable taphonomy, the jaw is far more evenly coloured and textured than the other remaining bone. The mandible has been permanently glued into place. On the left side, the mandibular condyle was mounted just forward of the temporo-mandibular joint and glued with clear glue that is now yellowed. The coronoid process is not glued to the skull and is visible just behind and beneath the zygomatic. On the right side, the mandibular condyle is mounted approximately in the temporo-mandibular joint. The coronoid process is glued to an area of plaster approximately 2 cm below the zygomatic. The yellow glue is clearly visible at both points. It is clear that neither mandibular condyle fits into the corresponding temporo-mandibular joint.



Figure 47: Osterby skull (Photo: Heather Gill-Robinson)

Following the identification of the mandible as belonging to a second individual, the archives pertaining to this find were checked. There are several photographs and drawings of the skull at the time of excavation and prior to reconstruction, none of which show any piece of a mandible. Photographs of the skull after reconstruction show it as it remains today, with the mandible in place. It is evident that the mandible was treated to

match the skull for display purposes. It is unknown from where the mandible originated, but it is unlikely to be another bog body.



Figure 48: Osterby skull: left mandible attachment (Photo: Heather Gill-Robinson)

Fragments of cranium were recovered and still exist, but they are firmly attached to the plaster reconstruction and impossible to separate or specifically identify. The remaining hair further complicates the possible identification of cranial bone. The facial area required less reconstruction but was not intact.

Metrics

Since the mandible was clearly not associated to the Osterby skull, no metrics were taken of the mandible. Measurement of the Osterby cranium was limited to upper facial height (n-pr), nasal height (n-ns), nasal breadth (al-al), orbital breadth (d-ec), orbital height, biorbital breadth (ec-ec) and interorbital breadth (d-d) (see Table 9). Since the facial region of the skull also underwent some reconstruction during the conservation process, it is unknown whether the reconstruction is accurate and these measurements may not be representative of the individual in life. Furthermore, the skull is substantially smaller than one might expect of non-bog skeletal material, as are many of the bog bodies, and the measurements may not be comparable with skeletal material that has not been exposed to the acidic bog taphonomy.

Measurement	**mm**
n-pr	70
n-ns	55
al-al	21
d-ec	40
orbital height	33
ec-ec	110
d-d	25

Table 9: Osterby: Craniometrics

Sex and age determination

This individual was originally estimated to be approximately 50 to 60 years of age at the time of his death. It is unknown what methods were used for the original assessment. In the case of the Osterby skull, only non-metric traits of the skull are available for sex determination; obviously the mandible cannot be included for sex or age assessment. Both mastoid processes appear to be part of the plaster reconstruction. The skull does have prominent supra-orbital ridges and relatively squared orbits that would suggest a male. The gracility of the skull can be attributed to taphonomic factors in the acidic peat, since bone often shrinks.

In terms of aging, there are no teeth remaining in the maxilla so it is not possible to age by dentition. Any cranial sutures that may still exist are obscured by hair or affected by the peat taphonomy or reconstruction process. It is not possible to determine an accurate estimate of chronological age for the Osterby cranium.

Image Analysis

The Osterby skull with attached mandible was scanned using multi-slice computed tomography (MSCT). The MSCT images were then partially reconstructed using Mimics in an attempt to visualise further information. It was hoped, for example, that cranial sutures might be visible below the hair. The plaster in the skull caused substantial imaging artifacts, specifically a large halo of interference was generated around the entire cranial region, although it was less evident around the facial region where there was no plaster. During the image reconstruction process the interference, along with the cradle in

which the head rested during scan, had to be removed from each of the scan slices individually. Figure 49 shows the face of the man after the image has been edited. This is the first time that the original facial bones have been separated from the reconstructed cranium. The gracility of the face is apparent. Finally, Figure 50 shows a sagittal cut through the skull of the Osterby Man. The extent of plaster in the cranium is clearly visible. This is the first cross-section view of this skull and is interesting from a both a museum conservation standpoint and an anthropological perspective. The highly reconstructed cranium is clearly thin and the robusticity of the mandible is evident.

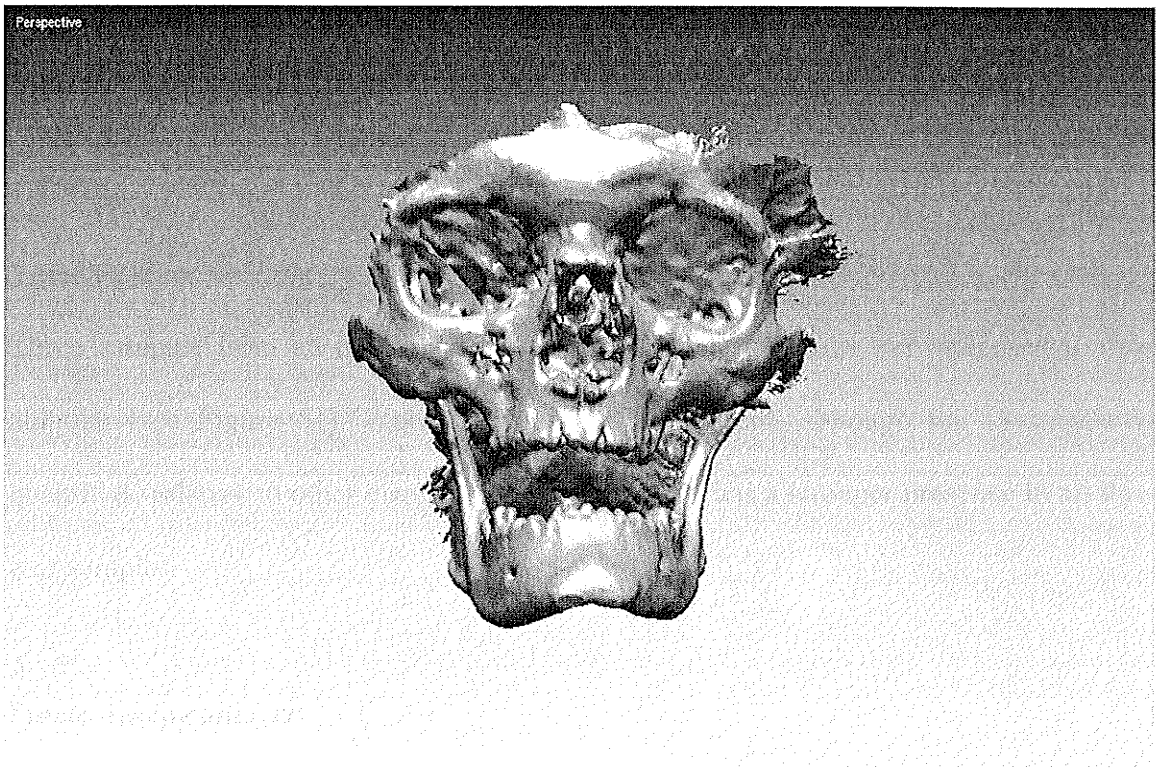


Figure 49: Face of the Osterby Man, after image editing

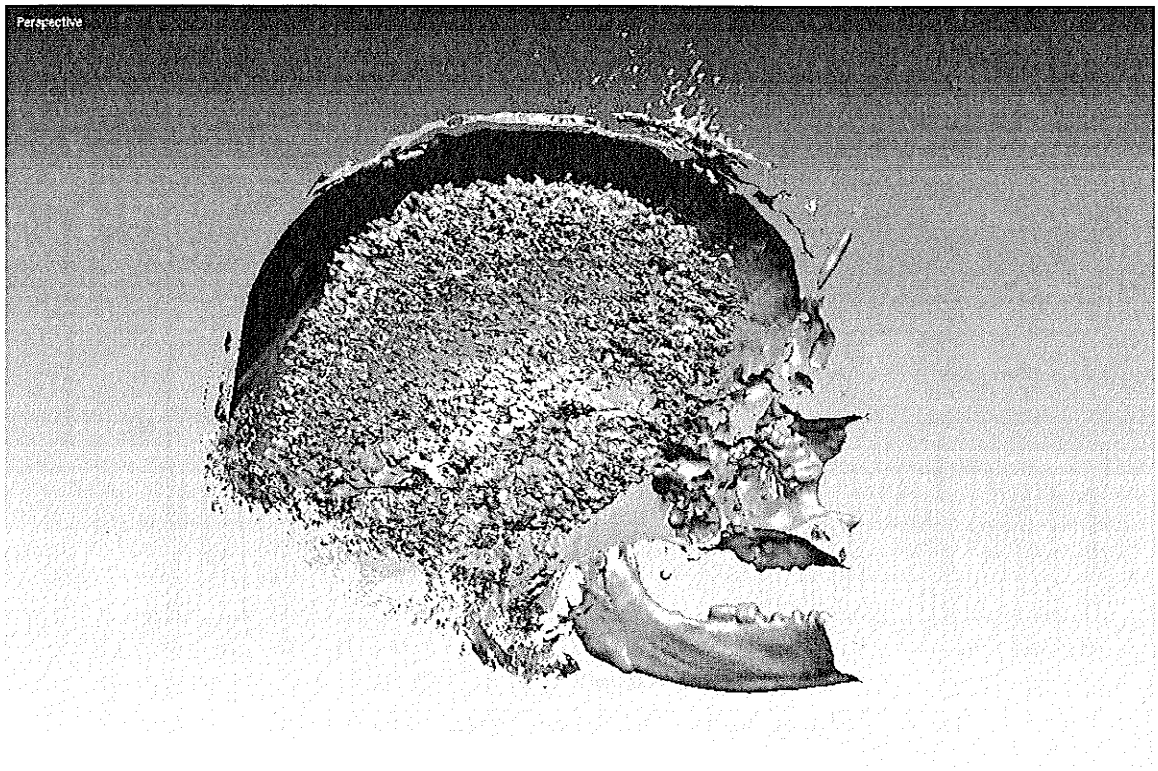


Figure 50: Osterby Man, view inside the skull, the extent of the plaster.

Trace element analysis

Three samples from an individual hair from the Osterby scalp were exposed to laser ablation (see Figure 51). Zinc was found to be present, although not in substantial quantities, relative to other elements. Lead, however, has a stronger presence in all three hair samples.

Stable isotope analysis

Approximately 12 hairs from the scalp of the Osterby skull were submitted for stable isotope analysis. Preliminary stable isotope data mean values were: δ13C -20.92/δ15N 6.78, suggesting that the man had consumed primarily a vegetarian diet. The results of the stable isotope analysis are discussed in more detail in Chapter 13.

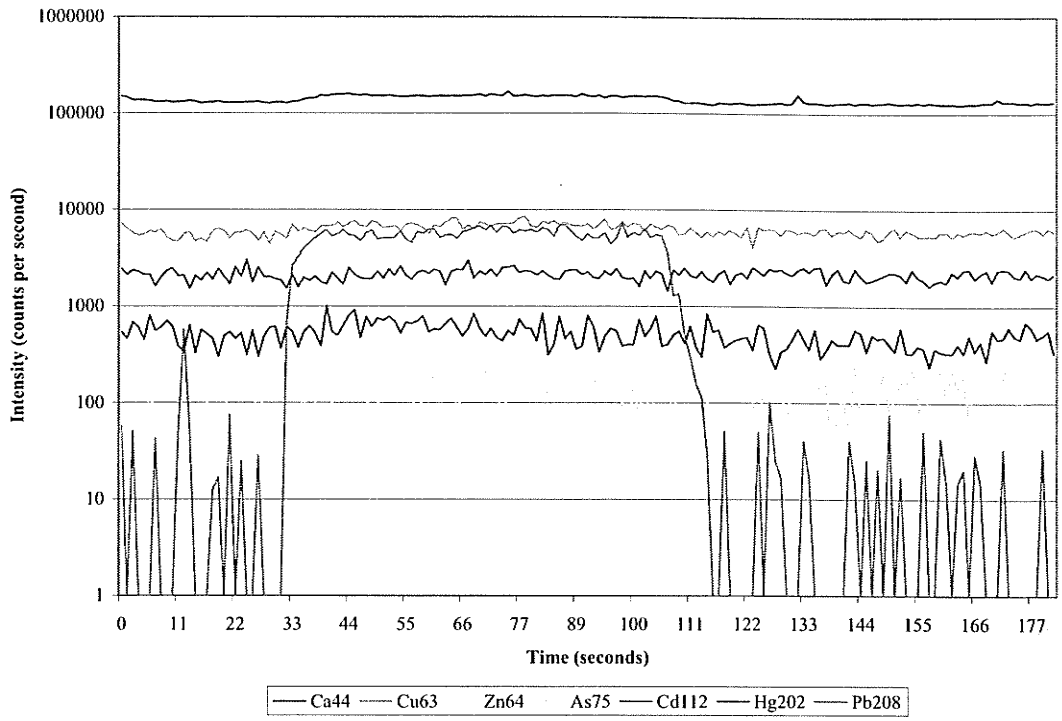


Figure 51: Osterby skull: Presence of trace elements

SUMMARY

The Osterby skull, discovered in 1948, is that of an adult male, but it is not possible to provide a definite age. The mandible currently attached to the substantially reconstructed cranium is not from the same individual. The skull reconstruction and subsequent conservation reduces the validity of craniometrics and it was not possible to evaluate the reported fracture to the left temporal region. MSCT imaging and three-dimensional reconstruction was unable to provide additional information for the interpretation of the skull. Trace element analysis suggested the presence of lead, but it is unclear what the presence of this element in this context means. The results of the analyses will be discussed and interpreted further in Chapter 13.

CHAPTER 10
WINDEBY I AND II

INTRODUCTION

The best known and most thoroughly studied bog body in the collection at Schloss Gottorf is known as the "Windeby Girl". Found during mechanical peat cutting in the Domlandsmoor near the town of Windeby in Kreis Eckernförde (Figure 52) on May 19th, 1952, the Windeby Girl is one of two bodies from this bog that form part of this research. The second body (Windeby II), an apparent adult male, was found five meters from the first body on June 9th, 1952 – just 20 days after the discovery of Windeby I (see Figure 53). This chapter presents an overview of the Windeby I and Windeby II bodies from the point of discovery through the results of the current research.

PREVIOUSLY PUBLISHED ANALYSES

Introduction

There are more publications on the Windeby I and II bodies than any other bog body in the Schloss Gottorf collection. The data from these publications are presented below, while theories that relate to the interpretation of the bodies are discussed in more detail in Chapter 13. Several artifacts that were recovered from the Domlandsmoor, at various times, are also discussed in detail in Chapter 13.

The first detailed publication about the Windeby bodies was published as a section of more than 100 pages in *Praehistorische Zeitschrift* in 1958. A multi-authored team presented data on the discovery and excavation of the bodies (Schlabow 1958a, 1958b);

conservation (Schlabow and Hage 1958); the preserved brain of Windeby I (Spatz et al. 1958); pollen analysis (Schütrumpf 1958); radiology (Hage 1958); anthropological

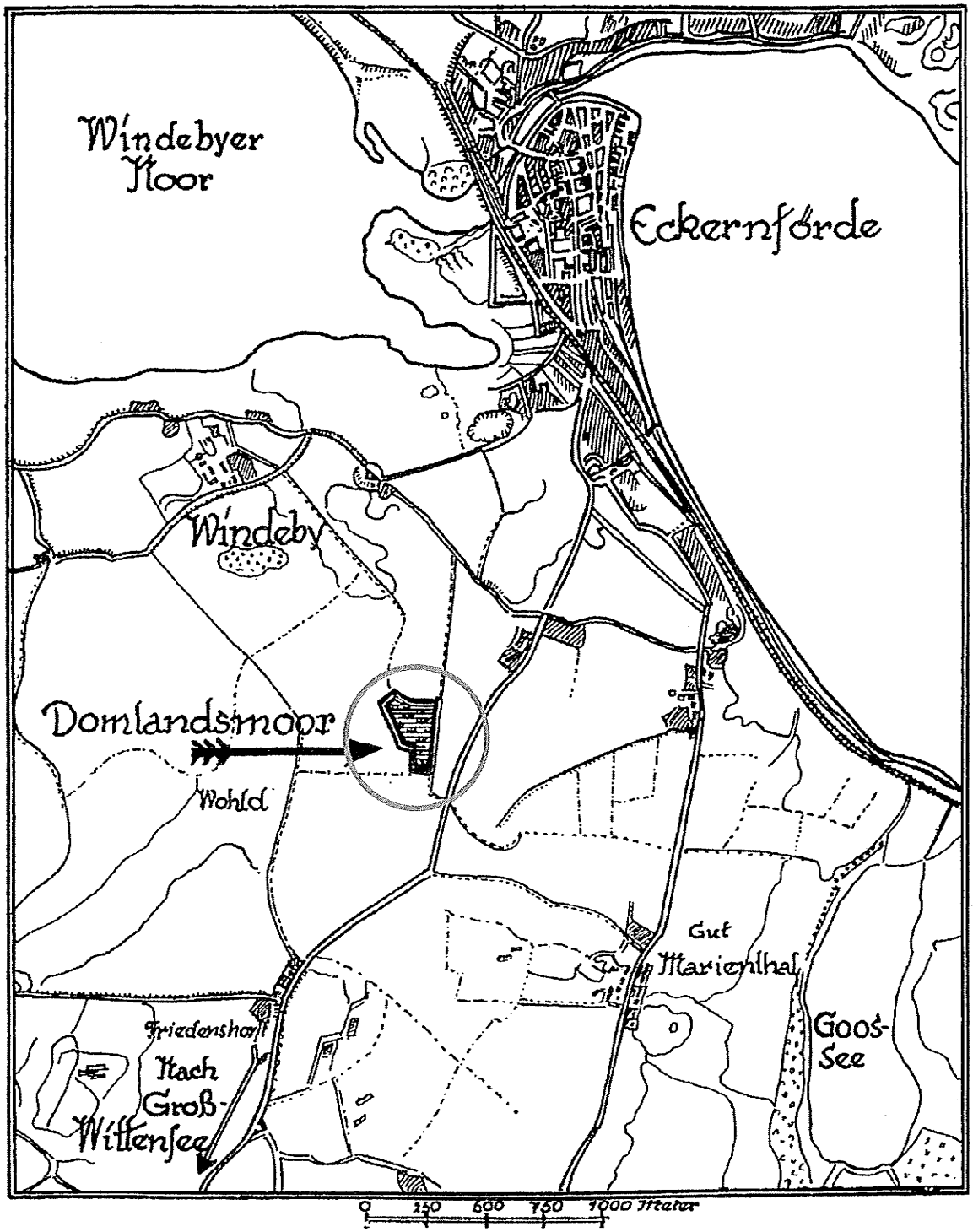


Figure 52: Map of the region showing the bog where Windeby I and Windeby II were found (Source: Schlabow 1958a:119). Reprinted with permission, 2005.

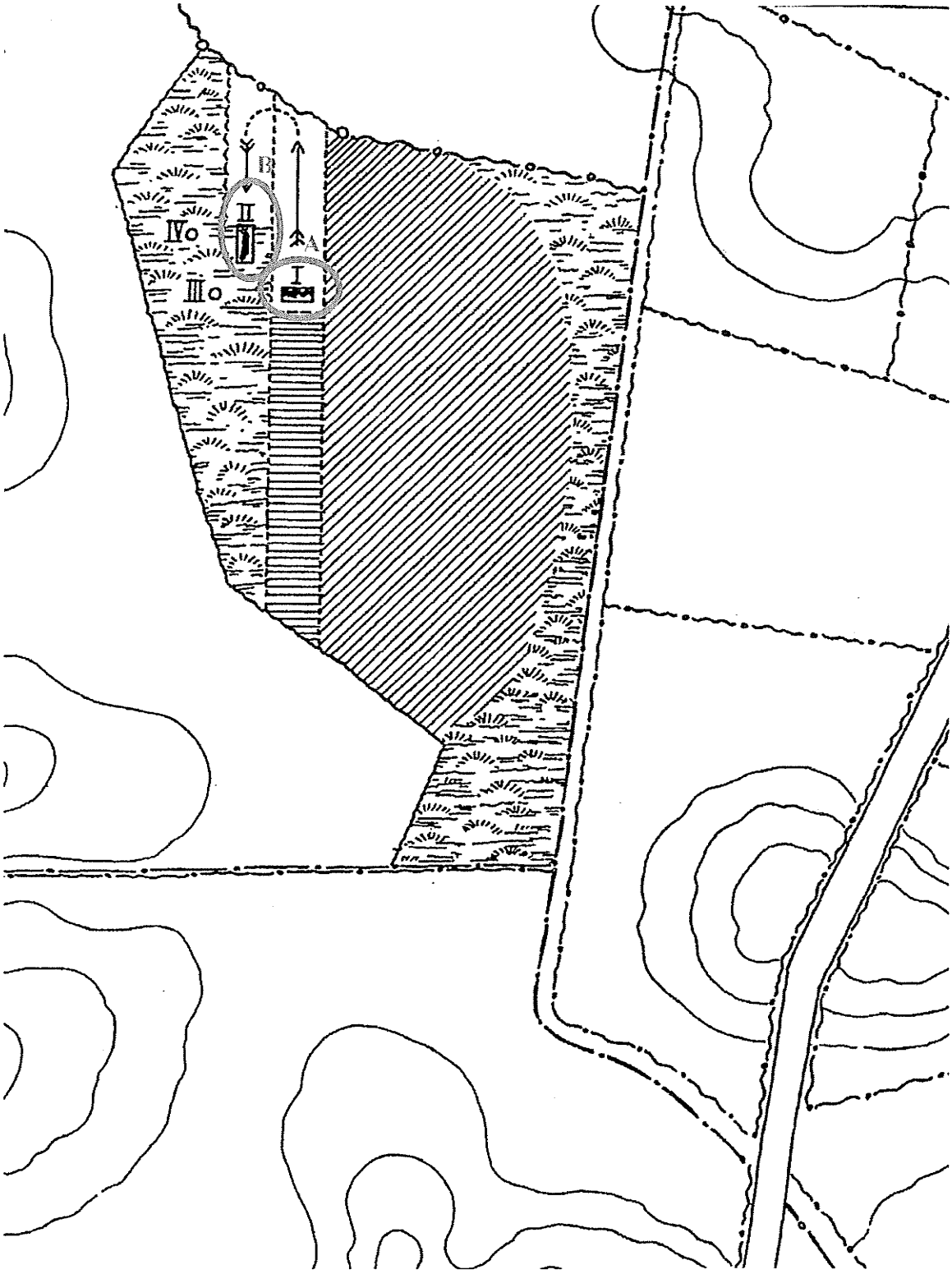


Figure 53: Map of the Domlandsmoor, showing the find location of the Windeby I (marked "A") and Windeby II (marked "B") bodies. It is unknown what the numbers "III" and "IV" identify (Source: Schlabow 1958c:186). Reprinted with permission, 2005.

examination (Schaefer 1958) and the potential interpretation of the bodies (Jankuhn 1958b).

Two decades later, in 1979, the journal *Offa* published a collection of articles related to the analysis of the Windeby I body. A brief forensic report discussed aspects of preservation and evidence for determination of a possible cause and manner of death (Grüner 1979). Another article reported methodology and results of a forensic facial reconstruction of the Windeby Child (Helmer 1983). Caselitz (1979) provided an overview of diet and nutrition in the Roman Iron Age, with specific reference to Windeby I.

This group of analyses also include the first comprehensive review of theories related to Windeby I body (Gebühr 1979). Gebühr (1979) presented evidence to support several alternatives to the common theory that the Windeby Girl was an adulteress who had been punished for her crime (Cordes 1960). For the first time, other possible hypotheses for the interpretation of the Windeby I body were outlined and provided the basis for the potential re-interpretation of bog bodies in general. Gebühr (1979) was also the first researcher to identify the Windeby I individual as the "Windeby Child", rather than "Windeby Girl". The possible meanings of, and explanations, for the bog bodies are discussed in detail in Chapter 13.

The Windeby I body was used as a case study in a volume discussing links between archaeology and forensic science (Berg et al. 1981). The chapter specifically addressed

the theory that the "Girl from Windeby" was the result of a "moral scandal" (Berg et al. 1981:84).

In 2003, a German forensic journal published an article on bog bodies and, more specifically discussed the "Girl from Windeby" (Windeby I) (Schäfer 2003). The article reviewed known information about Windeby I, including some of the previous interpretations of the body and a summary of the possible taphonomic processes allowing the preservation of the body. Schäfer (2003) also discusses the results of analyses conducted on other bog bodies, including identifying aspects of palaeopathology and trauma, and provides an overview of some of the artifacts, clothing and textiles found with various bog bodies (Schäfer 2003).

Radiocarbon dates have been published in relation to both Windeby bodies. In 1995, a sample of hair from the Windeby I body (GrN-20546) was tested at the Groningen laboratory; it was reported to yield a date of 6540 ± 70 B.P. or 5578-5322 B.C. when calibrated to 2σ (van der Sanden 1995b:147), which is the late Mesolithic on northern Germany. This very early date was considered problematic and was dismissed. In the same article, a sample associated with the Windeby II body (GrN-20547) was tested at the same laboratory; it provided a date of 7130 ± 70 B.P. or 6020-5866 B.C. when calibrated to 2σ), which is also a late Mesolithic date (van der Sanden 1995b, 148). The exact nature of the Windeby II sample was not specified. Like the Windeby I late Mesolithic result, this data was discounted.

Most recently, a comprehensive article detailing the dating of bog bodies by ^{14}C-AMS included samples from several of the bog bodies from the Schloss Gottorf collection, including Windeby I (identified as "Windeby Girl"). These dates referred to three samples taken from the fur cape around the neck of the Windeby Child and dates ranged from 225 B.C. – A.D. 55 when calibrated to 2σ (van der Plicht et al. 2004:480). The previous test (sample GrN-20547) was conducted by the same laboratory (Groningen) as the samples presented in van der Plicht et al. (2004), but the 1995 date was not included in the 2004 article. There was no date presented for the Windeby II body in van der Plicht et al. (2004), although the sample from the 1995 was, once again, from the Groningen lab.

van der Plicht et al. (2004) also lists dates for a sample of bone, a sample of wood and a sample of cape hair from the Windeby II body which were tested at the Leibnitz Laboratory in Kiel. There is some variation in these dates, which range from 520 B.C. to A.D. 83 (van der Plicht et al. 2004). More details on these specific dates, as well as issues related to radiocarbon dating of bog bodies, are discussed in Chapter 13.

Discovery and excavation

Windeby I

During mechanical peat cutting at the site, an oval area was identified where the peat was much lighter in colour than the surrounding peat. Investigation of the light patch revealed a body beneath it (Schlabow 1958a). When the body was first discovered the Schleswig-Holsteinischen Landesmuseums für Vor- und Frühgeschichte was notified and the decision was made to excavate the body as a 3 m by 3 m peat block. During excavation of the body from the peat block a birch pole was discovered at a depth of 1.27 m and the

right hand found only two cm lower. The thumb of the right hand was between the index and middle fingers, which later becomes important in the interpretation of this body and will be discussed in Chapter 13. The rest of the body was slowly excavated from the block, with the head laying in an east-west orientation. A fur cape lay around the upper part of the body. There was a stone found under the body but it is unclear whether the stone lay across the body at the time of deposition. Four small clay pots were also found near the body (Schlabow 1958a). Figures 54 and 55 indicate the placement of the body, stone and clay pots.

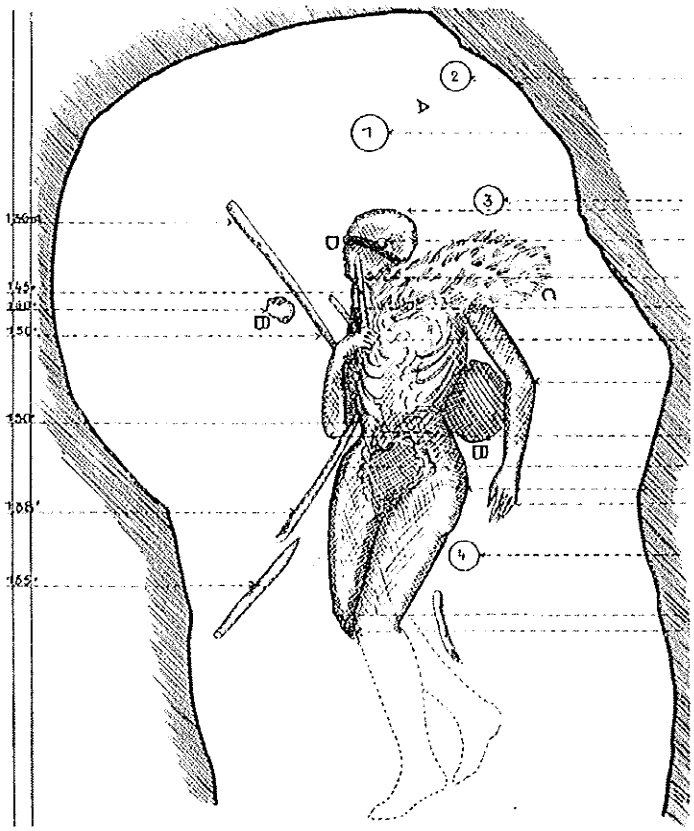


Figure 54: Sketch of Windeby I *in situ*. The stone found near the back is marked "B" and the clay pots are represented by circles numbered 1 through 4. (Source: Schlabow 1958a:123). Reprinted with permission, 2005.

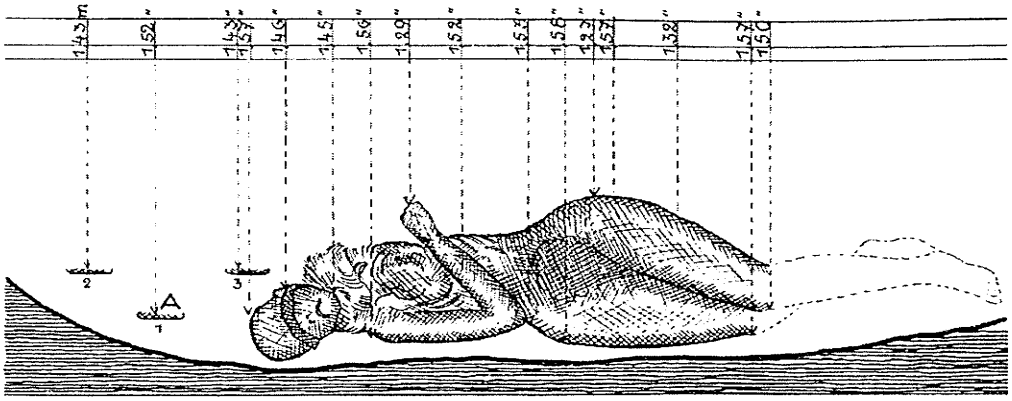


Figure 55: Sketch of Windeby I *in situ*. Three of the four clay pots are represented by hatched areas numbered 1 through 3. The fourth is behind the body (Source: Schlabow 1958a:123). Reprinted with permission, 2005.

Windeby II

The second body from the Windeby bog was discovered on June 9th, 1952, only three weeks after the first body was found (Helmer 1979a; Schlabow 1958c). As with Windeby I, the decision was made to excavate a 3 m by 3 m peat block, starting at a depth of 60 cm. During excavation, an oval area measuring 2.25 m by 1.3 m was identified as a grave (Schlabow 1958c:185). Figures 56 and 57 show the position and depth of the body *in situ* and the outline of the apparent grave.

At a depth of about 1 m, the first wooden branch, which was about the thickness of an arm, was found and the body appeared at a depth of about 1.29 metres. The naked body lay in a north-south direction on his back, with the lower arms crossed over the chest. The knee area was the highest point of the body, with feet and ankles deep in the peat. Eight thick branches, which appeared to have been cut with axes, lay across the body at various angles. The head was the lowest point of the body and seemed to be pressed down by the

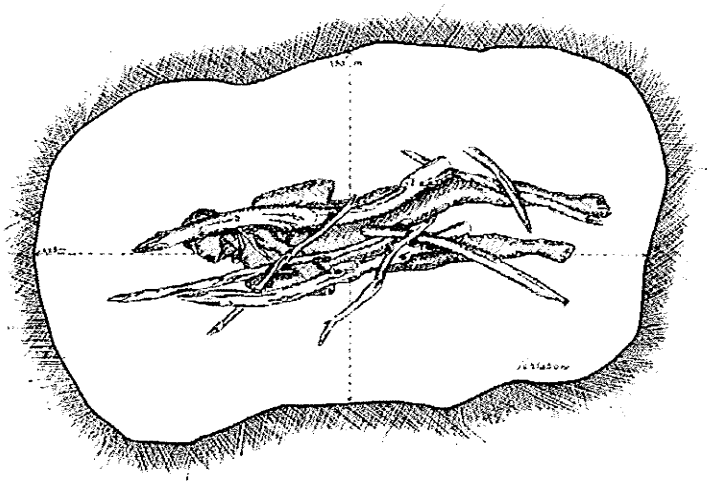


Figure 56: Windeby II body *in situ*, top view. (Source: Schlabow 1958c:187). Reprinted with permission, 2005.

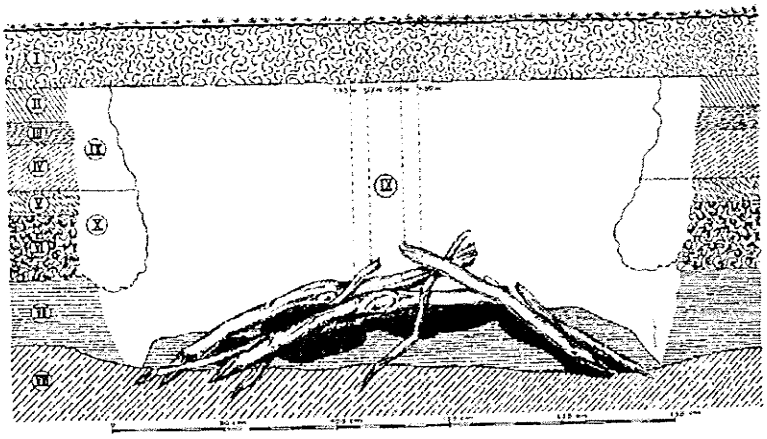


Figure 57: Windeby II body *in situ*, side view. (Source: Schlabow 1958c:187). Reprinted with permission, 2005.

largest branch. Around the neck was a ring of hazel roots that were about the thickness of a large finger and appeared to have been used to strangle the individual (Helmer 1979a; Schlabow 1958c:185).

Physical analyses

Windeby I

During excavation it became apparent that the skin had not preserved throughout the entire body. There was no skin remaining on the chest or abdomen and both sides of the rib cage were immediately visible. Physical and radiological examinations failed to identify any remaining internal thoracic or abdominal organs (Schlabow and Hage 1958), but the brain was exceptionally well preserved, although shrunken. The exceptional condition of the brain allowed extensive physical, histological and chemical analyses to be conducted and a cast was made (Spatz et al. 1958). The thoracic vertebrae were still articulated and showed no signs of violence; examination of the skin of the throat also showed no evidence for hanging or strangulation (Schlabow and Hage 1958).

Histological examination of the skin showed good preservation of even the fine structures of the skin. Further histological examinations of the cartilage and muscle were also undertaken. The muscular structure had completely disappeared but the outline of the cartilaginous tissues was still recognizable. The structure of the bone was examined by radiography, since histological analyses were not possible (Schlabow and Hage 1958).

All of the bones were severely demineralized. It was difficult to determine the best exposure time and strength to produce the best images and several attempts were required. To avoid accidentally bending the bones, papier maché forms lined with paraffin were made to provide support during the radiography process. From the 8th cervical vertebra to the first lumbar vertebra was preserved and visible on X-ray. Upper cervical vertebrae were not visible because of the presence of the fur cape around the

neck of the body. The ribs, clavicles, scapulae, and humerii were well preserved and imaged well. During X-ray of the skull the exceptional preservation of the brain became obvious (see Figure 58). The X-rays also revealed 11 distinct growth interruption lines on both tibiae and the distal epiphyses were also clearly defined on both tibiae (Figure 59). The individual was identified as a 14-year-old on the basis of epiphyseal fusion (Hage 1958; Schaefer 1958).

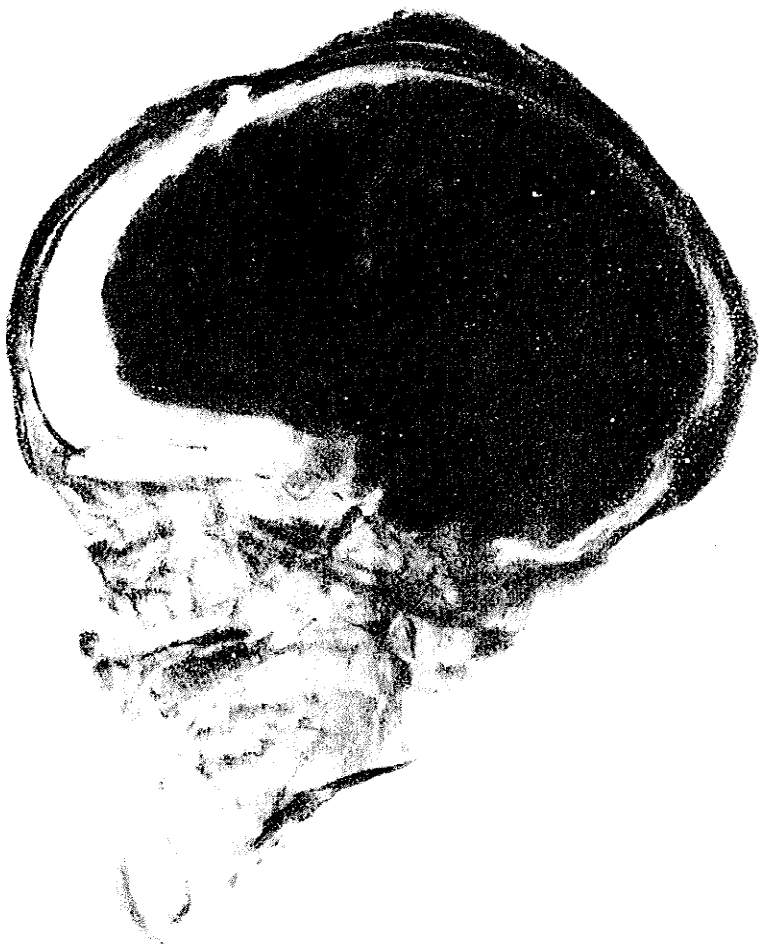


Figure 58: Windeby I – skull X-ray showing brain (Source: Hage 1958:168). Reprinted with permission, 2005.

Although the dentition was also severely demineralized, a few observations were possible. The teeth were black and shiny. Both crown and root had preserved in pieces.

The enamel was missing (Schaefer 1958). None of the wisdom teeth had erupted (Hage 1958; Schaefer 1958). No teeth remained in the mandible; the incisors and second right premolar of the maxilla were lost after death (Schaefer 1958). On the basis of eruption of

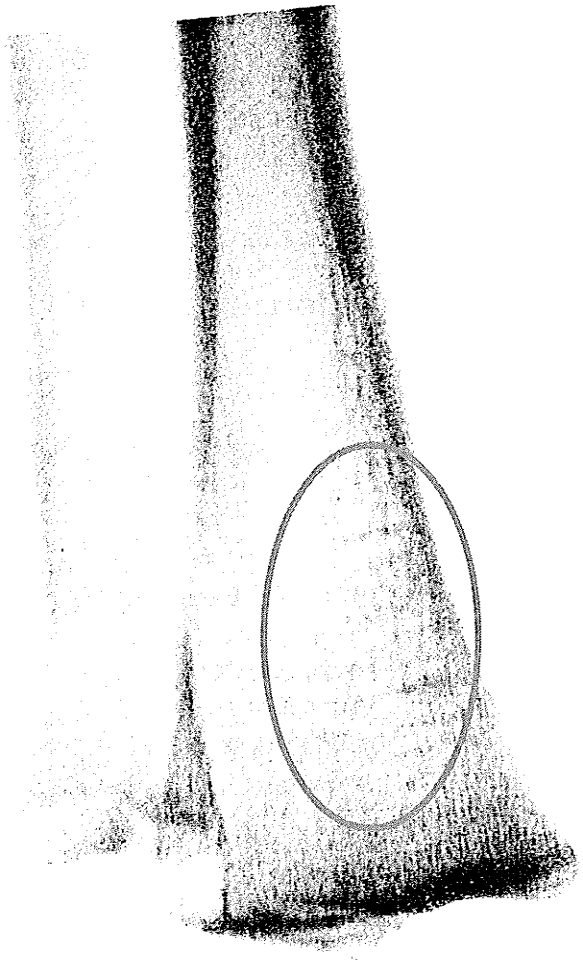


Figure 59: Windeby I – tibiae, showing possible Harris Lines (Source: Hage 1958: 169). Reprinted with permission, 2005.

the premolars, it was suggested that the individual was at least twelve years of age at the time of death. Based on the status of the second molars, it was estimated that age at death was between 14 and 17 years of age (Schaefer 1958).

Upon examination of the cranium, the spheno-occipital suture of the cranium was reported to be open. This would suggest an age of under 18 years at the time of death (Schaefer 1958:175). When the age estimates based on dentition and the spheno-occipital cranial suture were combined with the state of epiphyseal fusion it was suggested that the individual was a juvenile (Schaefer 1958, 175). Radiological and anthropological examination was used to identify the individual as a female (Schlabow 1958b).

The hair of the Windeby I body was examined microscopically. It was reported to have originally been light blonde, soft and lightly curled (Schlabow 1958c:189), although the peat had turned the hair dark reddish-brown in colour.

Fingerprints were taken from the second and fourth fingers of the left hand. Prints were also taken from the fourth toe of the left foot. The second finger was identified as a radial loop, while the fourth was an ulnar loop. The toe showed clear evidence of a delta (Schaefer 1958:175).

The body was found with a band across the eyes (see Figure 60). This has been interpreted as a blindfold (Schlabow 1958b). The band, woven in the "sprang" technique, is very similar to other woven bands used as hairbands during the Iron Age (Schlabow 1958b). This band is discussed in more detail in Chapter 13.



Figure 60: Windeby I head with band across eyes (reconstruction). (Source: Schlabow 1958b:181). Reprinted with permission, 2005.

Windeby II

After excavation it was realized that, unlike Windeby I, most of the skeletal material had dissolved in the body as a result of the acidic environment, so only the skin remained. The body was dehydrated and treated with Turkish oil for conservation (Schlabow 1958c: 189).

At excavation, Windeby II had hair that had been cut to about 2 cm in length and described as "stiff" (Schlabow 1958c:189). The hair was examined microscopically and

determined to have originally been dark brown in colour, but had turned red in the peat (Schlabow 1958c).

Pollen analysis

Windeby I

Samples for pollen analysis were taken from immediately underneath the peat block of Windeby I, directly under the location of the shoulder. The layer was 20 cm thick and consisted of sphagnum peat. Pollen samples were taken from the layer at 2 cm intervals. Analysis showed only small amounts of tree pollen and an abundance of *graminae,* with some ericaceous plants also present (Schütrumpf 1958). A pollen profile was also taken from immediately beside the area of the peat block. This second profile more accurately reflects the layers in which the body was found since these layers were parallel to the find spot of the body, rather than from underneath. This section was composed of sphagnum peat and sedge peat, with some ericaceous shrubs in the uppermost layers. The peat block containing the body suggested that the body had not been just dropped into the bog or left on the surface. It was determined that the body has been placed in a deliberately dug peat cut that had been lined with ericaceous shrubs, perhaps as a grave (Schütrumpf 1958).

Windeby II

Samples for pollen analysis were taken (Schlabow 1958c) from a location near the body. The pollen profile was very similar to that of the samples taken under and near the Windeby I body. Given the close proximity of the two bodies, it is not unexpected that the profiles are similar.

THE 2003-2004 RESEARCH

Data obtained from the archives

Windeby I

The majority of the data from the archives have been published. There are a few small details in the archives that have not been published. For example, an attempt to determine the bloodgroup of Windeby I was made in 1979. This test was unsuccessful (Helmer 1979b).

In addition, there is a series of letters between an interested member of the general public, Paul Köhler, and Schloss Gottorf. Mr. Köhler had numerous, detailed questions about the bog bodies (eg. Köhler 1976a, 1976b, 1976c, 1979a, 1979b, 1979c, 1979d), over a period of several years, that were thoroughly addressed by several members of museum at various times (eg. Gebühr 1976; Hoika 1976; Schlabow 1976a, 1976b, 1979a, 1979b).

In 1978, Dr. Michael Gebühr prepared a list of questions about the Windeby bodies to submit to Dr. Karl Schlabow, Herr Hoffmann and Herr Wilczek, all of whom had been involved in the original excavation and analyses. It was very important to be able to completely document all aspects of the original excavation, examination, analysis and preparation of the bodies while the people involved were still available. Copies of the questions and answers are also included in the archives (Gebühr 1978a, 1978b).

Radiocarbon dating was undertaken at the Leibniz Laboratory in Kiel for several samples related to both Windeby I and Windeby II. The reports from the Leibniz Laboratory are

present in the archive files (Grootes 2002a, 2002b). All of the dates will be presented and discussed in Chapter 13.

Windeby II

A single radiograph of the Windeby II body, taken in the 1950s, exists. The image shows the branches around the neck of the individual and clearly shows that there is no skeletal material remaining in the head and neck area (Figure 61).

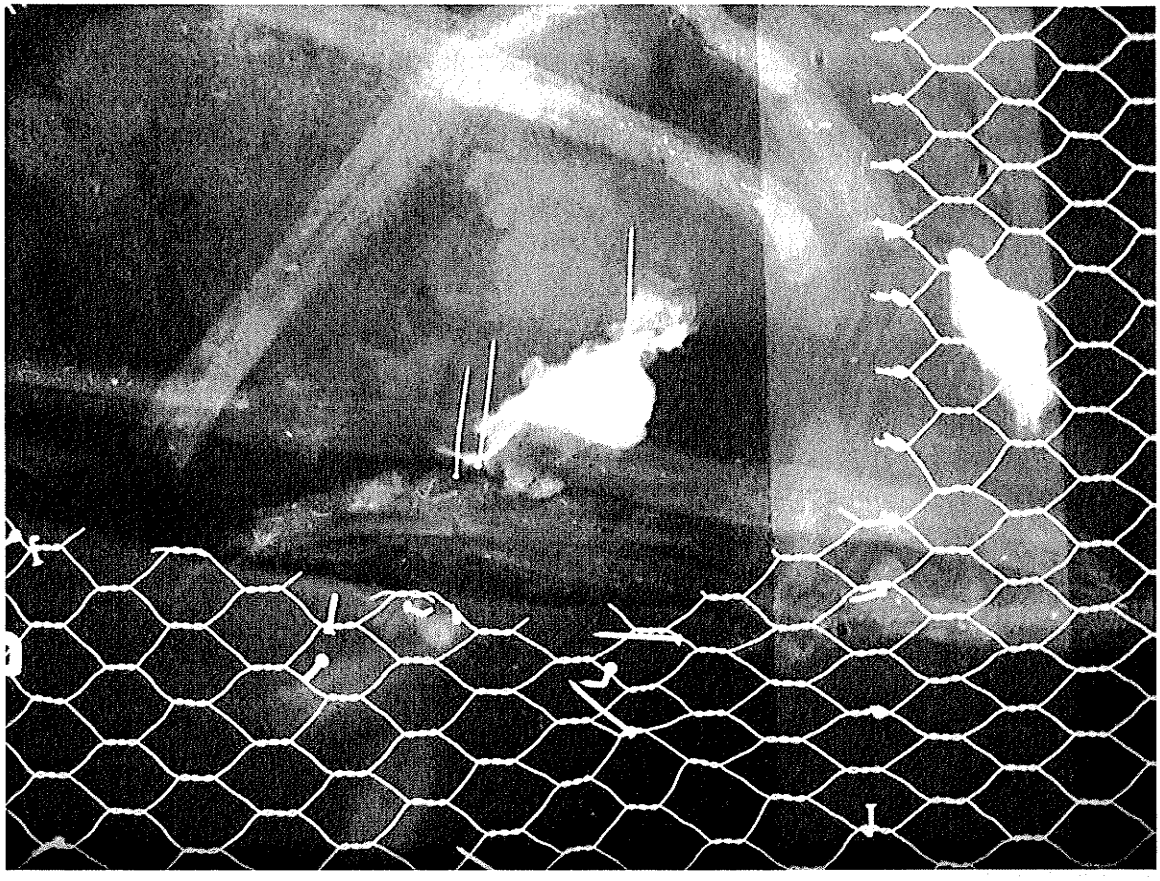


Figure 61: Radiograph of Windeby II neck area, showing branches (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

It was interesting to note that there were sherds from an urn immediately beside the body, although the pieces were in such poor condition that it was not possible to assign an age to the artifact (Anonymous n.d.a).

Results of the physical and anthropological analyses

Windeby I

Visual assessment

The reddish-brown hair is approximately 4 cm on the left side, but only a few mm long on the right side of the head. Although it is apparent that the hair is shaved on the right side, it is unclear exactly when or how the hair was cut. Although it is possible that the hair was inadvertently cut with a trowel or similar tool during excavation, there was no report of loose hair in the peat near the body. It is equally possible that the hair was cut shortly before the death of the individual, although the reason that only half of the hair was cut is unknown.

The thorax, abdomen and pelvis of the body are modestly covered with a substance resembling dried peat, to replicate the approximate conditions at discovery. The legs are slightly bent. The left arm is slightly bent with the hand resting on the left hip.

The majority of the skeletal material was removed from the body during conservation. All of the skeletal material is dark brown to black in colour with some traces of a white powder that appears to be plaster dust, possibly from a casting process during reconstruction. All of the skeletal material is currently stored in a large red plastic box labelled "Windeby, Eck KS 22672 Moorleiche" and kept in the organic storage unit of the museum. Inside the box the bones are not individually labelled but a tag identifying the contents as "Windeby, Eck Moorleiche, Mädchen" (Windeby, Eck bog body, girl).

Results of the physical and anthropological analyses

Windeby I

Visual assessment

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The cranium and mandible are both in good condition, although there are no teeth remaining in either the mandible or the maxilla (Figure 62). Both the cranium and the mandible are dark coloured and the mandible and underside of the cranium are nearly black. On the occipital the identifier "Windeby Eck KS 22672" is marked in white paint. There is some mild flaking on the surface of the cranium. Internally, there are patches of plaster residue remaining from a cast that was taken during conservation. There are two large pits on the left parietal. There have been attempts to fill these pits with putty, which was then stained dark brown. Both pits are shallow and concave, with rounded edges. It is unlikely that conservators would have chosen to deliberately obscure biological features, so these pits were likely viewed as taphonomic. Both pits are approximately 1 cm in diameter and smooth-edged. Both pits are deeper than would be expected of palaeopathological lesions and are likely taphonomic in origin.

There are traces of a white substance in some areas of the cranial sutures, as well as two small traces of a blue plasticine-like substance on the right coronal suture and left lambdoid suture. These trace materials may be from the process used to make a three-dimensional facial reconstruction in 1979. The point bregma and most of both coronal sutures have been filled with a putty or thick glue and are not suitable for determining age. Most of the sagittal suture is filled with a similar substance or the plaster residue described earlier, also making it unsuitable for accurate age determination. The cranium was opened during the conservation process to examine and cast the preserved brain. Although the skull was very skilfully reconstructed there are some areas that overlap slightly on the right lambdoid suture and the left lambdoid suture is partially concealed by putty and traces of blue plasticine. Given the apparent reconstruction of the cranium in

this area and the presence of the plasticine, it would be unwise to use these sutures for age determination.

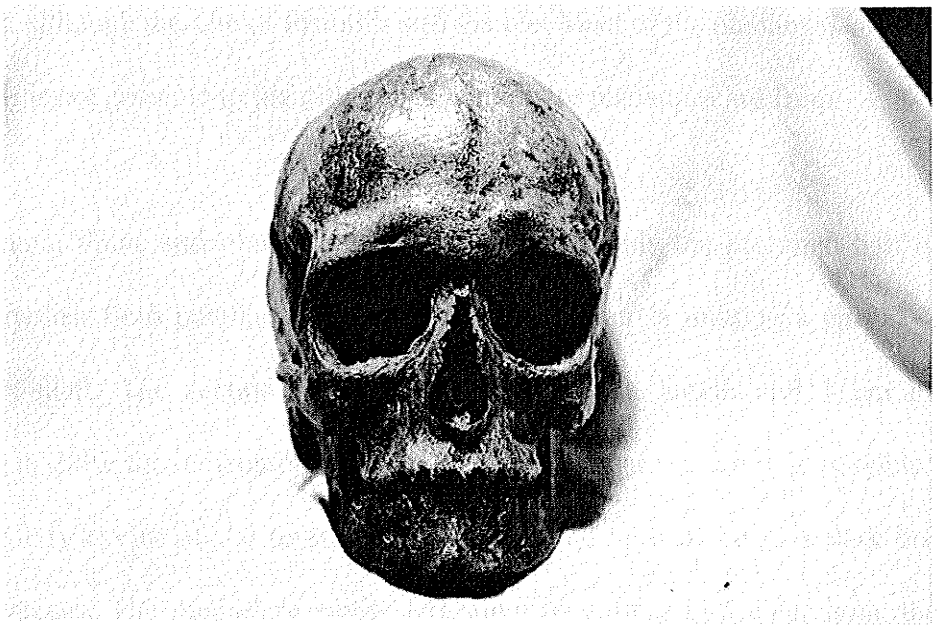


Figure 62: Windeby I skull (Photo: Heather Gill-Robinson)

Although it was reported that several demineralized teeth were excavated with the body (Hage 1958), it is unknown where the teeth are currently. It was not possible to examine any teeth and, therefore, teeth could not be used for aging of this individual or to assess health status.

The right scapula is present, but the central area is filled with thin brown putty that spreads to most of the edges. Both humeri, radii and ulnae are present and intact. There is some surface flaking on the diaphysis of the right humerus. There are traces of a black paint-like substance on all four bones; this was likely a preservative. Although the proximal ends of both humeri are both filled with putty and cannot be used for assessment

of age. There is some putty on the distal epiphysis at the lateral epicondyle of the right humerus, rendering it inaccurate for age assessment since the actual ephiphyseal region cannot be clearly observed. On the left humerus, both the lateral and medial epicondyles are fused, although the line of fusion is still visible. Most of the phalanges of one hand are present. It is not possible to identify which hand these phalanges are from.

Both femora, tibiae and fibulae are present, although only the proximal half of the left fibula remains. Both patellae are absent. The left femur is missing a partial section of bone mid-shaft. The section, approximately 5.3 cm in length and 1 cm thick, was removed in 2002 for radiocarbon dating. Through the cut section it is possible the view the medullary cavity of the femur. The inside of the cortical bone is dark brown with orange patches. The medullary cavity has some remaining trabecular bone that is also covered with an orange-coloured dust matching that of the cut sections. The epiphyses of the femoral head, greater trochanter and lesser trochanter are unfused and absent. The distal end of the left femur appears to be partially fused but the area between the epiphyses is filled with some sort of hardened putty, presumably to keep the bones together. The right femur is slightly bowed. The femoral head is partially fused. The greater trochanter is unfused and attached to the shaft epiphysis with a small metal nail. The distal epiphyses seem to be partially fused but are, once again, filled with putty. The lesser trochanter appears to be unfused. Both proximal and distal ends of both tibiae are unfused. The proximal end of the left fibula is unfused, as are both ends of the right fibula. The metatarsals of the left foot are present, along with several phalanges.

The right os coxa is present and virtually intact, although the epiphyses at the ilium are obscured by the same brown putty seen on the long bones. The pubis and ischium have fused. On the left side part of the acetabulum, the pubis and ischium are present. The left ilium appears to be unfused, while the pubis and ischium have fused.

The right scapula is present but held together with a brown paint-like paste. Nineteen vertebrae are present and all, except the atlas, are articulated and threaded onto a metal rod through each vertebral body. All of the cervical and thoracic vertebrae are present. None of the vertebrae have formed epiphyseal rings. The location of the lumbar vertebrae, sacrum and coccyx is unknown.

Metrics

The entire body as it rests in the display case is approximately 140 cm long, although this is an estimate since the peat mounded over the body prevents more accurate measurement. It was not possible to know exactly how much of the body existed below the mound. Although several bones from the body were included in the display, the majority of the skeleton was available for osteometric assessment (see Appendix D).

Sex and age determination

This body has previously been assessed as an adolescent female, although there have been reports that the individual may be male. The skeleton is generally quite gracile but that may be related to taphonomic factors since bone often shrinks in the bog. It is acknowledged that the accurate sexing of an adolescent individual is difficult but given the ambiguity of the data for this body it was felt that it would be appropriate to attempt to sex the individual.

Table 10 lists the non-metric traits used to sex Windeby I. The skull was evaluated for non-metric traits to attempt to determine the sex of the individual, using Buikstra and Ubelaker (1994) and the Workshop of European Anthropologists (WEA 1980) for guidance. The nuchal crest, mastoid process and supra-orbital margin all scored as ambiguous for sex determination. The glabella scored as ambiguous to probable male. The orbits of the individual are somewhat squared, suggesting a male (WEA 1980). The anterior dental arcade is slightly more squared than parabolic (by Sutter 2003), which would be consistent with a male.

METHOD OF SEX DETERMINATION	RESULT
Cranial morphology	
Nuchal crest	Indeterminate
Mastoid process	Indeterminate
Supraorbital margin	Indeterminate
Glabella prominence	Possible male
Dental arcade	Male
Orbits	Probable male
***Os Coxae* morphology**	
Pelvic aperture	Possible male
Obturator foramen	Male
Ventral arc	Male
Ischiopubic ramus ridge	Male
Greater sciatic notch	Male
Ischial spine	Indeterminate

Table 10: Methods used for sex determination of the Windeby I skeleton

Following the guidelines for the Phenice technique in Buikstra and Ubelaker (1994), the non-metric traits of the pelvis were assessed. According to this method, however, the

Windeby I child may be male. The overall pelvis is fairly narrow. There is no evidence for a ventral arc or subpubic concavity. The ischiopubic rami ridges are flat. Both obturator foramina are smooth-edged and oval. In a fully adult individual, all of these features would be suggestive of a male. Although there is a prominent ischial spine on the right ischium, there is only a small spine on the left, again causing ambiguity for sexing. Both the depth and the angle of the greater sciatic notch clearly suggest a male.

It is apparent that it is not possible to definitively sex this individual on the basis of non-metric cranial traits, but the pelvis strongly suggests that this individual is male. When the *os coxae* from the Windeby adolescent are compared to a known female skeleton, the Windeby I adolescent is very different. Samples were taken for DNA analysis and these are discussed in more detail below.

Although the most effective means to determine the age of this adolescent would be through dentition, there are no erupted teeth in either the mandible or maxilla of Windeby I . There are unerupted M3 on both sides of the mandible, which suggests an age under 21 years at death (Buikstra and Ubelaker 1994).

For age determination all epiphyses affected by putty have been discounted since the specific state of fusion cannot be accurately assessed. Table 11 lists the observable sites of epiphyseal fusion and the likely age estimate from that site, based on the Workshop of European Anthropologists (WEA 1980). The data suggest the individual may have been approximately 16 to 18 years of age at the time of death.

Area	Age Estimate
Left humerus – lateral epicondyles	17-18
Left humerus – medial epicondyles	17-18
Left femur – femoral head	≤18
Left femur – greater trochanter	≤18
Left femur – lesser trochanter	≤18
Right femur – femoral head	18-19
Right femur – greater trochanter	<18
Left tibia - proximal	<17
Left tibia - distal	<16
Right tibia - proximal	<17
Right tibia - distal	<16
Left fibula - proximal	<17
Right fibula - proximal	<17
Right fibula - distal	<17

Table 11: Windeby I: Age estimate by epiphyseal fusion

Palaeopathology

The entire skull is asymmetrical; it is much more flat on the left side than the right side. Since the body lay on its left side in the bog the asymmetry is pseudopathological. The pressure of the overlying peat on the body compressed the left side of the head.

There is evidence of an abscess at the right M1 and a more extensive infection at the right M2. The right M3 appears to be impacted deep within the ascending ramus and may not have erupted without complication. The left M3 is unerupted but would likely have erupted normally in time. The infection at the right M2 caused erosion and widening of the mandibular bone. There is some possible new bone growth, suggesting that the infection may have begun to heal but it is possible that the infection contributed to the death of Windeby I. While there is an apparent small fracture on the front of the mandible, extending down from the left canine, this is likely a pseudopathological

fracture caused by the taphonomy of the bog or through the excavation and conservation processes.

There is some mild pitting on the frontal area of the cranium. The original radiographs showed 11 Harris lines on each tibia of the adolescent. This may be indicative of nutritional deficiencies or other physical stressors. There is no further evidence for trauma or palaeopathology on the cranial or post-cranial skeleton. There is no identifiable cause of death, although it is possible that the dental infection identified at the right M2 in the mandible may have contributed to the death of the individual.

Image analysis

The original radiographs were not available for reassessment and the body was not subjected to digital radiography during this research. The cranium, mandible and pelvis were imaged using MSCT. The body with remaining soft tissue and some skeletal material, partially buried under a mound of artificial peat, is heavy and substantially reconstructed; it was felt that MSCT scanning would not provide any additional information. The skull and mandible were reconstructed in three dimensions using Mimics 8.11. The computer reconstruction made the pseudopathological flattening of the cranium even more obvious (Figure 63).

It was also possible to create three-dimensional models of the skull, mandible and pelvis of Windeby I using the Z406 rapid prototyping unit. A three-dimensional model of the Windeby I skull, following a sagittal cut, is seen in Figure 64. This model provided the opportunity to examine the inside of the skull, which was not possible with the original

skeletal material. The brain of this individual was preserved at excavation, although the current location of the organ is unknown. Since the skull was opened to

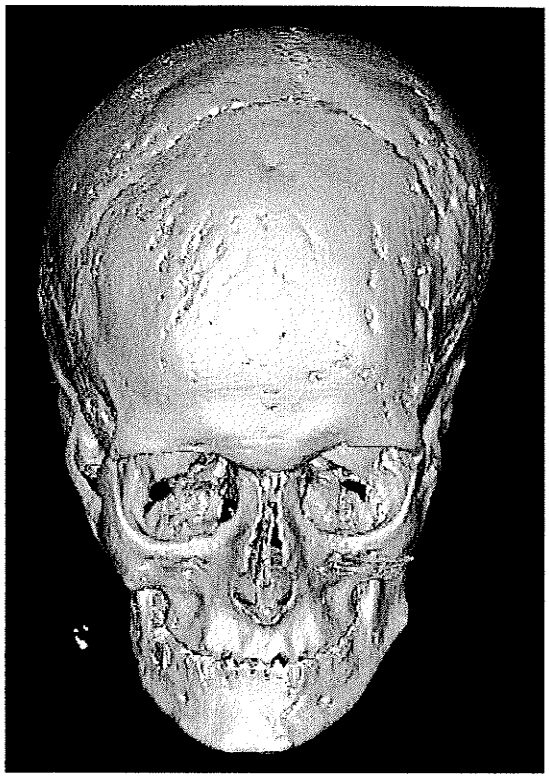


Figure 63: Three-dimensional model of Windeby I, showing pseudopathological flattening

extract and cast the brain, it was thought that there may be evidence of this process on the inside of the skull. Through the imaging, using a sagittal section to examine the inside of the Windeby skull, it was clear that the brain had not been returned to the skull after conservation. There were small traces of plaster adhering to the internal surface of the skull (circled in Figure 64). The arrow indicates the evidence of the cut mark from where the cranium had been opened to access the brain. This mark is virtually invisible on the surface of the original skull.



Figure 64: Model of the Windeby skull, inside view (Photo: T.T. Allard).

The pelvis of the Windeby I body was also printed, at full scale, through the rapid prototyping process. The examination of these models without benefit of the notes regarding the original visual appearance may be misleading. The presence of the putty at the epiphyses is not clearly visible on the models. If the observer was unaware of this conservation intervention, the pelvis may be misinterpreted.

Trace element analysis

Four samples from an individual hair of the Windeby adolescent were analysed by Dr. Norman Halden, of the University of Manitoba, using laser ablation (Figure 65). Zinc, lead and mercury were found in all four samples. The presence of copper was visible in one of the four samples. It is not clear whether the hair sample that tested positive for the presence of copper was at the scalp end or the cut end of the hair, so it is not possible to

say whether the copper was recently introduced to the system or the adolescent had been exposed in the months prior to death. A re-analysis of this hair to provide quantification of the level of copper would possibly allow further interpretation. This would require an additional hair sample of approximately 100 mg, which would represent most of the remaining hair on this body, so this testing was not feasible at this time. The levels of both zinc and lead from the hair of the Windeby adolescent are higher than those of both the Damendorf and Osterby hair samples, while the level of mercury is lower than that of the Damendorf body.

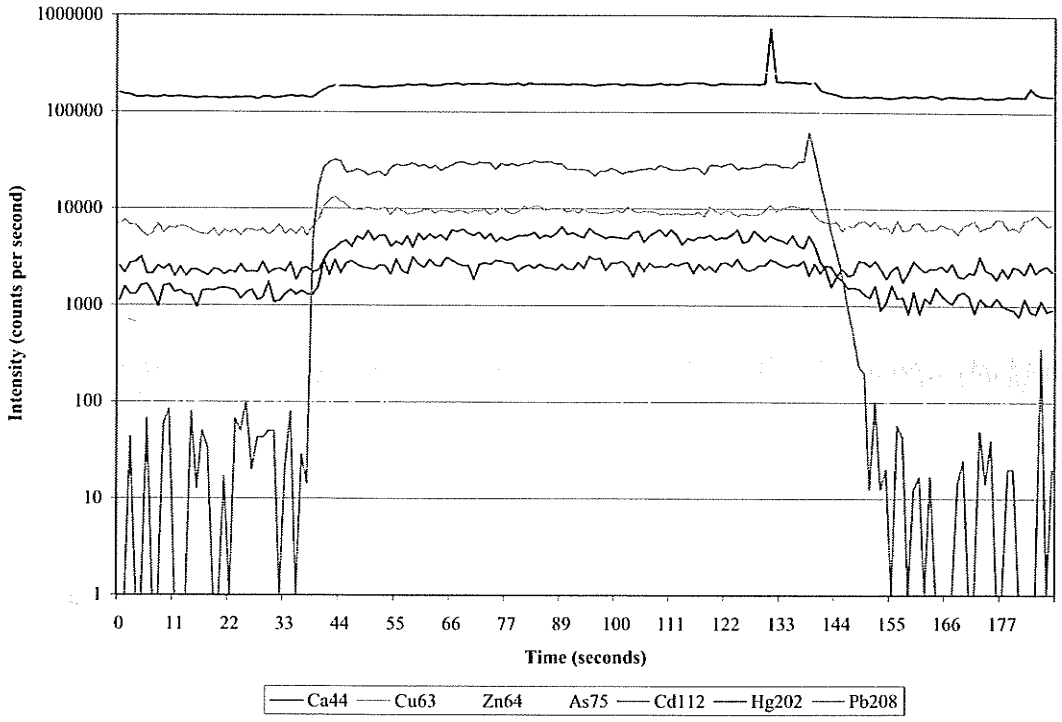


Figure 65: Windeby adolescent: Presence of trace elements

DNA

A total of three bone samples were taken for DNA analysis for sex determination. As discussed in Chapter 6, successful extraction and replication of bog body DNA is a new

development and very complicated so it was determined that multiple samples would be most appropriate. Two separate finger phalanges and a segment from the mid-diaphysis of the left femur were submitted to the Palaeo-DNA Laboratory of Lakehead University (Canada) for DNA analysis. Although replication at an external laboratory is still required, preliminary results suggest that the molecular data supports the morphological assessment. It is likely that Windeby I is male.

Stable isotope analysis

Approximately 12 individual hairs were plucked from scalp on the left side of the head, where the hair was longer. Approximately 12 individuals hairs were also extracted from the ox/cow hide cape around the shoulders of Windeby I. The hair was submitted to Dr. Andrew Wilson at Bradford University in the United Kingdom for stable isotope analysis. Table 12 shows the preliminary data for the hair from both the scalp and the cape. Preliminary results for two samples from the body suggest that the diet of the individual may have been primarily vegetarian, with little or no meat. These results are discussed in more detail in Chapter 13.

Sample	δ13C	δ15N
Windeby I – scalp #1	-21.71	6.81
Windeby I – scalp #2	-21.84	7.03
Windeby I – cape #1	-23.83	4.71
Windeby I – cape #2	-24.12	4.69

Table 12: Windeby I – Preliminary stable isotope data

WINDEBY II

Visual assessment

The entire body is currently mounted on a display board. The body is so thin that it cannot be separated from the mounting board and resembles more a silhouette than a three dimensional body. Although there was a detailed report of hair from the head of Windeby II (Schlabow 1958c), there is no longer any hair; neither on the scalp, nor in storage. A wooden box with a glass lid containing skeletal fragments from this body was located in the organic storage area (Figure 66), although the bones were not mentioned in the detailed examination of the body presented in the initial publication on the Windeby bodies (Schlabow 1958c). The bones are currently partially mounted in a cut-through board, which is then mounted in the wooden box. The individual bones could not be removed from the board for further examination.

Metrics

No metric assessment of the body was undertaken. The way the body is mounted, it is difficult to discern clean edges or specific points for measurement.

Age and sex determination

The Windeby II body was originally identified as an adult male, based on the macroscopic examination of a humerus, an elbow, one metatarsal and one metacarpal (Hage 1958). It is almost certain that the bone fragments described above are those used to determine the sex of this individual during the original analyses. Since those bones

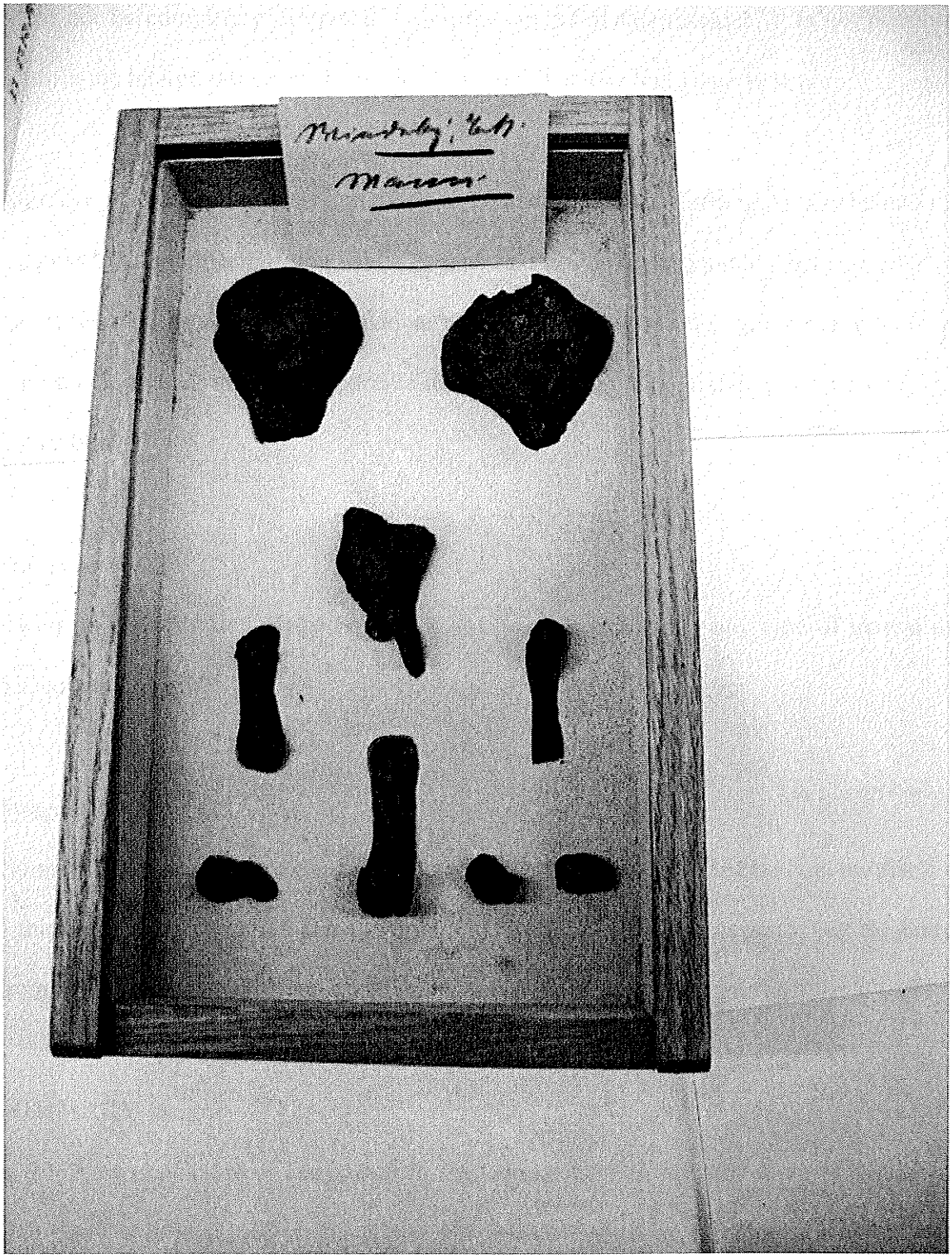


Figure 66: Windeby II skeletal material (Photo: Heather Gill-Robinson)

could not be completely examined during the course of this research, it is not possible confirm the interpretations presented in earlier publications (eg. Hage 1958).

Although the body is large enough to suggest an adult, more specific age determination is not possible. In terms of sexing, while there are no visible male genitalia, there are also no visible indications that the individual is female. Neither sex nor age of the individual can be determined, due to the extreme demineralization and generally poor preservation of this body.

Palaeopathology

Owing to the condition of the body it is not possible to identify any type of trauma or palaeopathology.

Image Analysis

No medical images were taken of this body during this research. The body is too flat for a thickness to be measured and it would have been impossible to separate out the body from the base on which it is mounted during any type of image analysis.

SUMMARY

In 1952, two bodies were discovered in the Domlandsmoor, near the town of Windeby. One body was identified as an adolescent female (Windeby I), while the other was identified as an adult male (Windeby II). This research has suggested that the possibility that Windeby I is male cannot be excluded. Both the numerous existing publications and the various archive resources contributed to this research. New assessment through

physical examination, imaging and some invasive analyses substantially contributed to the interpretation of these bodies.

CHAPTER 11
DÄTGEN

INTRODUCTION

The most recently discovered bog body in Schleswig-Holstein was found more than four decades ago. The body and head were found about six months apart and the head was very poorly preserved. The body appeared to be that of an adult male with a large amount of preserved soft tissue. This chapter is an overview of the Dätgen body (museum accession number KS C410) from the time of discovery through the results of the current research.

PREVIOUSLY PUBLISHED ANALYSES

Discovery and excavation

In September 1959 a decapitated corpse was found 50 cm below the peat surface in the Grossen Moor, east of the village of Schülp-Notorf in Kreis Rendsburg (Struve 1967). Figure 67 shows the location of the site. The naked body lay on its back with the feet oriented to the northwest. Three birch poles, "as thick as a child's arm" and 1.5 to 2.5 m long, were staked into the peat across the body (Struve 1967:34). A fourth pole was stuck into the peat between the thighs of the body. It is unclear where the right arm lay upon discovery of the body, but the left hand was on the left thigh. Although the body was naked, wool fibres were found around the right ankle (Struve 1967). The skin was relatively light coloured when first discovered, but the longer the body was exposed to the air, the darker the skin became (Struve 1967). The finger- and toenails that were found were rounded and smooth-edged, suggesting that the man had not engaged in heavy manual labour (Struve 1967).

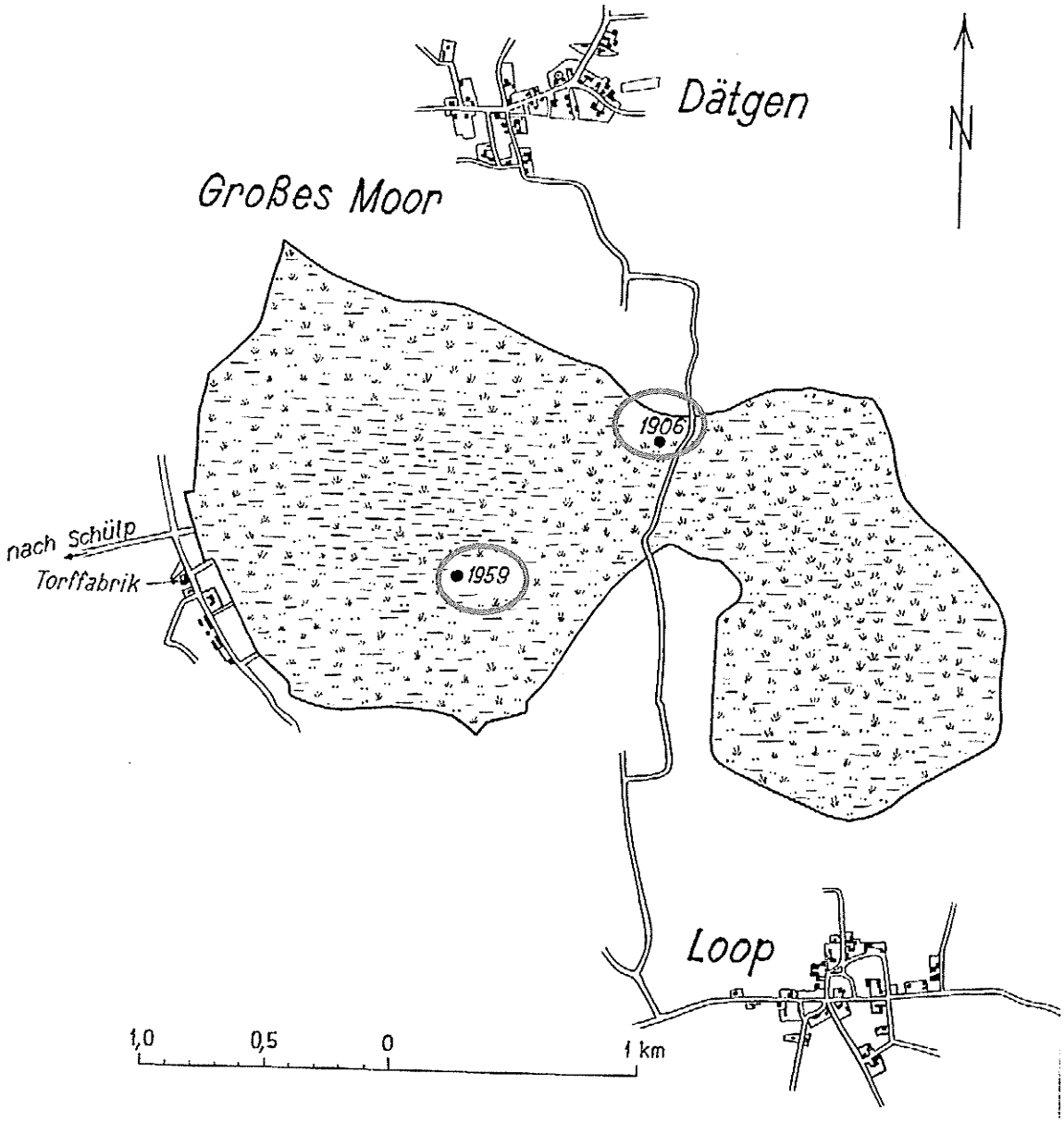


Figure 67: Location of the Dätgen bog body (1959) The second circle represents the find spot of a bundle of clothing, discussed in more detail below. (Source: Struve 1967:34).

Physical examination

From the state of the bones and joints the man was believed to be about 30 years old at the time of his death. The first lumbar vertebra showed signs of marginal lipping. The man's living height was estimated at approximately 170 cm when calculated using the left

humerus, left radius and left tibia (Kühl n.d). The long bones of the right side of the body were broken and not suitable for the calculation of stature estimation. The left lower arm was reported to be "stronger" than the right. All measurements of the left radius were greater than those of the right radius. In particular, in cross-section, the left radius measured 17.2 mm, while the right measured only 11.7 mm (Kühl n.d.; Struve 1967).

The body and the skin were well preserved. The top layer of skin in the area is dark brown-red but the underside is lighter in colour. Stab wounds were noted in the area of the heart and on the right hip (Schiebler and Schaefer 1961). The stab wound to the chest was 3.8 cm long and gaped open. Cut marks, likely inflicted at the same time as the stab wound, were identified on the left fifth rib. A second cut mark, 1.4 cm in length, was identified in the chest area. A 3.2 cm stab wound was also found on the back, over the right hip near the sacrum (Struve 1967).

The first thoracic vertebra had two clear notches on the ventral side of the vertebral body, likely made with two blows from a sharp instrument. A third mark is found on the seventh cervical vertebra. Two further cut marks were found on the back of vertebrae: at the third lumbar vertebra a cut from the direction of the head, while on the fourth lumbar vertebrae there was a cut from the direction of the feet. This last cut mark matched the injury over the right hip, discussed above (Struve 1967).

Fractures were found on the right leg and both sides of the pelvis (Struve 1967). The genitals were missing and there was speculation that the man had been emasculated since the rest of the body was so well preserved and no trace of the genitals were found (Struve

1964). The missing area also included the flesh from the tops and inside area of both thighs (Struve 1967). The primary cause of death was identified as the stab wound to the heart and the decapitation of the body occurred after death (Struve 1967).

Several internal organs were identified during excavation and subsequent examinations (Struve 1961a), although they were somewhat shrunken. For example, the kidneys were about 7 cm in length, instead of the usual 12 cm in a modern living adult male (Schiebler and Schaefer 1961). The intestines were shrunken but preserved and samples of the contents were sent to Dr. Otto Martin to attempt to identify the final meal. The samples from the stomach consisted of about 0.5 g of dark brown fine-grained material in three lumps (Martin 1967), which were examined through microscopy. Several grains, including *Spergula arvensis* (spurry), *Polygonus lapathifolium* (knotweed), spelt, *triticum sativum* (wheat) and *chenopodium* (goosefoot) were identified. There were also fragments of mosses, a few grains of sand and five hair fibres, four of which were animal hairs. The animal hairs were identified as belonging to *Cervidae*, although the species was not identified (Martin 1967).

A 0.1 g sample of dark brown powder-like material was taken from the upper intestine. When analyzed, the contents were similar to that of the stomach. The sample from the lower intestine, about 0.7 g, was dark brown loose material. Microscopic examination showed contents similar to those of the stomach and upper intestine, as well as a 0.5 mm length of cut human hair, a 0.5 mm red wool fibre and a fragment of charcoal (Martin 1967).

The final meals, therefore, consisted of grains and weeds. Although there were a few animal hairs, no trace of meat was found (Martin 1967) and it is likely that the hairs had been ingested accidentally.

Discovery, excavation and analysis of the head

The head was found six months later at a depth of 3.10 m, about 3 m west of where the legs had been (Struve 1961a), and had been staked into the peat with two poles (Struve 1964, 1967). The skull was severely compressed in the peat and several pieces of bone were loose. The brain was identified on X-rays. A thick Suebian knot, similar to that of the Osterby skull, was visible on the back of the skull; the hair was originally blonde in colour. Facial hair was also visible and was 3.5 to 4 cm in length (Struve 1967). Bernd Hermann used Raster Electron Microscopy to study the structure and preservation of both head hair and facial hair. The examinations indicated that hair from both sites had been cut and were generally well preserved (Hermann 1974).

Additional information

A socket axe handle of yew wood was found about 20 m southwest of the findspot of the body, in the same peat layer, along with more birch poles. In 1906 a bundle of clothing, including a cloak, knee-length trousers, a jacket with sleeves, a woven belt, a woollen decorative band was found 1000 m away from the place where the 1959 body was found (Struve 1967). This find is also indicated on Figure 67, above. At the same time and location some hair, later believed to be from the 1959 body, was found (Struve 1964). A cremation urn with wooden lid was also found nearby (Struve 1967). Samples of the peat

surrounding the body were sent to Dr. Aletsee in Kiel for pollen analysis; results indicated that the body was found in a peat layer that dated to about 100 b.c. (Struve 1961b). The body was conserved in a process that included bleaching, rinsing in isopropyl alcohol to dehydrate the body and the application of neutral lanolin and pentachloraphenol (Ketelsen 1966).

THE 2003-2004 RESEARCH

Data obtained from the archives

Discovery and excavation

The archives include a single sketch of the excavation. The sketch shows the body partially uncovered, so that it is possible to get a sense of the location of the legs, ribs and two of the poles that covered the body (see Figure 68).

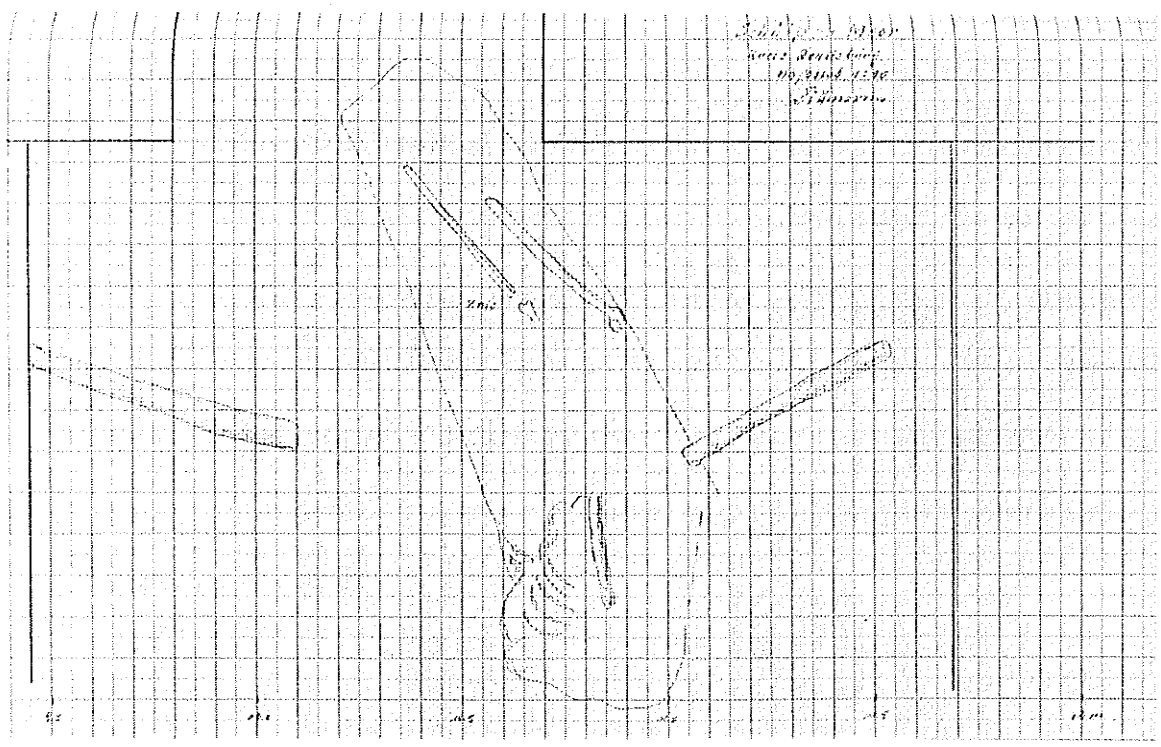


Figure 68: Dätgen body *in situ* – partial excavation (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf).

In a letter to the forensic institute in Wiesbaden, it was reported that the upper part of the body was damaged during the peat cutting process, although the lower part of the body was in good condition. It was also noted that several internal organs had been preserved, although the genital region was completely missing (Struve 1961a).

Pollen analysis indicated that the body had been placed in a water-filled area 20 to 40 cm in depth (Aletsee 1960). Although a date of approximately 100 b.c. was provided via the peat layer in which the body was found (Struve 1961a), C14 dating of skin and bone from the body was also recommended (Aletsee 1968).

A note in the file said that two pieces of skin had been sent to Dr. Herrmann in Göttingen for "research in bog body conservation methods" (Anonymous 1981). The author of this research contacted Dr. Herrmann to inquire if research had been conducted with those skin samples and if any data had been derived from the research. Dr. Herrmann informed the author that, despite what was written in the archive file, the research was not intended to determine methods of conservation for bog bodies. Furthermore, Dr. Herrmann indicated that he was not aware of any research that had been conducted with the skin and that he was not prepared to see if the skin samples were still kept at Göttingen (Herrmann 2003). A copy of the e-mail correspondence between the author and Dr. Herrmann has been placed in the archives.

The archive file also contains a letter from a curator at the Landesmuseum, Dr. Struve, to Dr. Alfred Dieck, reporting basic information about the Dätgen find (Struve 1960b); the letter pre-dates the discovery and excavation of the head. Dr. Dieck had produced several

publications on bog bodies (e.g. Dieck 1941, 1951, 1958, 1959) and was considered an authority on the subject. The work of Dieck as it relates to bog bodies was discussed in more detail in Chapter 3.

Physical examination

The body was extricated from the peat and cleaned in an alkaline bath before being neutralized with distilled water. The process of conservation consisted of immersion in solutions of increasing alcohol content over a period of ten to twelve months. The body was then air dried. Further specific details of conservation are described in a brief document in the archives (Anonymous 1961).

The archives include two very large black and white photographs of the vertebral column of the Dätgen body; one photograph is shown in Figure 69. The photographs, taken in 1966, are stored together in a large envelope from the Kiel Orthopaedic clinic; the envelope is filed separately from the main archive files so that it can be kept flat.

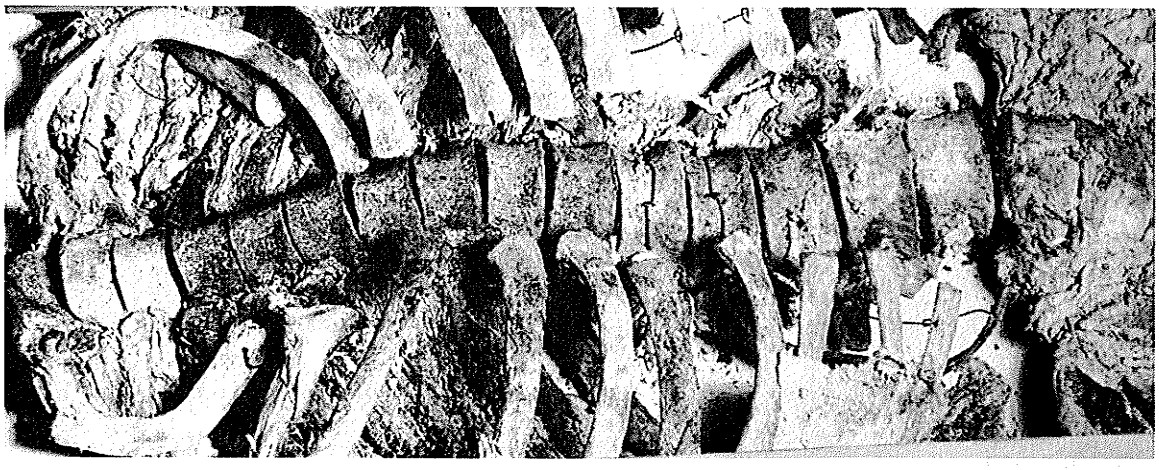


Figure 69: Vertebral column of Dätgen Man (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf)

A series of radiographs for this body exists in the archives. The radiographs were clearly taken after conservation of the body, since wiring of skeletal elements is visible. The radiographs were taken in 1966 at the University Orthopaedic Clinic in Kiel. Figure 70 shows the thorax, while Figure 71 shows the pelvis. The extent of the wiring of the feet is clear on the radiograph shown in Figure 72. There is a radiograph of the distal ends of both femora. On the radiograph, the right femur is fractured at this point, but is still lying in correct anatomical position. This will be discussed in more detail later in this chapter. Although three radiographs of the remains of the head exist, they show only an amorphous mass and provide no additional information. The head is identified in this second radiograph as "Dätgen II", which suggests that, at least at this time, the head was considered to be a separate body from KS C410.

Other

The area around the town of Dätgen, including the bog site where the body was found, has produced several archaeological discoveries spanning millennia. The finds include Stone and Bronze Age barrow graves; stone axes; an Iron Age burial site with urns; a cremation urn with a wooden lid containing bones (Roman Iron Age) and 53 silver Danish coins from the Middle Ages (Anonymous n.d.b).

In March of 1969, a Roman Iron Age "working site" was discovered to the east of the town of Dätgen during highway construction. There were several large pits that contained evidence of charred stones, several clay vessels, iron production slag and a kiln at the site (Schäfer 1970).

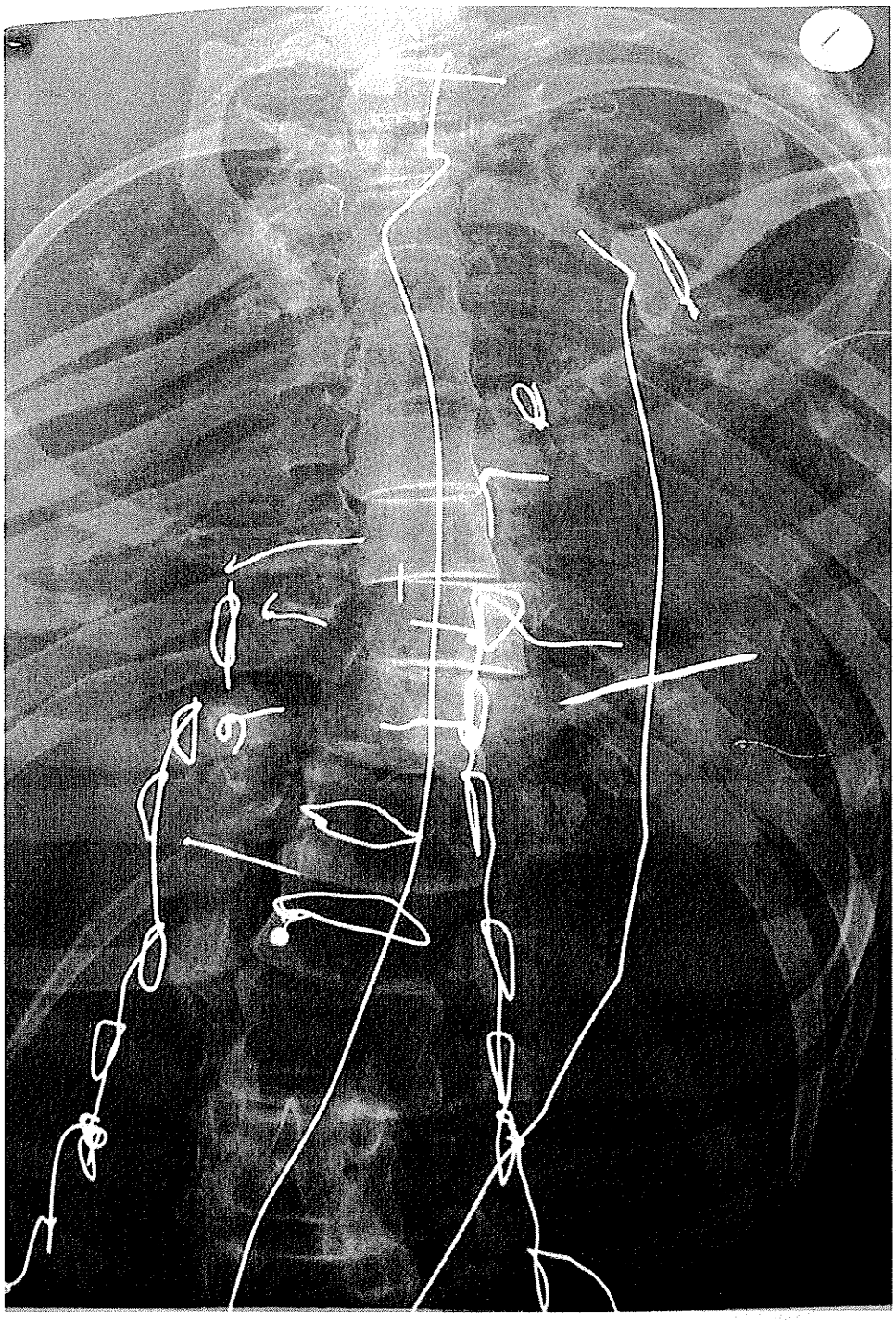


Figure 70: Dätgen - Radiograph of thorax (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf)

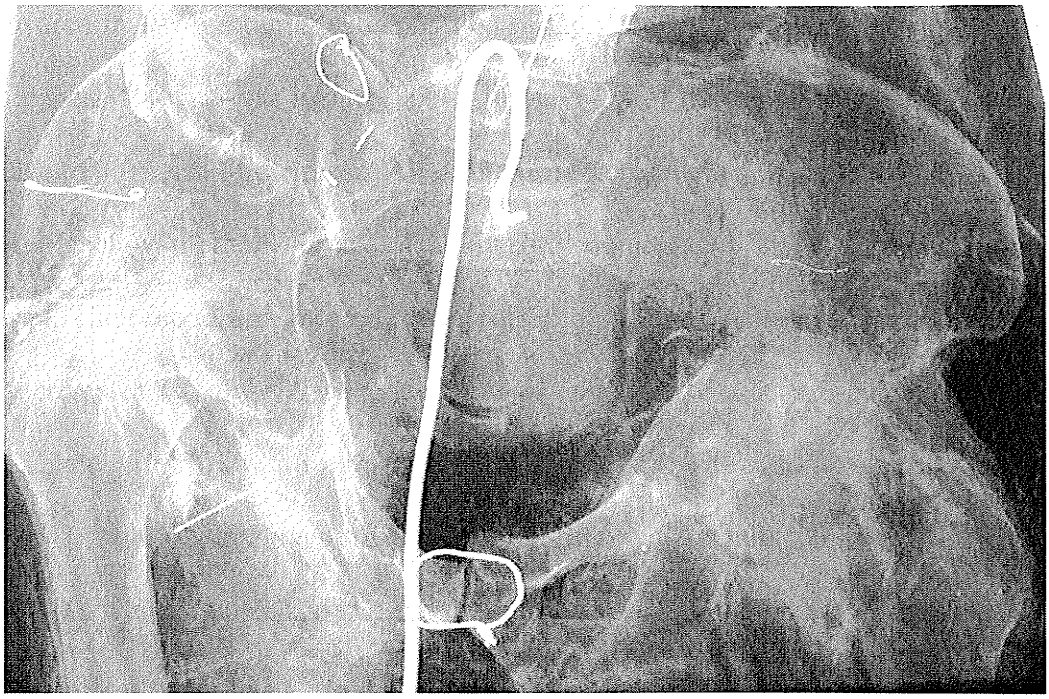


Figure 71: Dätgen – Radiograph of pelvis (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf)

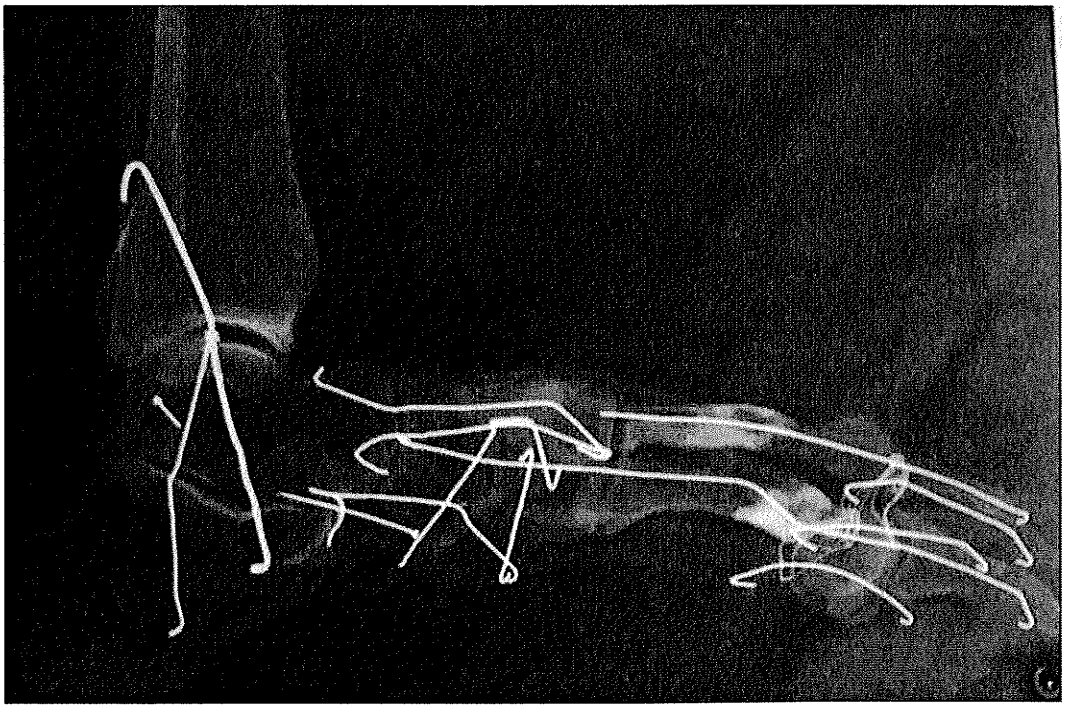


Figure 72: Dätgen – radiograph of foot, showing extent of wiring (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf)

Discovered in 1976, a burial site consisted of three cremation urns and two areas packed with stones. The site was located about 500 m west of the town of Dätgen, just a short distance to the north of the moss. All of the urns were found at a depth of between 50 cm and 1 m below the soil surface. The first urn contained a large amount of cremated material. The second urn, located just north of the first urn, contained a small amount of finely cremated remains, as well as a piece of dark bronze sheeting, melted bronze rings of an unknown form and a fragment of a rusty iron nail. The third urn, located just to the west of Urn 1 and Urn 2, was smaller than the first two and contained very fine cremated remains. It was hypothesized that the third urn was a cremation burial of a child (Schäfer 1976).

The bundle of clothing found in 1906 was been examined at the time of discovery and assigned museum accession number 11919/11920. The bundle included a cloak, stockings, a belt and a collar and sleeves from a jacket, although the jacket itself was not present. There was also an amount of human and animal hair. More detail on the clothing is available in the archives (Anonymous n.d.c, Anonymous n.d.d).

Results of the physical and anthropological analyses

Visual assessment

The Dätgen body was stored in a box with glass sides and top at the start of this research. The need to transport the body for CT imaging led to the construction of three wooden boxes. For the duration of this research, part of the body rested on each of three wooden bases with a box lid that fits securely over the body. The body was then safely packed for both storage and future transportation but was also easily accessible for examination (see Figure 73). Parts of the upper thorax, all of the pelvis and most of the femora were still

encased in skin and muscle tissue, although this tissue was extremely fragile and crumbled with only slight pressure.

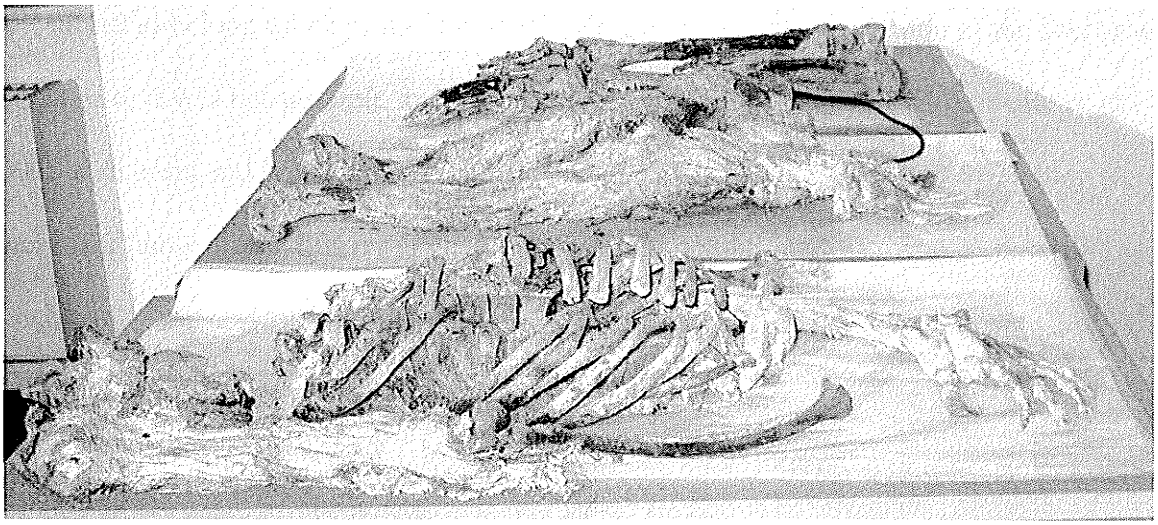


Figure 73: Dätgen Man – body resting on boards (Photo: Heather Gill-Robinson)

The skin was treated with pentachoraphenol during conservation, as discussed in Chapter 5. Unlike most bog bodies, which have strong, tough and often slightly brittle skin, the skin of the Dätgen body was very soft and supple, but delicate and friable. Most bog body skin is dark brown to black in colour, while the Dätgen body skin was beige to light brown with some darker brown patches. The changes in the skin colour and texture were attributed to the pentachoraphenol treatment. The difference in the skin colour reported in published data (Scheibler and Schaefer 1961) to the present can likely be attributed to conservation and storage.

The head was preserved only as crumbled fragments (Figure 74), pieces of scalp; no identifiable pieces of cranium remained. There was a substantial amount of well-

preserved hair resting on top of the crumbled fragments, including an elaborate Suebian hair knot that is similar in style, but not identical, to that of the Osterby cranium. This head was found at a later date and some distance from the body but has always been presumed to belong to the same individual (see Chapter 5). Since so little of the skull was preserved, it was not possible to conclusively determine if the skull and body are related. Although brain and facial hair were identified in earlier analyses (Struve 1967), they were not identifiable during this research, due to the poor condition of the head.



Figure 74: Dätgen Man: head (Photo: Heather Gill-Robinson)

Large parts of the post-cranial skeleton were preserved. The thorax, most of the upper limbs and one hand were one of the three boards (Figure 75). The pelvis and femora were

on a second board and the lower limbs and feet were on a third board. The right scapula, humerus, radius and ulna were present and articulated at the shoulder with soft tissue that extended across the entire shoulder and down most of the humerus. The right clavicle had no soft tissue and was disarticulated. The right humerus, with the exception of the humeral head, the trochlea and capitulum, was encased in thick, wrinkled soft tissue. The right radius and ulna were devoid of soft tissue and were bound together with thin copper wire at the distal end. The ulna was poorly preserved. The proximal end was splintered and fragmentary. The ulna was linked to the humerus by black wire. The proximal and distal epiphyses of the radius were both completely fused. The distal epiphysis of the ulna was fused. The right hand was missing.

The left scapula was absent but the clavicle was present. The left humerus, radius, ulna and the complete hand, with the exception of the distal phalange of the fourth finger, were present. The left humerus was still articulated to the thorax with soft tissue and there was extensive soft tissue on the radius and ulna, although most of the hand was skeletal. The distal end of the humerus was wrapped with copper wire. Both distal epicondyles were completely fused. The hand was held together with black wire. Copper wire wrapped the soft tissue and bone at the proximal end of the radius and ulna. There were no epiphyses clearly visible on either of these bones. The thumbnail and one fingernail were still present; the thumbnail was glued to the underlying bone, but the fingernail was loose. There was soft tissue articulating the thumb to the forearm.

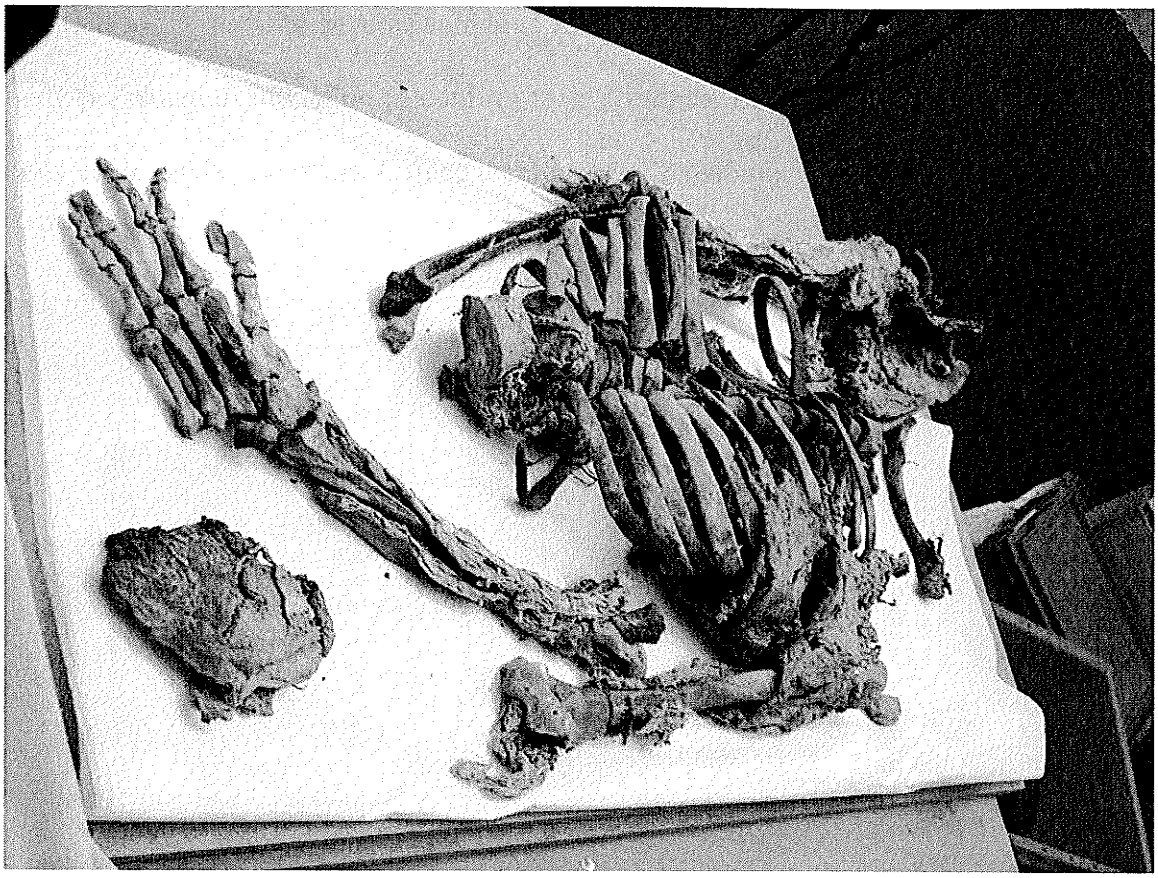


Figure 75: Dätgen Man: Upper body (Photo: Heather Gill-Robinson)

The sternum and manubrium were detached and stored in the organic storage area, in the same box as approximately one metre of preserved intestinal tract. Most of the rib cage was fully articulated and presently held together with a fine black wire. The third, fourth and fifth ribs on both sides had been removed, possibly during conservation. All of the ribs present were still connected at the vertebrae; most of the sternal ribs ends were visible, although there was wire protruding from several (see Figure 76). All of the lumbar vertebrae (L1-5) were present and articulated. Most of the thoracic vertebrae were present and articulated, although T4 and T5 had been removed at some point, likely during conservation. There were no cervical vertebrae remaining. Cut marks were

reported to the back of several vertebrae (Struve 1967), but the fragile condition of the body prevented examination to confirm their presence. Details of the decapitation of the body could not be ascertained, since there were no remaining cervical vertebrae.

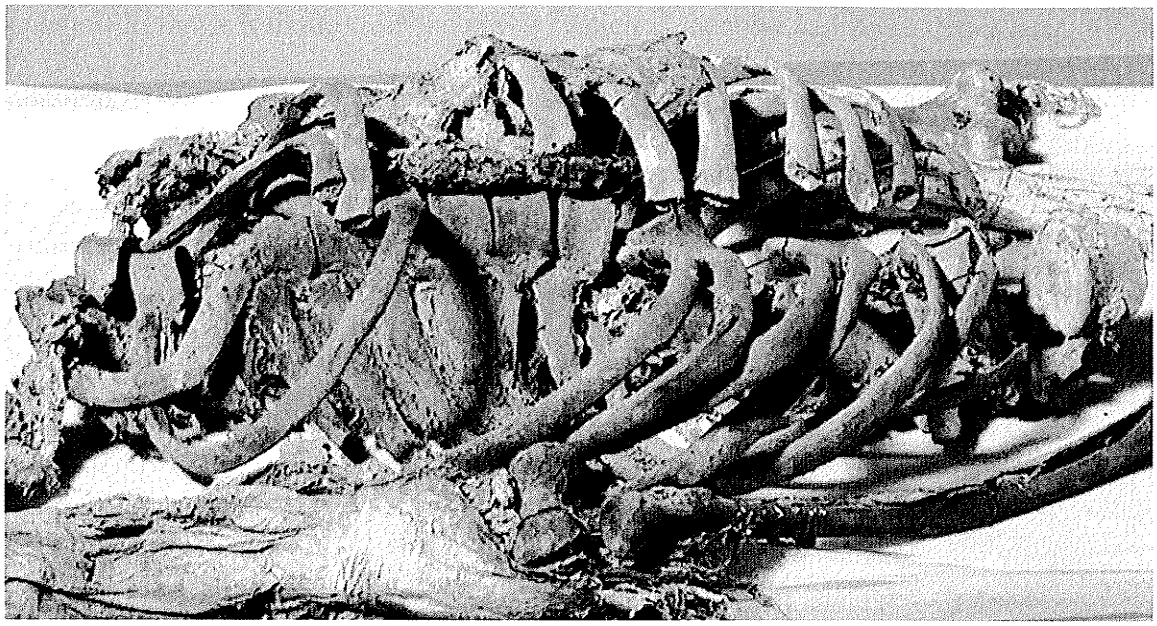


Figure 76: Dätgen Man: thorax (Photo: Heather Gill-Robinson)

The well-preserved heart was tucked under the ribs on the left side of the thorax. A length of intestines in two pieces, approximately 2 metres long in total, was preserved and stored in a red plastic box away from the rest of the body. Although kidneys were identified and measured in earlier analyses (Schiebler and Schaefer 1961), they were not located during this research.

There was a large amount of soft tissue covering the pelvis and the majority of both femora (Figure 77). The skin was wrinkled and lay thickly over the bone. Although a stab wound was noted on the back over the right hip (Struve 1967), the body was too

fragile to be lifted off the board and turned safely, so this reported wound was not located during this research. A plastic-coated wire protruded from immediately under the edge of the sacrum, which was buried in the soft tissue. The right iliac crest and part of the ilium were visible but the rest of the pelvis was completely encased in soft tissue. Through the hole cut in the soft tissue over the pelvis, which is discussed in more detail later, it was possible to view the parts of the pubis and ischium on both sides. The pelvis was wired together at the pubic symphysis. The right pubis was bent inwards slightly and there was some pelvic distortion, although it is unknown if this was taphonomic or pathologic in origin. The distal portions of both femora were visible although there was some soft tissue over the right distal area. The right femoral diaphysis was fractured and there was a wooden dowel protruding from the main portion of the diaphysis (Figure 78).

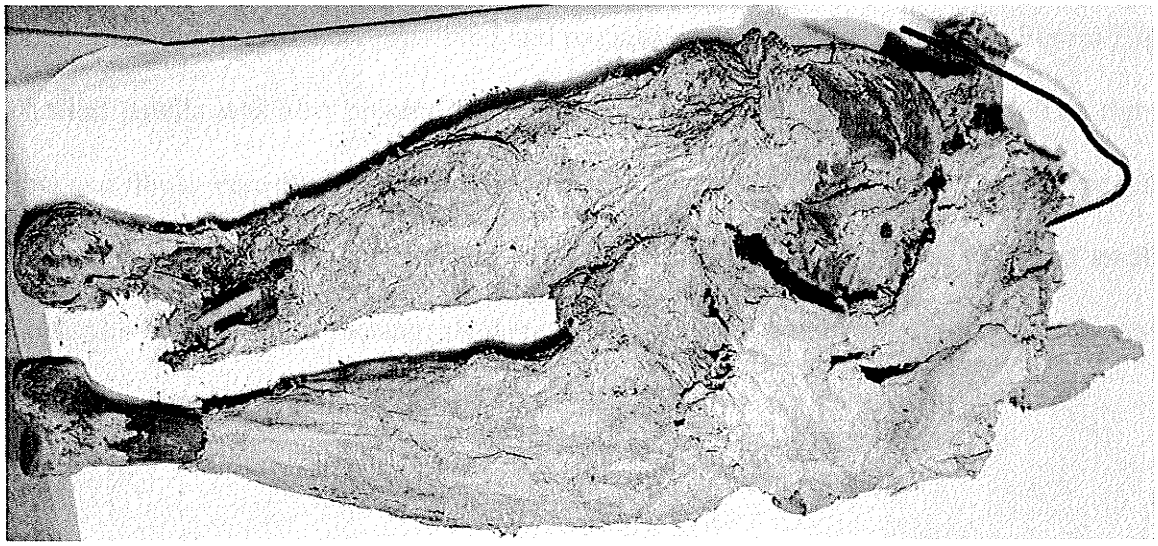


Figure 77: Dätgen Man: pelvis and femora (Photo: Heather Gill-Robinson)



Figure 78: Dätgen Man: Wooden dowel protruding from right femur (Photo: Heather Gill-Robinson)

Both tibiae and fibulae were preserved and partially encased in soft tissue (see Figure 79). The left patella was also present but it was desiccated and partially crushed. The right tibia and fibula were attached with copper wire in several places. Both feet, except the left calcaneus, were present and attached together with black wire, copper wire and small nails. The first and third metatarsals were darker than the other bones, although this was caused by dark conservation paint.

Age and sex determination

The visibility of the sternal rib ends provided an estimate for age. The second, third and fourth ribs have been removed bilaterally. Those were the ribs most commonly used for



Figure 79: Dätgen Man: lower limbs (Photo: Heather Gill-Robinson)

aging human remains (İşcan and Loth 1989). The second and sixth left sternal rib ends were not obscured by wire or soft tissue. All of the right sternal rib ends were affected by wire. Both of the rib ends (second and sixth) on the left side had fairly deep U-shaped pits with scalloped bone edges suggesting an age of approximately 26 to 32 years of age ((İşcan and Loth 1989). All of the vertebrae had fused epiphyseal rings with some evidence of minor lipping on those for which the surface can be observed. This suggested an age of over 30 years. The sternal epiphyses of both clavicles were completely fused, suggesting an age of over 30 years (Buikstra and Ubelaker 1994). It can be suggested that overall estimate of age at the time of death is around 30 years. Sex was determined by the presence of visible external genitalia. This body was male.

Palaeopathology

Although there was a clear fracture on the diaphysis of the left humerus that was obviously taphonomic, the splitting bone surrounded an area that appeared to be an antemortem fracture. The fracture had partially healed prior to death. In that region the bone may have been structurally weak during its recovery and therefore more susceptible to the taphonomic influences of the bog, leading the surface fracturing and splintering that is currently visible. The right clavicle was also fractured in several places, but these fractures were clearly taphonomic since the edges of the break were a lighter colour than the external bone surface.

The right femur was fractured on the diaphysis near the distal end. This appeared to be taphonomic. The edges of the fracture were ragged and in places the bone edges were bent in towards the trabecular bone, which may have occurred in the bog or when the wooden rod was placed in the bone. The pelvis sat at an unusual angle but it was not clear whether the apparent anomaly is pathologic or taphonomic. There was a ragged-edged hole over the pelvic region (Figure 80). The majority of the scrotal sac was present (indicated in Figure 80 by a blue arrow,"A"), but no penis. Although the edges of the hole were ragged and uneven, the specific margins of the cuts are sharply delineated (indicated by red arrows, "B" on Figure 80); clearly some type of knife or similar blade was used to remove the penis at the time of death or immediately afterwards. The similarity of the skin colour across all wound margins suggests that the cut could not have occurred at the time of excavation or through conservation. There was also a tiny even cut, approximately 1 cm long, at the bottom of the soft tissue on the left femur, mostly likely

from where a recent radiocarbon date sample was taken. The obvious differences in skin colour from where this sample was extracted make it clear that this sample was post-excavation and reinforces the perimortem timing of the penis removal.

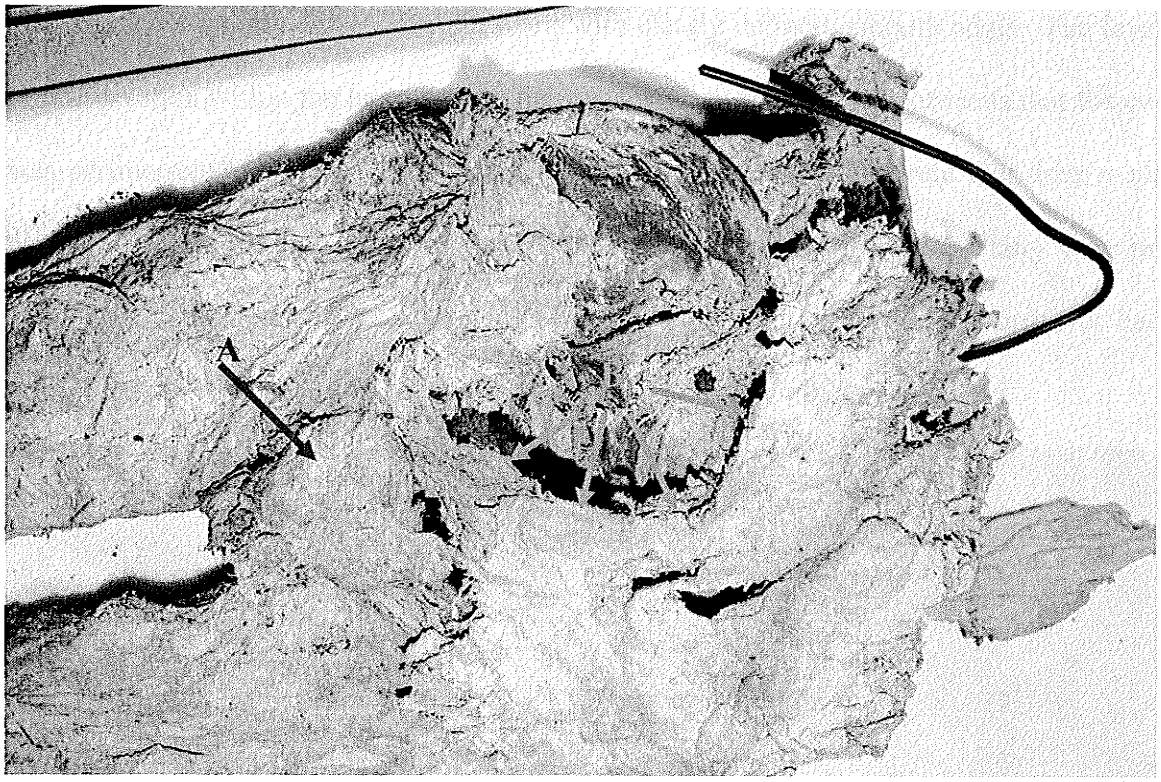


Figure 80: Dätgen Man: Pelvic region (Photo: Heather Gill-Robinson)

There was a small fracture on the diaphysis of the left fibula; this was clearly taphonomic, based on the sharp edges of the bone and the difference in colour between the bone surface and the cortical bone. Both the right tibia and fibula had evidence of several fractures, all of which appeared to be taphonomic in origin, based again on the sharp edges of the fracture and the similar coloration of the bone surface and the cortical bone.

There were two clear stab wounds in the skin that would have been over the thorax. The stab wounds measured 4.5 cm and 2.5 cm in length (see Figure 81). The margins were clearly defined; these were definitely not taphonomic tears. There was a cut approximately 4 cm in length and approximately 1 mm deep across the centre of the heart (Figure 82). This was an obvious cut mark with clearly defined, smooth edges. The level of preservation within the heart and on the surface was identical. It is obvious that the cut was perimortem and the most likely the cause of death. It was apparent that there were two stabs to the chest and one of these penetrated through to the heart. There were no visible corresponding nicks or cut marks but since the second, third and fourth ribs had been removed it is possible that there was skeletal damage on the missing ribs.

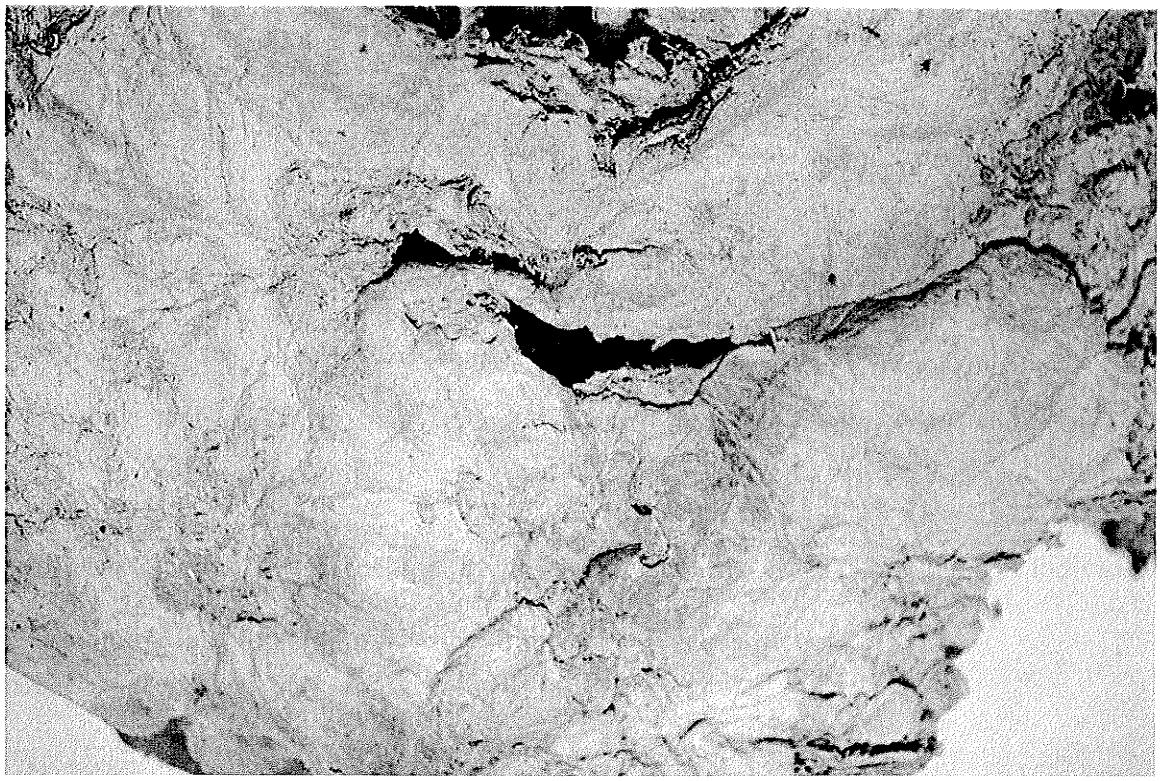


Figure 81: Dätgen Man: Stab wounds (Photo: Heather Gill-Robinson)

Image analysis

Although the skull was not preserved, the rest of the body was scanned using MSCT. Digital X-rays of the pelvis and femora were also taken. There were several additions of wire and wooden dowelling during the conservation process, visible both during visual inspection of the body and during the MSCT scanning processes. The wire, although narrow, caused some imaging artifacts. The body also has a substantial amount of layered

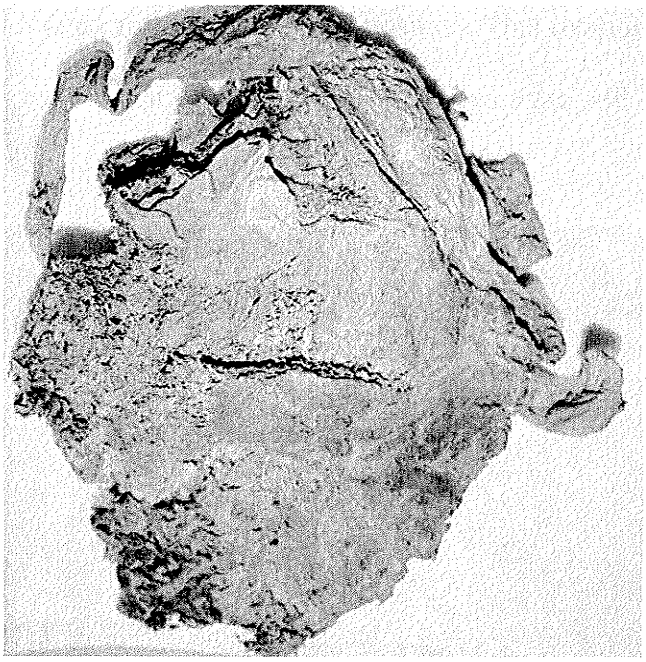


Figure 82: Dätgen Man: Heart with stab wound (Photo: Heather Gill-Robinson)

soft tissue, particularly in the area of the pelvis, which had to be edited out of individual slices during the preparation for three-dimensional reconstruction.

The fracture on the distal end of the right femur was selected for three-dimensional reconstruction. Using Mimics and RapidForm, much of the soft tissue was removed from the area of the fracture in order to allow better interpretation of the fracture (see Figure

83). The edges of the fracture were sharp and appeared torn. The interior of the bone appeared to lack visible cortical bone and was much lighter in colour than the bone surface. This suggested that the interior of the bone had not been exposed to the same taphonomic environment as the soft tissue and bone surface. It was clear that this fracture was taphonomic, rather than perimortem. The magnitude of the fracture was also exaggerated in the current examination, since the both the distal end of the femur and the femur diaphysis had rotated from their original position. This rotation had occurred since that last radiographs were taken in 1966, when the bones were still in place (see Figure 84).

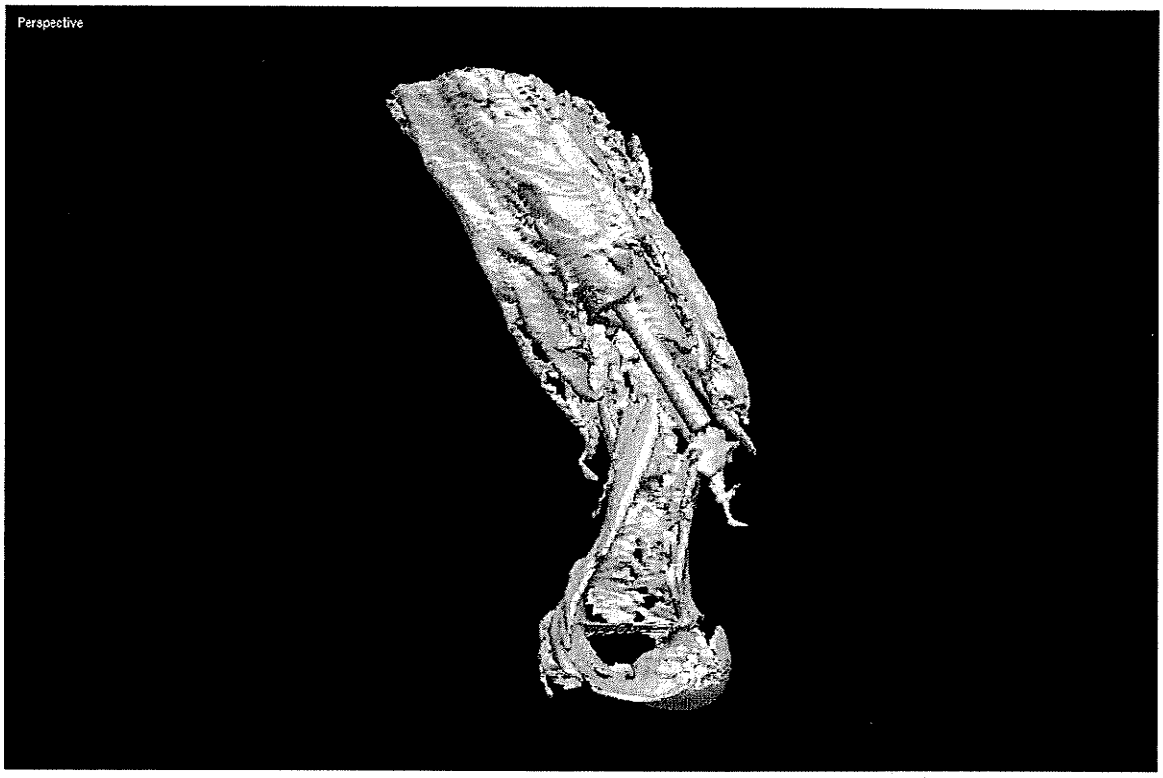


Figure 83: Dätgen Man – Reconstruction of fracture to right distal femur

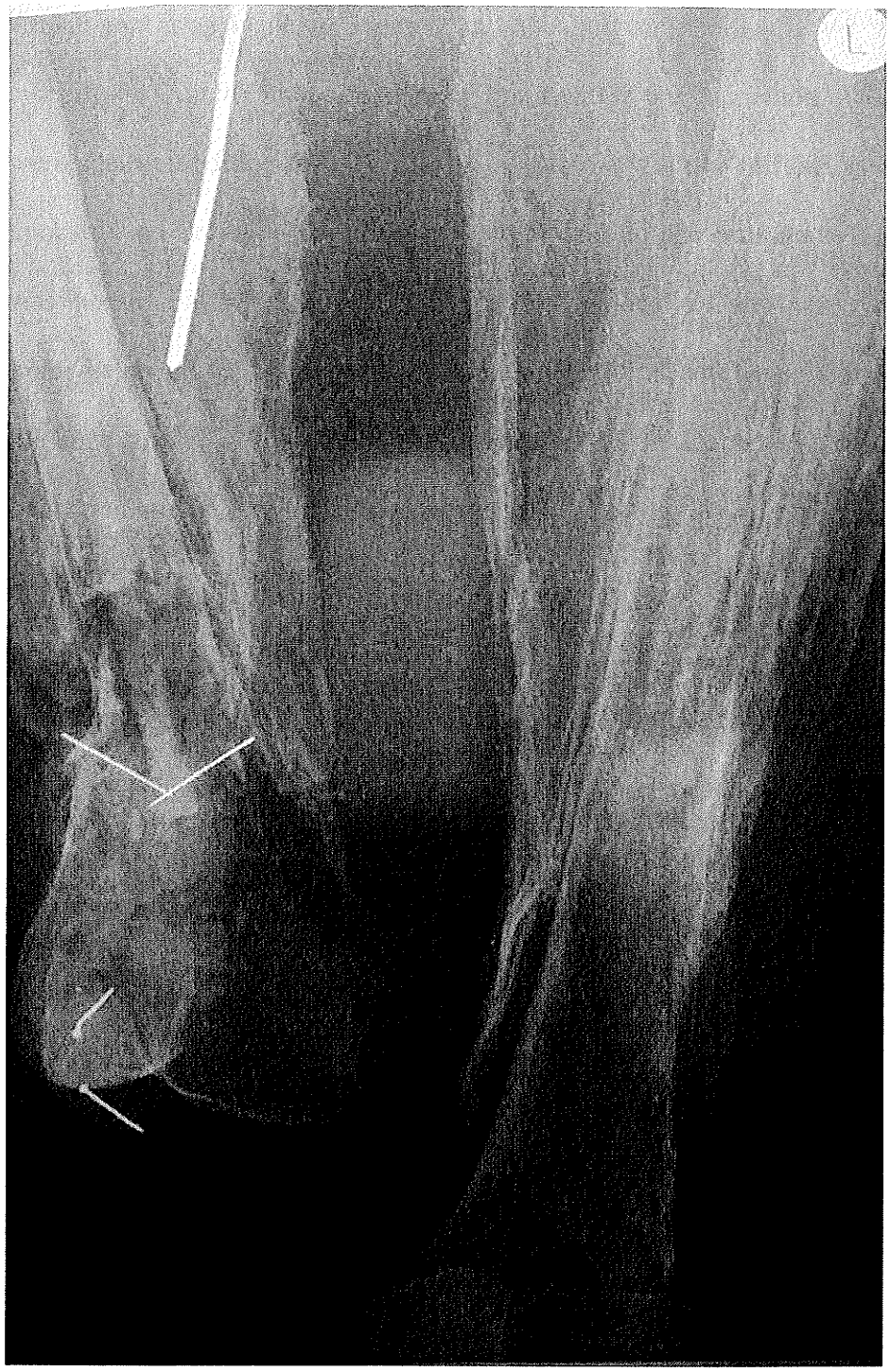


Figure 84: X-ray of Dätgen distal femora, showing original placement of bones (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf)

An attempt was made to separate out the pelvis, specifically the area of the pubic symphysis, with the intention of using this area for age estimation. Although many hours were spent on editing this section, the soft tissue was not sufficiently removed to allow unobstructed access to the pubic symphysis and no age estimation through this method was possible. Complications arose in the removal of the soft tissue layer resting immediately on the bone surface. In the removal of the soft tissue, small holes were left in the bone surface image, which altered the view of the shape and surface of the bone and could potentially have led to misinterpretation.

Trace element analyses

Three samples from an individual scalp hair of the Dätgen body were tested for trace elements using laser ablation. Zinc and lead were present in all three samples, while mercury was detected in one sample. The levels of lead, in particular, are quite high relative to the other elements (see Figure 85). It is not clear what may have caused the high levels of lead in this individual.

Stable isotope analysis

Approximately 12 hairs were plucked from the scalp of the Dätgen body and submitted to Dr. Andrew Wilson of Bradford University for stable isotope analysis. A single preliminary value has been obtained: δ13C of -22.28 and δ15N of 6.82. Although this will be discussed in more detail in Chapter 13, it is likely that the Dätgen Man consumed mainly a vegetarian diet.

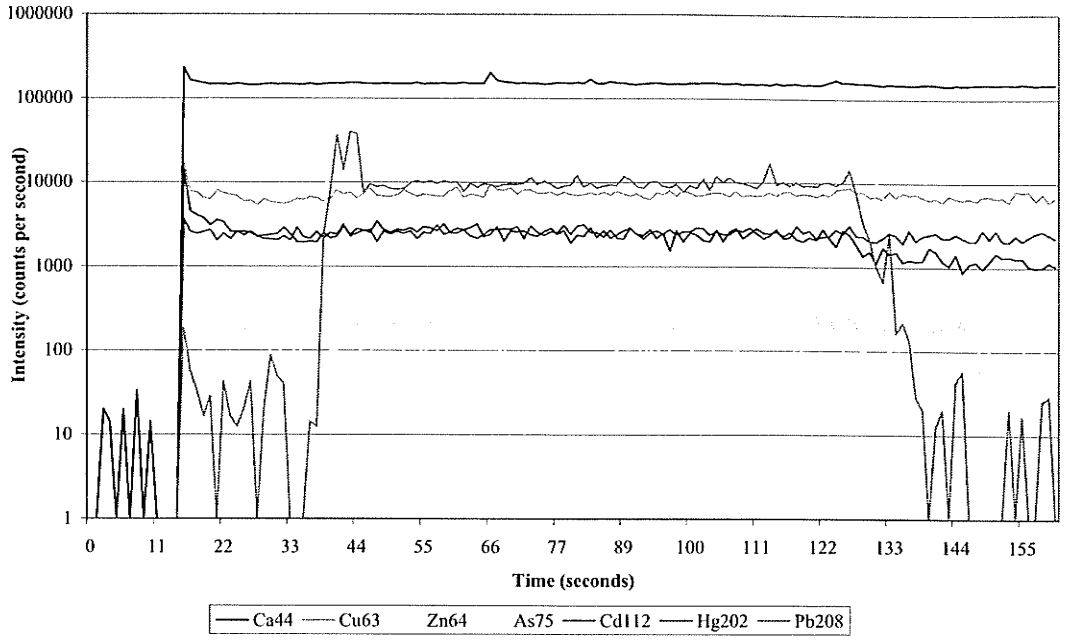


Figure 85: Dätgen Man: Presence of trace elements

SUMMARY

The Dätgen body, as it is presently defined, consisted of a headless body and an isolated head, discovered and excavated approximately six months and three metres apart. The body had generally good soft tissue present preservation, particularly around the pelvic region, but the head was very poorly preserved. The hair knot on the head was similar in style to the Suebian knot of the Osterby skull and is discussed in more detail in Chapter 13. There have been several archaeological finds in the area, including Iron Age burial and apparent "work" sites. The body displayed a number of fractures, most of which appear to be taphonomic. The context of the body is discussed in more detail in Chapter 13.

CHAPTER 12
KÜHSEN

INTRODUCTION

This skeleton was selected for inclusion in the research because it was believed to be a good comparator specifically for the Windeby I body. The skeleton is, unfortunately, undated so it cannot be determined whether the individual was from the Iron Age. Many bog skeletons from Denmark that were originally believed to have dated to the Iron Age were, in fact, from the Neolithic (Bennike 1999). It was, however, decided to include the Kühsen skeleton in this research for two reasons. The skeleton was previously identified as a young female; since the Windeby I is an adolescent and may possibly be male, the Kühsen skeleton is a valuable comparator in terms of possible differences between the individuals. There are no confirmed female bog bodies in the Schloss Gottorf collection for comparison, so the bog skeleton is appropriate. The skeleton was also selected for this study because of its importance for taphonomic comparison. All of the other bog bodies in this collection are from acidic peat environments, while this skeleton is from alkaline peat. The type and extent of preservation are very different between bodies from alkaline and acidic bog environments and this skeleton provided a good opportunity to examine the variations between the Kühsen individual and the skeletal material of the bog bodies. For the first time, these comparisons are undertaken within the same research collection. This chapter provides and overview of the Kühsen skeleton, from excavation to the present.

PREVIOUSLY PUBLISHED ANALYSES

This skeleton was briefly mentioned in only two publications (Schaefer 1961, Struve 1964). The first publication provided a quick summary of the discovery and excavation of the body. The skeleton was found in sedge peat on May 9, 1960 at a "meadow site" near the town of Kühsen in Kreis Herzogtum Lauenberg by a mechanical digger. The Landesmuseum in Schleswig was notified. It was determined that the skeleton lay in an east-west orientation, with the head to the west and the feet to the east. The peat above the head had been disturbed and could not be used to date the skeleton stratigraphically. Several alder poles ranging from "finger-thickness" to "arm-thickness" were found on top of the body; it was believed that the poles were likely used as restraints to keep the body in the peat (Schaefer 1961).

The Kühsen skeleton was very briefly mentioned in a second article by Struve (1964). The publication primarily discussed the Dätgen body (see Chapter 11), but since the Kühsen skeleton was found within a few months of the Dätgen body, it was included as a brief note, although there was no additional data (Struve 1964).

THE 2003-2004 RESEARCH

Data obtained from the archives

The archive file for the Kühsen skeleton consists of five documents and a single page with five small photographs from the excavation. A detailed excavation report exists, although there are no maps or sketches of the site included.

As indicated in Schaefer 1961, the skeleton was found by a mechanical digger in a peat parcel. The site was about 100 m southeast of the town of Kühsen. Digging was under way when a skull suddenly appeared. The local police and the local museum were notified. The find was then reported to Professor Kersten and Dr. Bantelmann of the Landesmuseum in Schleswig (Struve 1960a).

The skull was found 70 cm below the modern grass (1960) surface in sedge peat. Excavation of the surrounding area revealed several hand bones. Legs and foot bones were found *in situ*. All of the bones were found at the same level in the peat as the skull (70 cm). The entire skeleton appeared to be about 165 to 170 cm in length. There was no evidence of preserved human skin, textiles or animal hides; the absence of skin was attributed to the chemical composition of the peat (Struve 1960a). Several poles made from alder branches covered the body, some as thick as an arm. The area was searched to a depth of approximately 1 m from the 1960 surface, using a spade. It was suggested that the body had been taken out in a boat and deposited in a watery area, perhaps a small lake, which eventually became peat (Struve 1960a).

A peat sample from the site was taken and sent to Dr. Aletsee at the Botanical Institute in Kiel. If examination of the peat was undertaken, there is no report available in the archives.

Results of the physical and anthropological analyses
Visual assessment

The skeletal material from Kühsen was light to dark brown in colour, with patches that appeared similar to rust, and significantly more mineralised than the skeletal material from the acidic bog corpses. The skeleton was generally well preserved and nearly complete. Some bones had traces of a white paste that appeared to be the result of a casting process.

The cranium and mandible were present and in good condition (see Figure 86). There was a large area clearly cut out around the foramen magnum. The sharp edges and obvious difference in bone preservation indicated that this was a recent event. There were six teeth remaining in the maxilla: the left canine, M1, M2 and M3 and on the right M1 and M2. In the mandible, the left M1 and M2 were present, M3 had erupted but was missing postmortem. On the right M1, M2 and M3 were all present. All other teeth had been lost postmortem.

Both clavicles, scapulae, humeri, radii and ulnae were present and in generally good condition. The bodies of both scapulae were missing. There were fragments of white paper tissue adhering to the lateral end of the right clavicle. The lateral ends of both clavicles were eroded. Observation of the medial clavicular surface showed early epiphyseal fusion. The left scapula had a taphonomic fracture just below the glenoid fossa. Most the bone was badly eroded. The left scapula at the acromion appeared partially fused. The right scapula was also badly eroded. The acromion appeared partially fused.

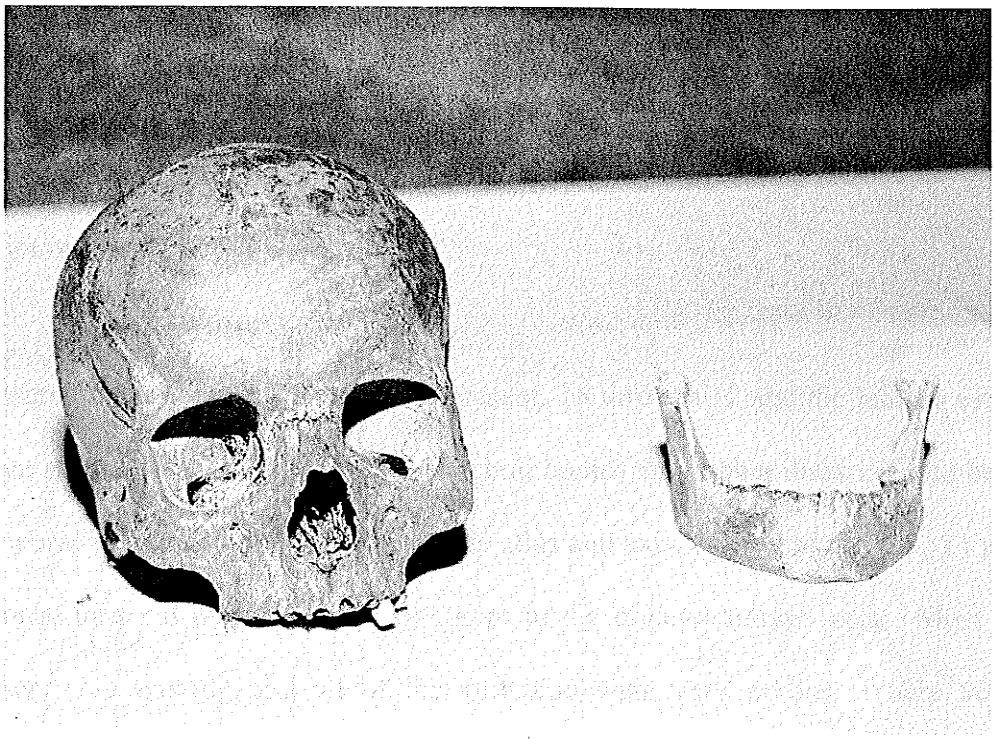


Figure 86: Kühsen cranium and mandible (Photo: Heather Gill-Robinson)

Both humeri were in good condition. The state of fusion of the humeral head could not be observed due to bone erosion under the head at the point of fusion. The lateral and medial epicondyles were bilaterally fused. Both radii were present and had some erosion at the distal ends, above the epiphyses, although it was not possible to observe the state of the distal epiphyses because of the poor bone preservation. Both proximal ends appeared fused. Both radii were labelled with the name "Kühsen" in black felt pen on the posterior side. Both ulnae were in good condition. Epiphyseal fusion was incomplete distally; the styloid processes were absent. There were several assorted finger phalanges and metacarpals, all of which displayed erosion; these were not examined in any detail.

The manubrium and part of the sternum were present. All of the ribs were present and in generally good condition, although there was some erosion evident. It was not possible to use any of the sternal ribs ends for age estimation due to consistently poor preservation at this point on every rib.

There were 16 vertebrae and the sacrum present. T8 through 12 and the lumbar vertebrae had been strung with wire through the vertebral bodies and rubber discs inserted between the vertebrae to simulate the soft tissue. The atlas and axis, as well as C4, C5, T1 and T2 were loose in a red plastic storage box kept in the organic storage area. Most of the processes were missing and all of the vertebrae were very porous. Where vertebral surfaces could be observed, they showed some minor billowing but no epiphyseal rings were observed.

Both *os coxae* were present and complete. There was a small piece of wire protruding from the ilium of the left *os coxa*. There was some slight erosion on both bones, particularly on the pubic symphyses and ischiopubic ramus.

Both femora were present and had wire protruding from the heads. The heads and greater trochanters of both femora were partially fused. The lesser trochanters were unfused. The distal condyles had only recently begun to fuse prior to death. The proximal epiphysis of the tibia was wired to the distal end of the right femur. Erosion was evident around the entire distal right femur. The left distal femur was covered with plaster residue and could not be observed. Both tibiae were present. The proximal epiphysis of the left tibia was wired to the tibia. The patella was held to this epiphysis with a large pin. There was no

evidence of fusion on the right tibial proximal epiphysis and the distal epiphyses had been covered with glue, so observation was not possible. The left tibial proximal end was badly damaged and the distal end was eroded. The name "Kühsen" had been pencilled onto the left tibia near the distal end on the anterior surface. Both fibulae were present. Both proximal heads were unfused. Both distal ends were badly damaged. The talus and calcaneus were present for both left and right, each connected with wire.

Metrics

Although some of the measurements were not possible due to the level of preservation of the bones, data was obtained for the both the cranium and post-cranial skeleton (see Appendix E). Stature was estimated from the femur using Trotter and Gleser (1958). The result was an approximate height range of 152.83 cm to 160.87 cm, with a mid-point of 156.83 cm.

Sex and age determination

Table 13 shows a list of the morphological traits observed in the determination of sex of the Kühsen skeleton. Examination of the nuchal crest, mastoid process, supraorbital margin and glabella indicated that all of these traits were minimally developed and suggested that the individual was female. The mental eminence was present but not strong and also suggested a female. The orbits were rounded and composed most of the facial area. The mandibular condyles were not large. All of these traits were suggestive of a female.

The pelvic aperture was broad. The ventral arc scored a 1 on the scale recommended by Buikstra and Ubelaker (1994).The ischiopubic ramus was delicate and rough-edged. The greater sciatic notch was wide and shallow, opening in a U-shape. There were only minimal ischial spines. Both obturator foramen were sharp edged and triangular in shape. The subpubic angle was nearly vertical. All of these features were typical of females. The features of both the skull and the pelvis were all suggestive of a female; it is possible to sex this individual as female.

METHOD OF SEX DETERMINATION	RESULT
Cranial morphology	
Nuchal crest	Female
Mastoid process	Female
Supraorbital margin	Female
Glabella prominence	Female
Mental eminence	Female
Orbits	Female
Mandibular condyles	Female
***Os Coxae* morphology**	
Pelvic aperture	Female
Obturator foramen	Female
Ventral arc	Female
Ischiopubic ramus ridge	Female
Greater sciatic notch	Female

Table 13: Methods used for sex determination of the Kühsen skeleton

Table 14 shows a summary of methods used for age determination of the Kühsen skeleton. Based on the observation of the dentition and the auricular surfaces of both *os coxae*, it is possible that this woman was between 20 and 24 years of age at the time of death. Fully erupted, but not worn, third molars were present bilaterally for the mandible

and likely the maxilla. This suggested that the individual was over 18 years of age but less than 35 (Buikstra and Ubelaker 1994).

Both pubic symphyses were eroded and are not suitable for the observation of age of the individual. Both auricular surfaces were, however, visible. According to the classification by Meindl and Lovejoy (1989) and presented in Buikstra and Ubelaker (1994), the auricular surfaces of both *os coxae* were phase 1. There was evident transverse billowing and organization which placed the individual at 20 to 24 years of age at death.

Method of age estimation	Age estimate
Dentition	18-35
Auricular surfaces	20-24
State of epiphyseal fusion	
Clavicle – medial	21-23
Acromion	16-22
Humeral - lateral and medial epicondyles	14-17
Radii – proximal	14-17
Ulnae – styloid process	<16
Ulnae – distal end	<16
Vertebrae – epiphyseal ring	
Os coxae	17-21
Femur – heads	15-19
Femur – greater trochanters	15-19
Femur – lesser trochanters	15-19
Femur – distal condyles	15-19
Tibiae - proximal	<15
Fibulae - proximal	<15

Table 14: Age estimation of the Kühsen skeleton

Examination of the epiphyseal fusion provided clarification of the age the Kühsen female. Determining an age range based on the state of fusion at multiple points in both the upper

and lower skeleton, based on guidelines from the Workshop of European Anthropologists (WEA 1980), suggests an approximate age of 15 to 17 years of age at death. When the epiphyseal fusion data are combined with the dental data and the state of the auricular sufaces, the approximate age estimation would be 15 to 18 years of age.

Palaeopathology

On the right mandibular M1 there was a large area of tooth missing on the mesial side (see Figure 87). The pulp cavity was visible. The edges of this area were sharp but stained due to the peat chemistry; it is likely that this tooth damage is antemortem or perimortem. The surface of the tooth was black and eroded, possibly signifying significant dental caries; the missing section of tooth may have cracked and broken off completely. There was no evidence for enamel hypoplasia. When possible, teeth were assessed for wear using the standards outlined in Buikstra and Ubelaker (1994: 53). On the right mandibular M1 the wear would be classed as 24 (out of 30) with enamel found on only one side of each quadrant, with one quadrant missing. The missing section of tooth is discussed below in more detail. The M2 wear would score 10 (out a possible 40) and the the M3 wear would score 4 out of a possible 40. On the left side, the M1 would score 36 (out of 38 out of 40, while the M2 would score 24 out of 30 (Buikstra and Ubelaker 1994, 53). The maxillary teeth are also worn. The left canine would score about 4 (out of 8). The right M1 would score 32, the M2 score 30 and the M3 would score 0 out of a possible 40. The right M1 would score 32, the right M2 would score 30 (Buikstra and Ubelaker 1994, 53).

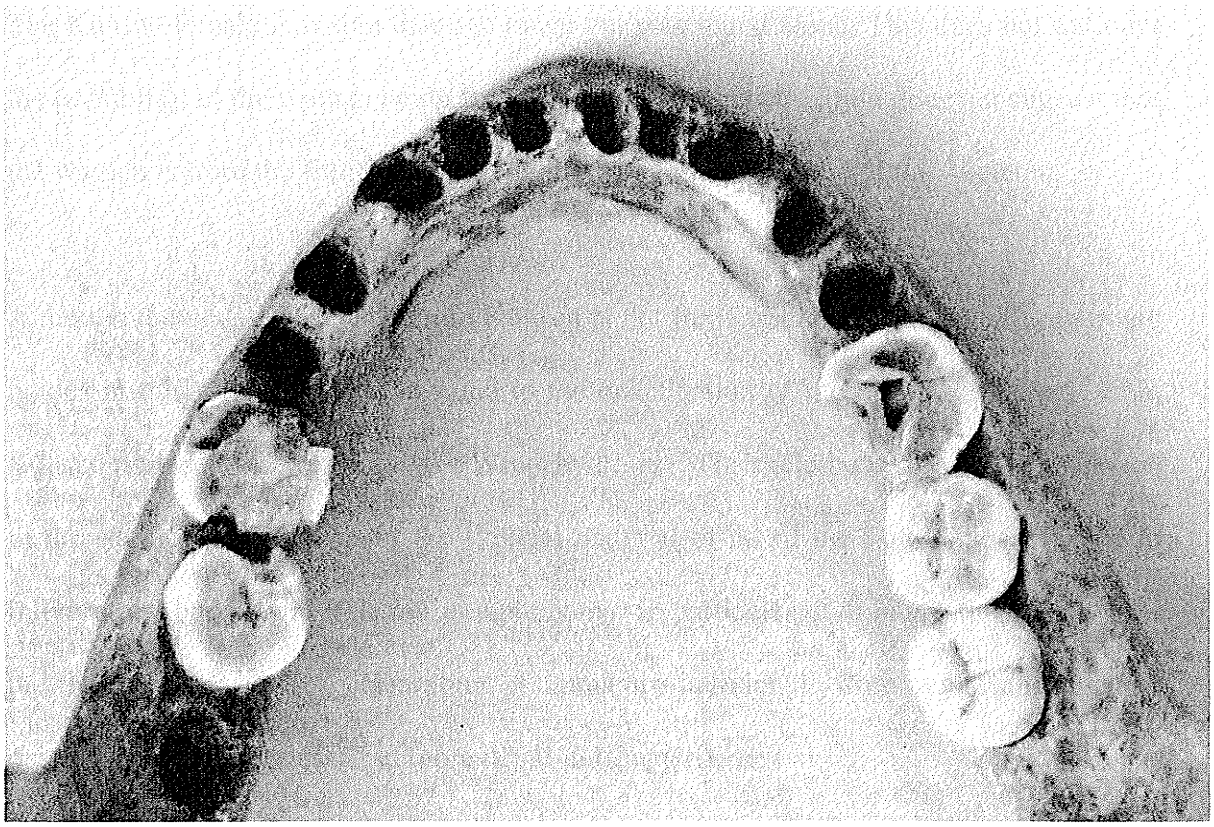


Figure 87: Kühsen mandible (Photo: Heather Gill-Robinson)

Image analysis

The cranium and mandible of the Kühsen skeleton were imaged using MSCT, mainly for archiving and future facial reconstruction. The pelvis was also MSCT scanned. A comparison of the thickness of cranial bones between the Kühsen female and the Windeby adolescent show much less demineralization in the bog skeleton (Kühsen). This is discussed in more detail in Chapter 13.

SUMMARY

It was reported that many of the Early Neolithic bog skeletons of Denmark were aged between 16 and 20 and that skeletons were found in pairs at several sites (Bennike 1999).

The Kühsen female is within that age range but was found alone. This does not discount the possibility of the woman being from the Neolithic, but equally it does not suggest that the woman is from the Iron Age. Only dating will confirm the age of this skeleton.

Although the undated skeleton from Kühsen is not from acidic peat, unlike the other bog bodies in this research, there is value to the examination of the body. The female from Kühsen is close to the same age the Windeby I body. The skeleton serves as a comparison to the state of preservation of the skeletal material of all of the bog bodies in order to interpret the bodies with relation to taphonomy. In particular, it is interesting to compare the differences in bone preservation of immature individuals from acidic and alkaline peat. This will be discussed in more detail in Chapter 13.

CHAPTER 13

DISCUSSION

INTRODUCTION

This research provided a re-examination of all of the data related to the bog bodies at the Archaeologisches Landesmuseum, as well as the bodies themselves. For the first time, data from the archives, and the physical remains of six bog bodies and one bog skeleton were incorporated into a single research project and compared with previously published research. New methods of analysis were tested to determine techniques appropriate for the examination of bog bodies. This chapter places all of the previous and newly acquired data regarding the bog bodies into context, allowing some interpretation of the bodies within the environment of Iron Age Schleswig-Holstein. As discussed in Chapter 4, the chronology of the Iron Age is, for the purposes of this research, limited to the Pre-Roman Iron Age (500 B.C. to A.D. 1), Early Roman Iron Age (A.D. 1 to A.D. 150), Late Roman Iron Age (A.D. 150 to A.D. 380) and Migration (A.D. 380 to 700) periods, due to the large radiocarbon date ranges of the bog bodies.

TAPHONOMIC ISSUES

In his 1734 article, Balguy described two bog bodies as being fair-skinned and soft after nearly 30 years immersion in the peat. This description is interesting, since bog body skin is usually dark brown and, although supple, is usually quite tough. This suggests that the preservation process seen in the Iron Age bog bodies, including those in the current research, is long-term process. In contrast, experimental archaeology fieldwork has shown that dramatic changes to the colour and texture of skin can occur within a few

months, after an initial period of stabilization (Gill-Robinson 2000, 2002). Clearly the taphonomy of human remains in a peat environment is a very complex issue.

Kühsen as alkaline-preserved skeleton vs bog body preservation

In 1766, a report on archaeological investigations in the Sheltands discussed the possible conditions for the preservation or destruction of human remains in peat (Hunt 1866). There was some debate as to whether or not peat would preserve, since it seemed that sometimes bodies would preserve, but that bones disintegrated. Hunt also recognized that "...it becomes of the greatest importance to understand that varieties of peat may so entirely differ in their chemical components as to have entirely opposite effects" (Hunt 1866:366). This was an early interpretation of the differences in preservation between alkaline and acidic peat environments.

The most obvious difference between the Kühsen body and all the other bog bodies in this collection is the fact that the Kühsen body was completely skeletonized when recovered. All of the other bodies in this research have some soft tissue preservation. Although specific environmental conditions of the Kühsen skeleton are not reported, it is known that it was found in an alkaline bog in the southern area of Schleswig-Holstein, so the skeletonization is expected. Upon examination, the bones of the Kühsen skeleton are lighter in colour than those of the bog bodies. The bones are also heavier and slightly rougher to the touch than the bog body bones. The soft tissue present on the bog bodies prevented much bone erosion, while the Kühsen skeleton showed evidence of erosion over most of the bones. The scapulae, which are not dense bones, were particularly badly

affected, while the femora and humerii were in better condition. Epiphyseal regions of the long bones were also affected.

Figure 88 shows a comparison between the demineralization of the skull of the Windeby I body and the Kühsen skeleton. The Windeby I skull is noticeably thinner. The red areas highlight the frontal and occipital regions for comparison. Clearly the Windeby I skull is thinner and appears to lack the cortical bone structure visible in the Kühsen skull.

Figures 89 through 94 show individual diagrams for each of the bodies in this study; presence of soft tissue and skeletal material is indicated. Although these bodies are generally well preserved, there is some variation in preservation between the bodies. Soft tissue is present to some extent on all of the bodies. The Osterby skull has only a very small amount of soft tissue remaining. Skeletal material is also present for most of the bodies. While Rendswühren, Dätgen and Windeby I have a nearly complete skeleton, Damendorf Man has only five lumbar vertebrae, a few toes and some cranium remaining. Windeby II has only a few unidentified skeletal fragments. The presence or absence of the soft tissue or skeletal material may be able to assist in drawing some conclusions about wetland taphonomy and human remains. Unfortunately, only limited environmental data is available for the peat that surrounded each of the bodies and as a result the taphonomic interpretation is also somewhat limited.

There are no environmental data available for the Rendswühren and Damendorf bodies. These bodies have very different levels of preservation and it is unfortunate that an



Figure 88: Comparison of the Kühsen (top) and Windeby I (bottom) skulls

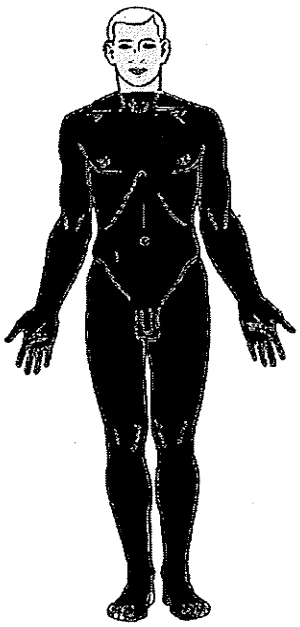


Figure 89: Diagram of Rendswühren. Grey indicates soft tissue only. Black indicates both soft tissue and bone.

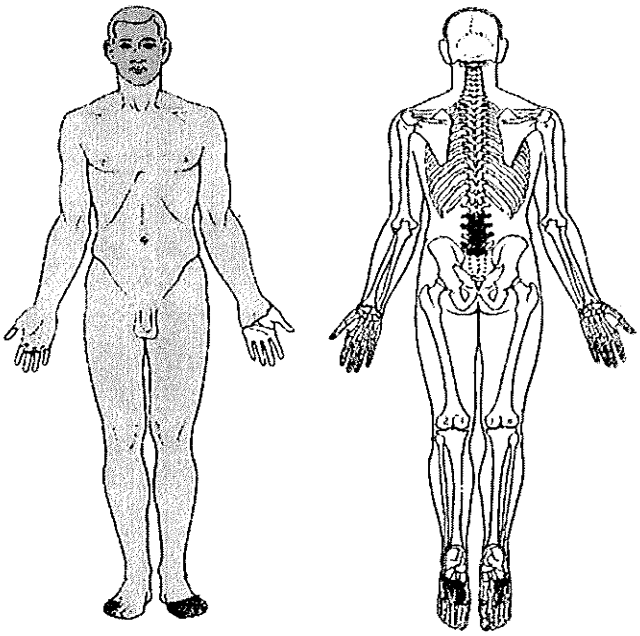


Figure 90: Diagrams of the Damendorf body. Grey indicates soft tissue only, black indicates bone and soft tissue.

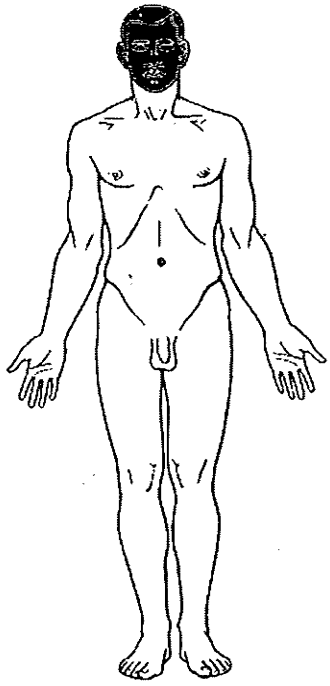


Figure 91: Diagram of Osterby. Black indicates bone and soft tissue (limited soft tissue).

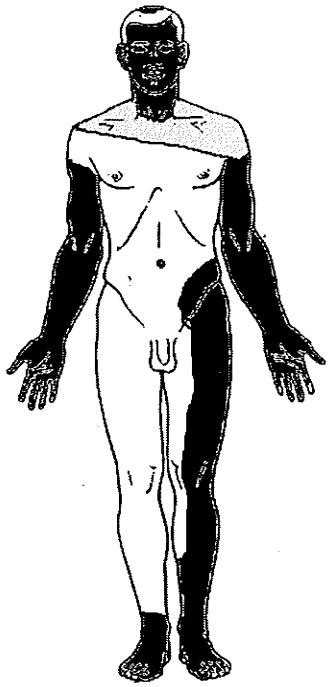


Figure 92: Diagram of Windeby I. Black indicates soft tissue present. Grey indicates the animal hide cape. All skeletal material is present.

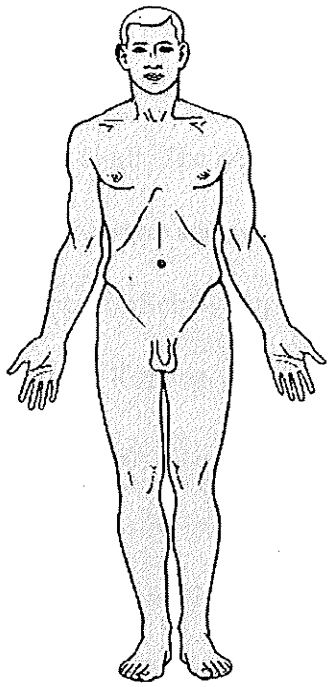


Figure 93: Diagram for Windeby II. Grey indicates the presence of soft tissue. The fragmented skeletal material has not been marked since it was not conclusively identified.

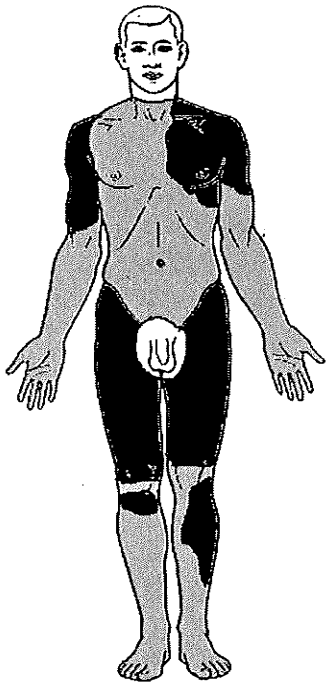


Figure 94: Diagram for Dätgen. Black indicates the presence of soft tissue and bone. Grey indicates the presence of bone only.

assessment of the environment in relation to the taphonomic changes to the body cannot be undertaken. Pollen analysis and basic vegetation description was done from a peat core taken near the find site of the Osterby skull. The peat was in several layers of *Sphagnum* with increasing concentration of *Eriophorum* species at greater depths and a sedge-rich peat at the lowest level (75 cm to 85 cm). (Schütrumpf 1958). The skull was found at a depth of 65 to 70 cm below the surface (Kersten 1948). The peat from the core sample at the same depth was characterized by a dark mixed *Eriophorum-Sphagnum* peat (Schütrumpf 1958). Both of these genera are acidophilus and prefer a waterlogged environment. The sedge peat at the lowest depth of the core sample is more characteristic of a drier environment, so clearly there was a slightly wetter environment in the bog at the time of the deposition of the skull. The species of sphagnum was, unfortunately, not specified. With enough species-specific data collected from peat related to the bog bodies, it may be possible to connect species, and their associated preferred environments, to levels of preservation of soft tissue and bone.

Environmental data are also available for the Windeby bodies, although this information is very general for the Windeby II body. Samples were taken from the bottom surface of the spot where Windeby I was found, following removal of the peat block. When the body was excavated from the peat, other samples were taken from directly beneath the shoulder, hip and head. A general sample was also taken from near the find spot of Windeby II. Most samples for both Windeby I and II consisted of sedge-rich sphagnum peat, although the peat from the sample directly beneath the Windeby I body included darker, younger sphagnum. The layer associated with the Windeby I body had a large amount of wood and bark, mainly birch. There also appeared to be evidence of ling

species, possibly *Calluna vulgaris* lining the grave (Gebühr 2002; Schütrumpf 1958). The ling would not have been present in that layer without the assistance of humans and it is possibly that it was placed at the site as part of a deliberate burial.

Taphonomy as it relates to pseudopathologies

Taphonomy is an important factor to be considered in the interpretation of bog bodies. As discussed in chapter 2, pseudopathologies are particularly common in bog bodies recovered from acidic peat. While it is unlikely that extreme deformation or bone could be misdiagnosed as pathology, in some circumstances, minor distortion or shrinkage could potentially be misinterpreted.

There are a number of potential factors that contribute to the post-mortem damage and deformation of skeletal material in bog body bones. In some cases, the body may have been exposed to the air and partially decomposed at the time that it entered the peat. This would allow putrefactive bacteria to colonise the body, particularly if open wounds existed. Although the peat environment would reduce, and eventually halt, the rate of decomposition, some decay would have already occurred. The Borremose II bog body is considered to be an example of this (Andersen and Geertinger 1984). Even if the body was deposited into the peat immediately after death, the chemical environment of the bog causes leaching of the hydroxyapatite, leading to a softening of the bone. Eventually, some skeletal material may completely disintegrate, as seen in the Windeby II and Damendorf bodies. As a result of the loss of bone mineral, the skeletal material reacts to the pressure of the overlying peat, leading to bone deformation and distortion. The asymmetry seen in the skull of the Windeby I body is an example of this type of bone

deformation. The head rested on its right side; pressure from the peat pressed on demineralized bone of the skull and the bottom surface (the right side of the head), was slightly flattened.

A second aspect of interpretation that is affected by taphonomy is the presence of pseudopathological fractures on the bog bodies. As seen with the Dätgen Man, bone fractures occur after death. Taphonomic fractures also been identified on the Grauballe Man (Asingh 2003), Elling Woman (Langfeldt and Raahede 1980), and possibly Lindow II (Bourke 1986). Post-mortem fracturing may be due a combination of bone demineralization and the slight movement of the body in the peat. It is known that bodies in the peat are not completely static. They may move both vertically and horizontally, as experimental research has shown (Gill-Robinson 2000, 2002). Once the bone is demineralized it is more susceptible to fracture, so this type of post-mortem damage may occur during the slight movement of the bodies and due, in part, to the pressure of the peat. Other fractures may occur during excavation or conservation processes. It is possible that in the early stages of demineralization, and when desiccated after excavation, bones are more susceptible to fracture. Later in the process, after the hydroxyapatite has dissolved substantially, the bones may bend rather than break.

The three-dimensional reconstruction and modeling of the reported trauma has proved to be very beneficial in the re-analysis of bog bodies. Imaging provides a non-invasive method for the examination of skeletal material and internal soft tissue structures. Imaging can help identify the presence of previously-unknown skeletal material, as well as assist with the re-interpretation of fractures. The Damendorf Man is an excellent

example of the importance of imaging. It had been believed since his discovery that all of the skeletal material and internal organs had completely dissolved (eg. Bahn 2003:189). As this research demonstrated, Damendorf Man does, in fact, have both some skeletal material and preserved internal organs. There is evidence of five articulated vertebrae, the cranium, the brain and, possibly, intestines. It is possible that similar re-analysis of other "flat" bog bodies, such as the Weerdinge couple from the Netherlands, could also lead to the discovery of unknown skeletal material. The detection of unidentified internal structures, whether skeletal or soft tissue, is important to fully understand the taphonomy of bog bodies. It is essential to be able to map levels of preservation on each body and attempt to determine if there is a pattern to this preservation that is currently unknown. Furthermore, it may be possible to undertake invasive analyses, where permitted, for additional information. For example, it may be interest to attempt to sample the intestinal tract of the Damendorf Man. Although flattened, there may be preserved food remains, which may provide an indication of the social status of the individual. The body would, however, have to be cut for the sampling to occur, so it may not be possible for these examinations to be undertaken in the near future.

Imaging is also important to the re-analysis of fractures on bog bodies. Three-dimensional modeling provides the opportunity to digitally remove soft tissue from the bones to allow for direct examination of the surface and internal structure of the bone. It is also possible to rotate the bone and examine the apparent fracture, which is not usually possible when examining bog bodies.

It has been noted during the imaging and interpretation of the Danish bog bodies that there are differences in the cortical bone of taphonomic versus perimortem fractures on bog bodies (Lynnerup 2004, pers. comm.). Most of the fractures of the Dätgen Man have, however, been further altered during conservation, some by the insertion of wooden rods, which have damaged the internal structure of these bones so this method of interpretation was not possible. One bone that bears evidence of a definite taphonomic fracture is the left humerus of Dätgen. A small area of remodelled bone was visible, suggesting that the fracture had healed but was recent enough that it had not been completely re-absorbed into the bone. Surrounding that was an area of split bone; the internal appearance of the bone splinters was significantly lighter in colour than the outer surface of the bone and it was clear that these areas of the bone had not been exposed to the peat. It is possible, as noted in Chapter 11, that the presence of a recently-healed fracture may have meant that region was structurally weaker and more susceptible to taphonomic alteration in the peat environment. Imaging provided an opportunity to examine this area of fractured bone more carefully. Since some areas of fractured bone were partially obscured by soft tissue, the imaging allowed examination of fractures beneath soft tissue. Furthermore, the imaging provided the chance to view the length of the wooden dowling used during conservation. In all cases, several inches of dowling were inserted into the centre of the bone.

INTERPRETATIONS OF THE BODIES

Table 15 is a summary table of key results from all seven bodies.

Body	Sex	Age	Stature (in cm)	Pathology	Trauma	Other
Rendswühren	Male	Adult	163	None	skin wound to foot (antemortem or perimortem); wound to left thorax (antemortem or perimortem)	Head completely reconstructed
Damendorf	Male	Adult	N/A	None	Possible cut mark in thorax area	
Osterby	Male	Adult	N/A	None	None	Head filled with plaster, skull reconstructed; mandible apparently does not match
Windeby I	Probable Male	17-18	165	Harris lines	None	Body partially obscured by "peat mound" in display; most skeletal material removed and stored separately from body
Windeby II	Probable Male	Adult	N/A	None identified	None identified	Body cannot be separated from base
Dätgen	Male	30-35	164.9	None identified	Soft tissue: 2 stab wounds through chest; cutmark to heart; deliberate removal of penis Skeletal: multiple fractures, some taphonomic	
Kühsen	Female	15-18	151.2	Dental caries	None	

Table 15: Summary of key results from the analysis of the Schloss Gottorf bog bodies

There appear to be no female bog bodies with soft tissue in the collection of the Archaeologisches Landesmuseum Schloss Gottorf, assuming the interpretation of Windeby I as male is correct. It is also probable, based on morphological and molecular evidence, that the Windeby I body is, in fact, male and not female as previously interpreted. This is not the first research to offer a revision of the age and sex of a bog body. Pieper (2003) reported that the skeleton of the "Woman from Sedelsberg", believed to be a female from 20 to 40 years of age, was actually male and probably less than 16 years old (Pieper 2003:107). All of the Schloss Gottorf bodies are adults, with the exception of the Windeby I body, which is slightly younger than adult. The Kühsen skeleton is also likely sub-adult and the only female. Statures could not be calculated on three of the bodies: Windeby II, Damendorf and Osterby. The living stature estimation of the Rendswühren Man is very approximate because of the extent of the soft tissue preservation. Stature for Dätgen was based on femur measurements from the MSCT images. The only two bodies for which specific stature could be calculated were Kühsen and Windeby I; both were based on skeletal measurements. Inflicted trauma was identified on four of the seven bodies; none were identified on Windeby I or Windeby II or Kühsen. Inflicted trauma ranged from fractures (both perimortem and taphonomic) to soft tissue injuries such as stab wounds. Pathological conditions were identified on only Windeby I. Pseudopathologies were identified on four bodies. Only the Windeby I body was wearing the clothing with which it was associated. Clothing was associated with five bodies in total, but was only accompanying the body or located nearby in four cases. Both woven textiles and skin clothing were found. Only the Windeby I body was accompanied by artifacts: four small clay vessels. Three of the bodies were found with, or under, branches or staves of wood: Windeby I, Windeby II and Dätgen.

The earliest body is the Windeby II individual, who dates to the Pre-Roman Iron Age. Rendswühren, Osterby and Windeby I are all from the Early Roman Iron Age. Damendorf and Dätgen are from the late Roman Iron Age. None of the bodies date from the Migration period.

In general, only the Windeby II individual would have known life in northern Europe before the Roman invasion. The Windeby II man may have worked a Celtic field system to produce food and probably lived in an isolated home, rather than a village setting. He would have had a diet rich in grains and wild grasses, possibly supplemented with both wild and domesticated meat. The man may have worn breeches and a tunic and possibly a sheepskin hat in winter. He would certainly have had access to some iron tools or weapons. The current state of the body means that it is not possible to determine the presence of disease or specific inflicted trauma, although the cause of death is possibly strangulation by the hazel roots found around his neck.

The Early Roman Iron Age was a time of transition. Roman culture and practices were intruding upon, and conflicting with, local beliefs and practices. The Rendswühren Man, Osterby Man and Windeby I adolescent would have experienced a drier, warmer climate. Although they may have lived in forested regions, extensive land clearing for agriculture was leading to deforestation. The agricultural system changed to become more intensive and people lived in small groups of houses to form small settlements. We cannot be specific about how the Rendswühren Man lived, or how he died. The reported skull trauma could not be confirmed due to the absence of the skull following reconstruction.

The apparent cut to the left side of the thorax is possibly peri-mortem, but whether it contributed to the man's death is uncertain. The small wound on the sole of the right foot is probably peri-mortem and suggests that the man was barefoot just prior to the time of his death.

The Osterby Man was possibly a man of status. His Suebian hair knot was typical of a free man from a Germanic tribe. This confirms that the man was probably Germanic and not Roman and possibly had some connection to the military. The unique hair knot found on both the Osterby skull and the Dätgen skull is known as a Suebian, or Schwabian, knot. Named for one of the Germanic tribes, the hair knot is usually associated with a free adult male (Reid 1999). The knot has been found in Roman art; this hairstyle is similar to those seen on a piece of sculpture from the Roman site of Tropaeum Traiani in Rumania. Several of the men also appear to have their hands bound behind their back and it has been suggested that these men were possibly human sacrifices (Lund 2002). It is also interesting that both Osterby and Dätgen were decapitated. It is unknown if the decapitation of the Dätgen and Osterby bodies was perimortem or an extreme measure taken after death, to prevent the spirit from walking (Hoffmann-Krayer 1941).

If, in fact, the head that has been associated with the Dätgen body is actually an isolated find and not related to the body, it would suggest that there are several links between the Osterby head and the Dätgen head. For example, both heads have Suebian knots and were decapitated, with the rest of the body disposed of by other means. Until confirmation that the head and body are from the same individual is available, speculation about the link between the Suebian knot and decapitation is limited. Finds of isolated heads in peat are

not unusual; examples include the Roum male and Stidsholt female from Denmark (Munksgaard 1984) and Worlsey Man from the United Kingdom (van der Sanden 1996). Although another isolated head with a Suebian knot, apparently found wrapped in a skin cape, was reported from Hooghalen in the Netherlands, the source was Alfred Dieck (van der Sanden 1996). Given the recent discrediting of many of Dieck's reports, the report of the Hooghalen head must be viewed with suspicion and assumed to be false.

A hair knot that is almost identical to the Suebian knot is also known from ethnographic accounts. Figure 95 shows a photograph of a Maranao woman from the Philippines with such a traditional hair knot (Anonymous 1965). Clearly the knots in Iron Age Germania are associated with men, while the ethnographic evidence demonstrates the knot's use by Maranao women. This may serve as an example of the potential problems with the use of ethnographic analogy for interpretation of archaeological material.



Figure 95: Marano woman (Philippines) with traditional hair knot. (Source: Archives of the Archaeologisches Landesmuseum, Schloss Gottorf – originally published in "Aracamo World", August 1965).

Windeby I was clearly buried in a grave of sorts. The peat had cut sides and although this may simply be an indication that this was a former area of peat cutting, the grave was

lined with ericaceous plants, such as cotton grass (Schütrumpf 1958). The lining of the area suggests a grave. Windeby I is not the only bog body that was placed in what appears to be a grave. There is evidence of a possible grave-cut for Windeby II also (Schlabow 1958c). Kayhausen Boy and Husbäke (1936), for example, were also placed in old peat cuts, which may have been graves (Kalis and Meurers-Balke 1998).

There are several unusual aspects to the Windeby I body in comparison with the other bodies in this group. Windeby I is the only adolescent; was the only one wearing clothing; is the only body displaying signs of long-term illness or malnutrition and, perhaps most significantly, was the only with accompanying artifacts. There are no signs of violence and no apparent cause of death. Windeby I is also the only individual in this group who appears to have been placed in what appears to be a grave. It must be considered that, based on archaeological and anthropological evidence, Windeby I is so different from the others in this small group that there may be a different interpretation of this body than for the others. Although traditional interpretations of this body have centered on the individual as a young adulteress, and some have suggested that Windeby II was her partner, there are clearly problems with this interpretation. First and foremost, assessment of skeletal morphology and preliminary aDNA evidence suggest that the Windeby adolescent is male and not female. Although it would still be possible for the Windeby I and II bodies to have had a relationship and to have been punished by burial in the bog, since homosexuality is one of the crimes identified by Tacitus, this interpretation is still problematic. The radiocarbon dates indicate that Windeby II pre-dates Windeby I by several centuries. Windeby I is dated to approximately A.D. 41 to A.D. 118, while

Windeby II is from approximately 380 to 185 B.C. (Gebühr 2002:47). Issues associated with the radiocarbon dates will be discussed later in this chapter.

One particular item of interest is the "sprang" band found with Windeby I. The interpretation of this artifact is difficult. The band, woven in a specific style known as "sprang" was, at the time of excavation, over the eyes. The band is 49 cm in length 3 cm wide. It rested across the face with the large knot at the nape of the neck (Schlabow 1958b). It is possible that the band had secured the hair of the individual at one point, but since the head was partially shaved, probably near the time of death, the band may have slipped over the face while in the peat. The shrinkage of the head in the bog, as is typical with bog bodies, may also have allowed the band to slide off the top of the head and over the face, although it is possible the band was tied too tightly for the individual to have used the band in his hair (Schlabow 1958b). It may also be that the band was used as a blindfold; since it was resting across the area of the eyes (Glob 1969, Schlabow 1958b). There are no marks on the neck to suggest the band was used to strangle the boy (Schlabow 1958b). If this band was used as a hair band it is curious that the band was still in use even though that hair had been shaved on one side of the head. Although the sprang hair band is commonly associated with females in Iron Age Denmark (Munksgaard 1978), the previous assumption that the Windeby adolescent is female, based on the presence of this woven band, has affected earlier interpretations of this body. The morphological features of the pelvis, discussed in Chapter 10, suggest that this body is probably male. There is no way to determine if the individual was wearing the head band at the time of death. It is possible that the band of another individual, a female, perhaps

the mother, was used to cover the eyes of the dead adolescent, either as a blindfold, or as an acknowledgement of passing into death. It is not uncommon in many societies for the eyes of the dead to be closed or covered; the use of the sprang band to cover the eyes of the Windeby adolescent after death is not impossible. Thus, previous assessments of sex as female may be an example of an erroneous interpretation based on gender-specific artifacts belonging to someone else. If the band was used as a blindfold, then the sex of the individual cannot be linked to the band. The problems of using artifacts as sole or primary evidence for determination of sex are well known and have been demonstrated in other research (eg. Meiklejohn et al. 2000).

There are numerous publications that offer interpretations of the Windeby I body. Almost without exception, these publications refer to Windeby I as a "girl" (Aldhouse Green 2001b:120; Bahn 1997:67; Berg et al. 1981:84; Beuker 2002:123; Buell 1997:42; Deem 1998:13; Fischer 1998:257; Glob 1969:113-114; Lund 1976:30; Lund 2002:60; Menon 1997:64; Parker Pearson 1999:68; Schäfer 2003; Turner and Briggs 1986:159; van der Sanden 1996:93; Williams 2003:95). There are a few publications that have considered the possibility that Windeby I is not female (Caselitz 1979:109; Gebühr 1979), but these publications are in German and may not have been widely read by other authors. As noted by van der Sanden (1995c:149), the publication that discussed the methodology used in the facial reconstruction of Windeby I does not mention the possible conflict regarding the determination of sex (Helmer 1983).

It is difficult to conclusively determine the reason for the deposition of the Windeby I body in the bog. The most common interpretations are that the "girl" was a punishment burial and may be connected to the adult male found at the same site or the catch-all term of "ritual".

Gebühr has consistently argued that the Windeby I body was placed in a regular grave (Gebühr 1979). Although this interpretation is not accepted by most, occasional signs of support can be found in the literature. For example, while Briggs (1995) does not state his own opinion on the matter, he does state that "[D]issidents to this view [that Windeby is a ritual burial] like Gebühr are all too readily dismissed" (Briggs 1995:175).

Popular press publications thrive on the sensationalistic aspects of the Windeby I body and speculate on the cause of death. One children's book even describes the Windeby I body as an "evildoer", when referring to the burial of the "girl" as a possible punishment (Buell 1997). Another publication states: "She was probably strangled with her headband, which now covers her eyes" (Menon 1997:64). There were no ligature marks visible on Windeby I, so the probability of strangulation is low. Another author discussed the "girl drowned at Windeby" (Aldhouse Green 2001b:120), but cited no source for the stated cause of death. Although microscopic examination of lung tissue in forensic cases may permit the identification of drowning as a cause of death (Fornes et al. 1998; Torre and Varetto 1985), lung tissue was not preserved on the Windeby I body. No definite determination of drowning could possibly be made in the case of Windeby I. The band covering the eyes, usually interpreted as a "sprang" hair band used as a blindfold, has also been described as a "waist band" (Aldhouse Green 2001b:117), although the band seems

far too small to have been used for this purpose. Furthermore, the band has been used as possible evidence for the Windeby I individual to have possessed an unusual gift: "...her 'blindness' might – on analogy with certain present-day traditional practices – suggest that, in life, the Windeby girl was a "seer", a prophetess whose inner sight was enhanced by her physical sensory deprivation" (Aldhouse Green 2001b:120). While Parker Pearson (1999) suggested that bog bodies may represent the elite of the society and may have been "witches, shamans or priests" (Parker Pearson 1999:71; Williams 2003); this has been interpreted by some to mean "prophets" (Aldhouse Green 2001b:194). It is difficult to provide archaeological evidence from the body of Windeby I to support these hypotheses. As discussed in the earlier section interpretation of the Windeby I body, there are other more logical interpretations of the presence of the band across the eyes, including the possibility that the band slipped off the head after death.

When referring to the Windeby I body, the author of one children's book noted that "[A] new scientific study of her may help scientists solve of the mysteries still surrounding her death" (Deem 1998:37). While this research was not able to determine a cause of death or solve all the suggested mysteries, it was able to provide substantial new information about the individual. In particular, since the morphological and molecular evidence suggests that the Windeby I body is that of a young male, many previous interpretations can be discarded and new ideas proposed.

During the Late Roman Iron Age, Damendorf Man and Dätgen Man would have experienced an expansion of farm sites. They may have worn dyed woven textiles, including a tunic and breeches, as well as shoes made from a single piece of leather.

Some of the fashion may have been influenced by Roman styles. Trace element analysis of the hair of Damendorf Man revealed high levels of lead and mercury. These elements suggest that the Damendorf Man may have been involved in gold and silver gilding. One method of gilding, known as fire-guilding", would release substantial amounts of mercury vapour (Anheuser 1996, 1999), which would have been absorbed in the hair of anyone involved in the gilding process. It has also been suggested that the mercury may have been used as an adhesive: "...the base metal surface was cleaned and polished and then a very thin layer of mercury was rubbed into the polished surface. When the gold leaf was applied on top it would stick by a process of partial amalgamation..." (Oddy 1991:32). This would also expose the gilder to a substantial amount of mercury with risk of inhalation. The lead exposure may have come from working objects of lead (to be gilded) or lead alloys, such as lead-bronze sculpture, which is known from Roman times (Oddy 1991). Changes in the methods used to purify or extract mercury were developed around the second century A.D. in the Roman world (Oddy 1991), and some of these innovations may have moved north with Roman contact. It is known that although gilding was common in Germanic craftsworking (Becker et al. 2003), mercury fire-gilding was linked to Roman techniques (Oddy 1991). There are numerous artifacts from Denmark and northern Germany, some dating back to the first century A.D., which display niello. "Niello is the collective term applied to silver, copper and/or lead sulphides, which are inlaid as dark embellishments on bright metal objects" (Stemann Petersen 1994:133). Research into the composition of niello on Danish Iron Age artifacts shows that pure silver sulphide was used from the first century A.D. to about A.D. 1000. (Stemann Petersen 1994). Other sulphides, some also containing silver, were in used, but did not flourish until the end of the 5th century A.D., so these were likely not used by the

Damendorf Man. Many of the objects that were decorated with silver sulphide were made of lead, which may account for the presence of the lead in Damendorf Man's hair.

It is possible that the Damendorf Man was exposed to mercury fire-gilding. It cannot be determined whether Damendorf Man was the trained craftsman or some sort of assistant, either an apprentice or a slave. The age of the man would suggest he was not an apprentice. It may be that Damendorf Man was not local to northern Germany; it is possible that with his artistic skills he was brought to the area by the Romans, or chose to move to the region from a southern part of Europe, for some unknown reason.

For the most part, there are few published interpretations or opinions related to the Damendorf Man. This is primarily due to the flattened condition of the body. It was believed that little information could be drawn from such a body. Numerous publications report that there is no skeletal material remaining in the Damendorf body, only skin, other soft tissue and hair (eg. Bahn 2003, Brothwell 1986; Brothwell and Gill-Robinson 2002; Buell 1997; Coles and Coles 1989; Fischer 1998; Glob 1969; Turner and Briggs 1986). In fact, Glob notes that "[T]he rest of him completely disappeared as if by magic" (Glob 1969:107). As discussed in this research, imaging revealed the presence of five articulated vertebrae and pieces of crania, as well as possible preserved brain and intestines. This research was also to identify a possible occupation for the Damendorf body. It is possible that the man was a skilled artisan or craftsman, a gilder, based on the trace element analysis of his hair. It is clear the interpretation of a bog body cannot be based on the current visible condition of the body, but thorough examination through imaging and minimally-invasive sampling is required.

Very detailed analyses of gut contents of the Dätgen body were undertaken in the 1960s (Martin 1967). As reported in Chapter 11, there is length of desiccated, but well-preserved, intestine. Preliminary scouting of the intestine using an X-ray unit at the Archaeologisches Landesmuseum did identify some tiny dark spots that may be preserved gut contents. Since one of the intentions of the research was to conduct analyses in manners that were minimally invasive, it was decided not to re-sample the gut contents at this time, particularly in view of the high-quality analyses conducted shortly after the body's discovery. All of the elements of the Dätgen gut contents are similar to those of the Danish bog bodies (Helbæk 1951, 1958, 1959). Like Lindow Man, there was no evidence for ergot or other potentially hallucinogenic substances in the gut contents of Dätgen Man. Bog bodies are not the only ancient European people with which mind-altering substances have been associated. Cannabis was identified at the tomb of an apparent Iron Age chieftain near Hochdorf, Germany (Aldhouse Green 2001a).

The injuries to Dätgen Man are both taphonomic and peri-mortem. It is evident that the cause of death is the two stab wounds to the chest, one of which penetrated the heart. The removal of the penis was probably peri-mortem, but may have happened after death. There is a partially healed fracture to the left humerus, which is surrounded by an area of taphonomic splitting. The fractured femur was taphonomic and does not reflect the events surrounding the death of this individual. Like Osterby Man, it is impossible to say if decapitation occurred peri-mortem or post-mortem. If decapitation was part of the man's death, then Dätgen Man experienced an exceptionally violent death: stabbing through the heart, excision of the genitals and decapitation. There are no other bog bodies that have

had their genitals removed deliberately, as far as is known, so the interpretation of this act is open to speculation.

Restraints

Three of the seven bog bodies in the research group were found with poles and branches and, in the case of the Windeby I adolescent, large stones. Previous research has shown that as many as 14% of bog bodies may have been restrained in the peat using wooden poles, stones or both (Gill-Robinson 2003). These have been interpreted as a means of pegging people into the bog, perhaps to drown them as part of a punishment, based on the writings of Tacitus. The Danish body known as "Queen Gunhilde", from Juthe Fen in Haralskjær, was discovered with wooden stakes and branches still firmly driven into the peat surface below the body. Stakes were found over both knee joints and both elbow joints and large branches across the chest and lower abdomen were also held firmly in place with stakes across each end. All of the stakes had to be removed before the body could be excavated (Glob 1969).

There are other possible interpretations for the wooden poles with bog bodies. It was suggested recently that the poles were used by people who had accidentally slipped into the bog and attempted to use the poles to pull themselves out (Anonymous 2005). The branches may have provided the body a measure of protection from predators, as also seen in the votive finds discussed below. Experimental archaeology has demonstrated that animal corpses will be scavenged from peat by foxes, even when buried at depths exceeding 60 cm (Gill-Robinson 2000). It is possible, therefore, that human remains

buried in peat might also be susceptible to animal predation. It is also possible that if the burial site was very wet at the time of body deposition that the body may have floated to the surface after burial, as a result of decomposition. In order to prevent this, it would be logical to stake the body into the peat to prevent it from rising. As discussed above, during the Iron Age there would have been fears that the person's spirit would walk among the living if the body was unrestrained (Hoffmann-Krayer 1941). It may be that there was some significance to the branches that is not yet known. Gebühr (1979) demonstrated that similar poles, some laid across the body, were found in 64 inhumation graves associated with a stave church (Gebühr 1979:103). Although the date of the church is certainly more recent than the bog bodies, it is an interesting parallel.

EVALUATING METHODS FOR STUDYING BOG BODIES

Archives

Table 16 is a summary of the major methods of analysis used in this research and other studies of soft tissue bog bodies. The archival research was not included in this table because this information is seldom reported in publications; it is unclear whether other researchers access archival material but do not report it, or do not access archival material. Since most of the bog bodies available for study are on display or otherwise curated in museums, there are likely museum archive files available for study. Any new bodies discovered, such as the recent finds in Ireland, are likely to undergo rigorous examination and analysis, including detailed documentation.

BODY	X-RAY	CT SCANNING	3D RECON	PHYSICAL EXAMINATION	GUT CONTENT ANALYSIS	TRACE ELEMENT ANALYSIS	STABLE ISOTOPE ANALYSIS	DNA
Rendswühren	X	X	X	X				
Damendorf	X	X	X	X		X	X	
Osterby		X	X	X		X	X	
Windeby I	X	X	X	X		X	X	X
Windeby II				X				
Dätgen	X	X	X	X	X	X	X	
Husbäke Man		X	X	X				
Kayhausen				X	X			
Neu-Versen Man		X	X	X				
Emmer-Erfschidenveen				X				
Exloërmond				X				
Weerdinge I				X				X
Weerdinge II				X				X
Yde	X	X	X	X				
Zweeloo				X	X			
Grauballe Man	X	X	X	X	X		X	
Borremose I				X				
Borremose II	X	X	X	X	X			
Borremose III				X				
Huldremose	X	X	X	X	X			
Elling Woman	X			X				
Tollund Man	X	X	X	X	X			
Lindow II	X	X	X	X	X			E. coli
Worsley		X	X	X				
Meenybraddan	X	X		X				

Table 16: Major methods of analysis used for bog body studies

Archival resources may provide context for the bog bodies. Details of discovery and excavation may provide data related to the environmental conditions at the time of excavation. Since the results of environmental sampling or other records of environmental data were not often published, archival material may provide those details. Other information about the site, including the location of any features or artifacts contemporary with the bog bodies, may also be recorded in the archives. Often these data were gathered at earlier or later excavations and may not have previously been linked directly to the human remains. All of this information provides a more thorough context for the interpretation of the bog bodies.

In the case of this research, the archives provided substantial information to assist in the interpretation of the bog bodies. For example, in the case of the Windeby bodies, Iron Age settlement sites and shell middens were identified near the bog site where the bodies were found. Although it is impossible to be certain that either of these individuals lived at the settlements or consumed the shellfish, a clearer picture of the area at the time that both Windeby I and II lived can be created with the knowledge of these features. Furthermore, the evidence of daily habitation in the form of settlements and household refuse near the site of deposition of the bog bodies suggests that perhaps the bog sites were not deliberate places of isolation, but may be linked to settlements. Documents in the archives also indicated the presence of pottery, both intact and broken, by both Windeby I and II, which suggests that cremation urns were located near both bodies. As discussed above, Windeby I was clearly buried in a cut grave. The presence of cremation

urns may indicate that this bog site was used for deliberate disposal of the dead, both cremation and inhumation.

Archival sources may also provide details of any analyses previously conducted on the bodies. During this research, the detailed records of the autopsy of the Rendswühren Man were crucial to the analysis and interpretation of that body. Without access to data about the presence and condition of internal organs, for example, it would have been impossible to understand the high degree of preservation on this body. Since the internal organs appear to have been removed during autopsy, or otherwise not preserved after excavation, the written documents from the original medical examination were the only sources of data available. The highly detailed medical notation made it possible to understand exactly which organs had been preserved and their state of preservation upon excavation. Any researcher who failed to consult archival sources during the re-analysis of the Rendswühren Man would have lacked data about the internal organs and may have misinterpreted the taphonomic changes to the body.

Physical examination

By far the most common approach is the most obvious – physical examination. The level of invasiveness varies according to the date of the investigation; full autopsies were previously conducted on some bodies, including the Rendswühren body from this research, while other bodies were not autopsied. Most bog bodies were measured and recorded in some way for documentation, although, as discussed before, there is rarely identification of specific points used for measurements and the replication of metric data may be difficult or impossible in future re-examinations.

The physical examination provides an opportunity to assess the body in its current state. While archival data may provide data from previous examination, it is important for a physical assessment of the body to be made at an early stage in the research. The examination may allow for a comparison of observations at the corpse at the time of excavation and its current condition. For example, methods of conservation and long-term display may have caused a physical alteration to the body. In some cases, decay may have occurred. The physical examination is an excellent opportunity to identify any apparent deterioration in the preservation of the body and allow conservation teams to develop immediate preservation strategies or plans for long-term monitoring.

The physical examination may also provide the basis for the determination of further appropriate methods of investigation for both the research in progress and in planning for future analyses. The Dätgen clearly had taphonomic damage to the bone that was visible during the initial physical examination. The decision to undertake computed tomography scanning and subsequent three-dimensional reconstruction to further examine the nature of the taphonomic damage was based on the physical examination. In the case of the Rendswühren Man, physical examination revealed visible evidence of packing material in the chest. Although invasive examination was not within the scope of this research, further investigation of the thorax and abdominal cavity using an endoscope may provide additional details on the specific nature of the packing material.

Imaging

The importance of radiology to the study of ancient human remains is undisputed; recently palaeoradiology was the focus of a special issue of The Canadian Association for Radiologists Journal (Vol. 55, No. 4, October 2004). Nearly a decade ago at the 2nd World Congress on Mummy Studies a single paper discussed the "experimental" use of CT-scanning in an attempt to diagnose pathology on a South American mummy (Reinhard et al. 2001). At the recent 5th World Congress on Mummy Studies, hosted by Italy in September 2004, more than 20 papers and posters were based on the use of CT scanning and 3D virtual reconstruction, mainly for visualization and animation. CT scanning and 3D virtual reconstruction have become routine for visualization, but it appears that many projects are not extending the use of virtual technology to the diagnosis and interpretation of trauma. Imaging and reconstruction are being used for individual case studies, but these often fail to address specific hypotheses related to the health or lifestyle of the individual being examined. Rapid prototyping technologies such as stereolithography, which allow for the creation of a physical model of an object, have also been experimented with on the occasional high profile case (eg. zur Nedden et al. 1994). Although the use of radiography and CT scanning for the diagnostic evaluation of skeletons and mummies is not unusual, stereolithography has been limited, due to the need for specialized equipment and the costs of production in its use, most often for the creation of models of the skull to facilitate facial reconstruction. In this research, three-dimensional virtual and physical reconstruction of skeletal material in the Dätgen body provided an opportunity to examine the apparent fractures without soft tissue obscuring the view.

Imaging has become the preferred method for early investigations of newly discovered bog bodies and for the re-examination of known bog bodies. Imaging provides a quick, thorough and relatively inexpensive overview of the body that allows for decisions about other analyses to be made. Three of the bog bodies from Schloss Gottorf were imaged using digital radiography. Although digital radiographs provide good quality images that can be manipulated to improve visibility, CT scans are the most beneficial method of imaging bog bodies. The collection of three-dimensional data that can be used for archival purposes, or for virtual or physical modeling, is non-invasive, relatively inexpensive and readily available.

Many bog bodies have been scanned using computed tomography (CT), including most of the bodies in this research. Most of the Danish bog bodies have undergone CT scanning and are currently being analyzed and modeled in three dimensions. Computed tomography of the bog bodies in this research group enabled the discovery of previously unidentified skeletal material and internal organs in Damendorf. The fragility of bog bodies restricts the potential for repeated examinations by researchers or movement of the bodies to research institutions. Once bodies are scanned in three dimensions, however, they can be virtually recreated at any location. In the case of this research, MSCT data from the bodies was brought to Canada for the interpretation of two dimensional CT slices and both virtual and physical 3D rendering, all of which allowed accurate interpretation of the bodies, without the physical presence of the bodies on site.

Another key aspect of the CT imaging was documentation of all of the bodies in three dimensions. Copies of the CDs with the original CT scan data were provided to the

museum for the archives. These data can then by accessed by future researchers and to check the preservation and conservation status of the bodies in the future. Complete three-dimensional baseline data have now been established for all of the bodies, except Windeby II.

Invasive sampling

Although the intention of this research was to keep invasive sampling to a minimum, the research goals required some physical sampling of the bodies. In order to undertake DNA analysis, small bone samples had to be taken from the Windeby I skeleton. The skeleton is not on display, so the viewing public was not affected. Two finger phalanges were selected and duplicates made prior to the submission of the original bones for DNA analysis. A sample of bone from the femur was taken from an area that had already been cut for radiocarbon dating samples, so there was minimal additional damage to the bone.

The only other destructive sampling was the removal of hair from the scalp of Dätgen, Damendorf, Windeby I and Osterby for stable isotope and trace element analyses. Although hair sampling is not always considered invasive in mummy studies research, this author feels than any physical sample removed from the body, whether internal or external and whether or not cutting is required, is an invasive sample. The hair sampling is, however, significantly less invasive than taking specimens from bones or organs for histological analyses, or undertaking a complete autopsy. Macko (1999) indicated that hair from archaeological sites was an underexploited resource for isotopic analysis. Although isotopic of analysis of hair from mummies has become common, this method of analysis had not been applied to bog bodies until very recently. Table 17 shows the

preliminary data from the stable isotope testing of the hair from the four individuals, plus the hide cape found on the body of Windeby I.

Sample	δ13C (‰)	δ15N (‰)
Dätgen	-22.28	6.82
Osterby	-20.92	6.78
Damendorf	-21.66	7.39
Damendorf (repeat)	-21.79	7.88
Windeby I	-21.71	6.81
Windeby I (repeat)	-21.84	7.03
Windeby cape hair	-23.83	4.71
Windeby cape hair (repeat)	-24.12	4.69

Table 17: Stable isotope data from the hair of Dätgen, Osterby, Damendorf and Windeby I and the fur cape found with Windeby I

The range of the human samples is very small: just 1.4 parts per thousand (‰) for carbon and just over 1‰ for the nitrogen. This suggests that all of the individuals had similar dietary patterns and may indicate a limited selection of foods. Macko 1999:66 suggests that carbon values around -20 ‰ reflects the consumption of C_3 plants from a marine environment. As the values in Table 17 are close to this, it may be that many of them represent a marine plant diet, although it cannot be determined whether the marine plants were consumed directly or via minimal consumption of herbivores. Given the proximity of the state of Schleswig-Holstein to the North Sea on the west and the Baltic on the east, it would be unusual for there to be no evidence of marine C3 plants. Nitrogen values of marine plants normally range around +6 ‰ (Macko 1999:66), similar to the values seen in the bog body samples.

Figure 96 shows a plot of the stable isotope data of the four individuals, plus data for the ox hide cape worn around the neck of Windeby I. Hair grows an average of 0.35 mm per

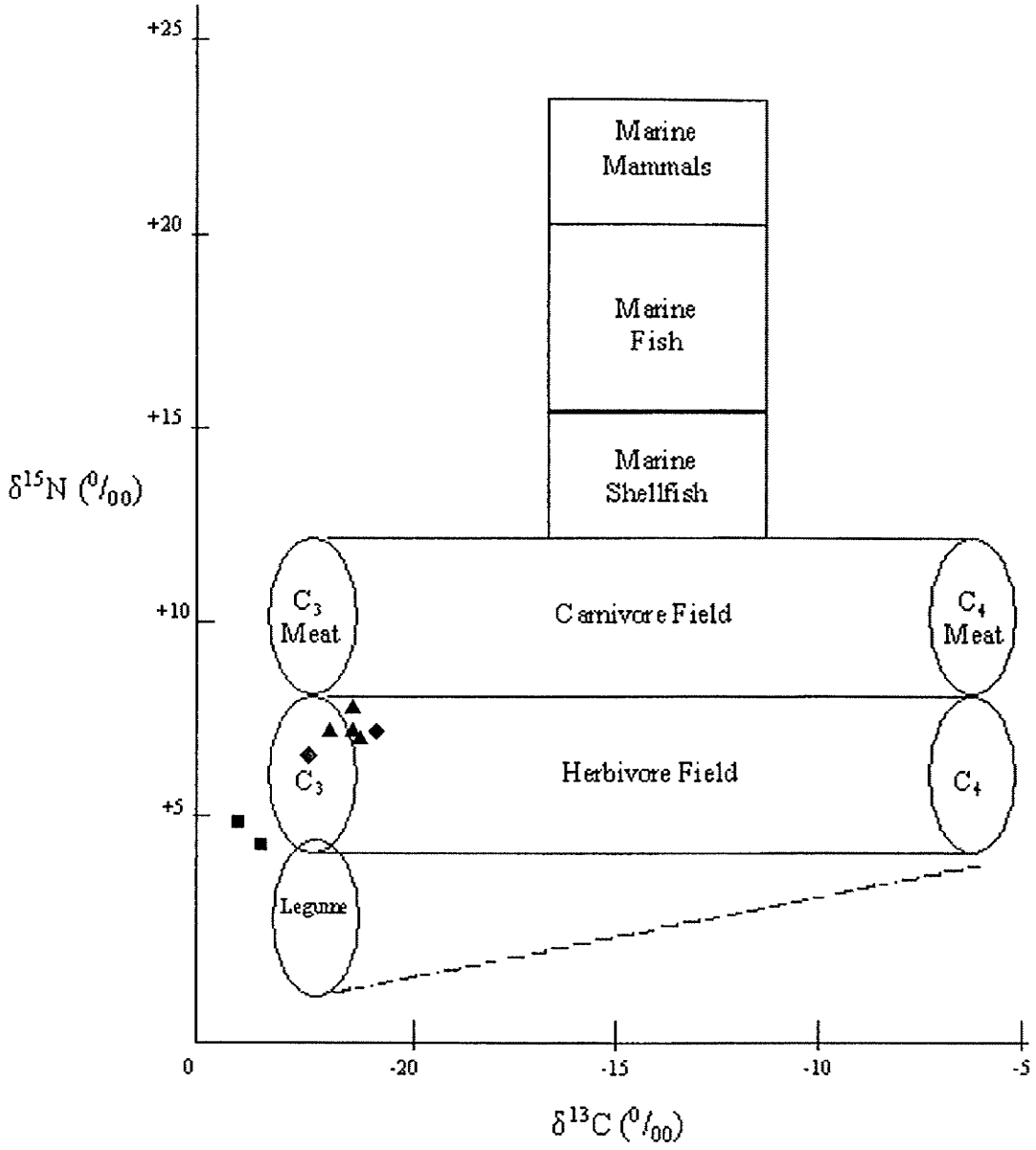


Figure 96: Stable isotope data of the Schloss Gottorf bog bodies (diamond = confirmed data; triangle = preliminary data; square = ox-hide cape values)

day (White, pers. comm.), so it is possible to estimate the period of time during which the food was consumed. The hair of Windeby I was approximately 5 cm in length, which provided a maximum dietary interval of approximately 142 days (more than four months). The hair from Osterby was approximately 15 cm in length, representing approximately 428 days or more than 14 months.

The Dätgen sample was approximately 10 cm in length, representing 285 days, more than nine months of dietary data. The sample from Damendorf was approximately 6 cm in length, providing data for the final 171 days (nearly six months) of the man's life. When these data are plotted over a diagram that represents the meaning of the stable isotope data, it appears that all of the individuals were consuming primarily a C_3 plant diet with minimal consumption of either wild or domesticated meat resources. C_3 plants are those found in cool moist environments and would include species of domesticated grains such as barley and rye, as well as wild species such as knotgrass. It is reported that the average δ15N values were approximately +4‰ for legumes, +6.5‰ for non-leguminous plants and +8.5‰ for meat for samples from antiquity (Mays 1998:185). The bog body samples consistently fell below +8.5‰, suggesting there was very little meat in the diet, although it is possible that protein was obtained from legume sources (White, pers, comm.). Research with hair samples of modern individuals indicated that δ15N values were more enriched in vegetarians, who consumed dairy or eggs, than vegans. The nitrogen values for lacto-ovo-vegetarians were similar to omnivores with a substantial meat component to their diet (Macko 1999). When compared to the values for modern vegans (Macko 1999:Fig. 2), the data for the Schloss Gottorf bog bodies were very similar. This is not

conclusive evidence that the bog bodies were vegetarians, but it does suggest a limited amount of meat in their diet.

It is interesting that, despite the presence of substantial shell middens near the site of Windeby, there is absolutely no evidence that Windeby I consumed shellfish as part of his diet. Furthermore, none of the four individuals tested appeared to consume meat, possibly suggesting that they were not of high-status. Although there has been some suggestion of a "ritual final meal", as discussed in Chapter 3, based on the similarity of the gut contents of the Grauballe and Tollund bodies, those meals consisted primarily of an apparent porridge of mixed grains and wild grasses; this would seem not have been a special ceremonial meal, but may have been representative of a typical daily diet.

Although nitrogen isotope data are not available, carbon isotope data are available for several Danish bog bodies, based on the work of Tauber (1979). Samples from the Grauballe Man; Borremose 1946; Tollund Man (2 samples); Elling Woman and the cape around the Elling Woman all have δ13C values between -20.1 ‰ and -26.8 ‰ (Tauber 1979:76-78). All of these values indicate a terrestrial-based diet, although a ratio between plant- and animal-based food consumption has not been determined.

Radiocarbon dating

There has been controversy surrounding the validity of radiocarbon dating of bog bodies for more than a decade (Briggs 1995, Buckland 1995; Gowlett et al. 1986, 1989; Housley et al. 1995). Painter specifically addressed the potential inaccuracy of radiocarbon dates as a result of the presence of sphagnan, the origin of which was discussed in Chapter 2,

and stressed that "collagen and other proteins in preserved bodies could bind sphagnan photosynthesised at a different, normally later, period in history" (1995:99). If Painter's sphagnan theory is correct, radiocarbon dating of bog bodies could be almost impossible.

In a recent article, it was noted that in a comparison between dating by peat stratigraphy and by ^{14}C, there were discrepancies. All of the body radiocarbon dates were younger than the stratigraphy would suggest and the bodies were between 400 and 1000 years more recent than the layer of peat in which they had been placed (Kalis and Meurers-Balke 1998). Although the latter issue can be explained through the use of peat cuts, which may have placed the body far below the peat surface and into a much earlier layer, the differences between the ^{14}C dates and stratigraphical interpretation is problematic.

Problems in Accelerated Mass Spectrometry (AMS) dating of the human bodies from Lindow Moss in the mid-1980s were readily acknowledged (Gowlett et al. 1986). These complications still exist in the application of AMS dating to bog bodies, but recent researchers have stated that "reliable ^{14}C dates can indeed be obtained for bog bodies" (van der Plicht et al. 2004:472). The main problem with AMS dating of bog bodies is contamination of the body from humic and fulvic acids in the peat (van der Plicht et al. 2004). In order to reduce the negative effects of this contamination a process of physical and chemical pre-treatment is usually employed to recover the "datable fraction" - the carbon atoms of the "material ... representing the proper age of the find" (van der Plicht et al. 2004:473). Although most samples tested and reported in van der Plicht (2004) were subjected to some pre-treatment, some samples were placed directly in the Elemental Analyser/Mass Spectrometer (EA/MS) and combusted.

The dating of the remains, as review in van der Plicht (2004) is as follows: dates for Rendswühren Man, Damendorf Man, the Osterby skull and the Dätgen find were all determined at the Centre for Isotope Research at Groningen University in the Netherlands. One sample from Windeby II (adult male) was done in Groningen, with an additional two samples tested at the Leibniz Laboratory for Radiometric Dating and Isotope Research at Christian Albrechts University in Kiel, Germany. For the Windeby I adolescent four samples were done at the Groningen lab and three samples at the Kiel laboratory. Two of the skin samples from the Rendswühren Man, the wool textile of the Damendorf Man and the Osterby hair sample were all tested at the Groningen laboratory without pre-treatment. The Windeby I and Dätgen samples tested at the same lab were subjected to pre-treatment. These data are reported from published literature (van der Plicht et al. 2004) or from the original laboratory reports. The radiocarbon dates for the bog bodies in this collection were all measured prior to this research and both published data and the re-calibration of the dates, using OxCal for calibration and plotting, are included in Table 18 and Figure 97. All date are calibrated, unless otherwise indicated.

Given the presence of substantial Iron Age shell middens in the region of northern Germany under study, calibration with consideration of the possibility of a substantial marine component in the diet should also be considered. Tauber (1981) reported $\delta^{13}C$ values of several Danish archaeological bodies, including four Iron Age bog bodies. All four of the bog body $\delta^{13}C$ values clearly fell within the range for terrestrial diet (Tauber 1981). Since the stable isotope data for the Schloss Gottorf bog bodies is inconclusive regarding the consumption of marine resources, despite the presence of the shell middens

(ie. the suggestion of possible C_3 marine plants, but not a marine diet per se), calibration of the radiocarbon dates using a marine reservoir effect may be incorrect.

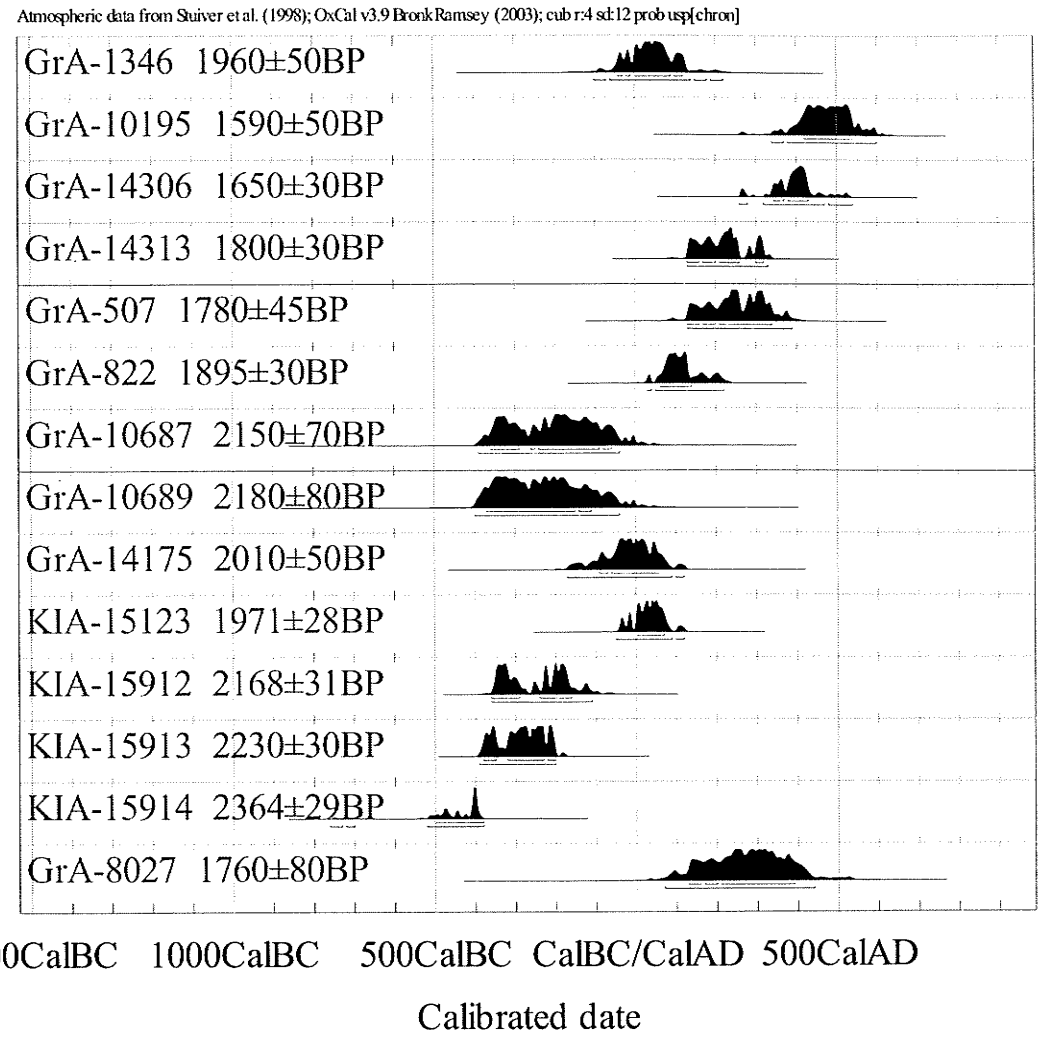


Figure 97: Plot of radiocarbon dates for the Schloss Gottorf bog bodies
Key: GrA-1346 Rendswühren – textile*; GrA-10195 Rendswühren – skin*; GrA-14306 Rendswühren – skin*; GrA-14313 Rendswühren – skin*; GrA-507 Damendorf – wool*; GrA-822 Osterby – hair*; GrA-10687, GrA-10689 and GrA-14175 Windeby I fur cape*; KIA-15123 Windeby I – bone; KIA-15912 Windeby I – cape hair**; KIA-15913 and KIA-15914 Windeby II – wood**; GrA-8027 Dätgen. (Sources: Samples indicated with * denotes data from van der Plicht et al. 2004, Samples indicated with ** denotes data from Grootes 2002a, 2002b, 2002c).**

Of the 16 radiocarbon dates from the bog bodies in this collection, six were from a part of the body – skin, hair and, in a single case, bone. All of the remaining samples were taken from clothing or wood in likely association with the bodies. In the case of the Damendorf man, the single sample was taken from the textiles found at the foot of the body. The resulting calibrated date, A.D. 135-335, is Late Roman Iron Age (Nørgård Jørgensen 2003). Although it is likely that the textiles can be associated with the body, the individual was not wearing any of the clothes and it cannot be determined with absolute certainty that the clothing belonged to the man or was placed in the bog at the same time as the individual. There is no way of knowing if the clothing and the man were immediately contemporary.

Four samples from the Rendswühren Man were dated – three skin samples and a piece of textile that was found on the body. There is some variation in the dates. All of the skin samples are younger than the date for the textile, although there is a slight overlap of dates at 2σ. The textile dates to the Early Roman Iron Age, two of the skin samples fall in the range for the Late Roman Iron Age and one skin sample dates to the Migration Period (Nørgård Jørgensen 2003). Van der Plicht et al. (2004) acknowledge this inconsistency but they do not explain it. Although it is understood that invasive sampling of the bog bodies must be limited in order to protect the remains, the use of artifacts to assign a radiocarbon date directly to a body is problematic (Parker Pearson 1999; Wicker 1999).

There are other problems with the radiocarbon dates for the bog bodies at Schloss Gottorf. One sample for Windeby I, taken from a wooden pole that accompanied the body, provided a Mesolithic date (van der Sanden 1995b), although, as seen in the dates

above, several other dates place the body firmly in the Iron Age. Furthermore, the original date provided for the Windeby II body was based on a wood sample and dated to the late Mesolithic (van der Sanden 1995b) (see Figure 98). Two additional samples were tested at Kiel in 2002, both taken from wood in association with the Windeby II body. Both of these samples dated to the Pre-Roman Iron Age – a difference of approximately 6,000 years. Both Mesolithic dates were discounted as inaccurate by van der Sanden (1995b), although he did not offer an explanation. In order to ensure accuracy, it is suggested that a bog body should not be conclusively dated by a single sample.

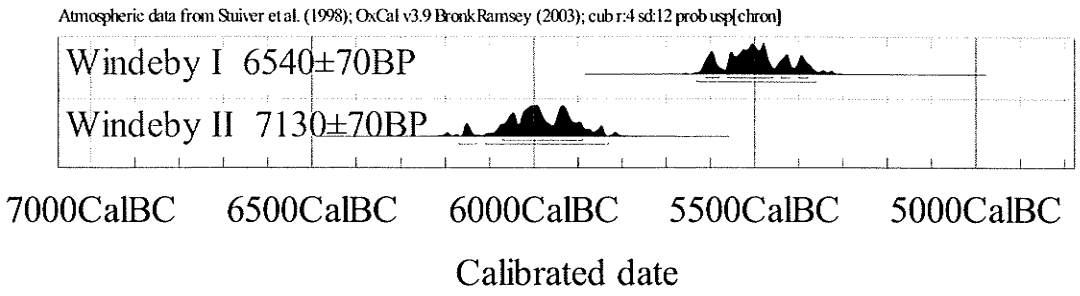


Figure 98: Plot of rejected radiocarbon dates for Windeby I and II (Data from van der Sanden 1995b).

The hair sample from Dätgen may accurately represent the date for the head but, as discussed above, the body may not be the same individual. The hair has been dated to the Late Roman Iron Age (Nørgård Jørgensen 2003). In order to try and determine if the head and body belong to the same person a first step would be to acquire an accurate AMS date from the body. Although the bog body dates all have very large range, if a substantial discrepancy between the two dates is noted it would provide the first indication that the head and body are not the same person. Although DNA analysis of the remains may also

address this issue, DNA testing of bog bodies is still at an early stage and may not be able to provide this type of data yet.

There have been six samples taken to radiocarbon date the Windeby I body. Four of the samples were from the fur cape (tested in two labs), one sample of wood from the pole accompanying the body and a single bone sample taken from the mid-shaft of the left femur. There is some variation in the dates obtained from the fur cape: ranging from 365 B.C. to A.D. 55. (van der Plicht et al. 2004). The bone sample has been dated to A.D. 2-69 (Grootes 2002b). Even if there is certainty that the artifacts being tested can be directly linked to the body there is no guarantee that the cape originally belonged to the individual and was not from an earlier time period. The radiocarbon dates show a slight overlap of the dates of the cape and the single bone sample, although the cape almost appears to be more recent than the bone. The hair from the cape found on the Windeby I body was dated to 200 B.C. by the same laboratory in a sample taken at the same time as the bone sample. While it is possible that the fur cape is actually 200 years older than the body itself, this unexplained difference in dates between the body and the cape is problematic. According to the chronology of the Iron Age discussed earlier, the cape would be Pre-Roman Iron Age, most likely Period II. The body, however, is definitely Early Roman Iron Age. This example, once again, emphasises the importance of dating the body directly and not from associate textiles or other artifacts. When the Leibnitz Laboratory in Kiel was consulted regarding this apparent difference, they emphasised that the slight overlap of the dates for the body and the cape suggest that the cape and the individual are indeed contemporary. It is also reassuring to note that the dates derived from the cape at the Groningen Laboratory are similar to the results of the cape hair sample tested at the

Leibniz Laboratory in Kiel. The similarity of the results between two laboratories suggests that both sampling and methodologies are appropriate and as accurate as possible.

In summary, the individuals in this collection of bog bodies lived throughout the Iron Age. The Windeby II adult lived during the Pre-Roman Iron Age, between 500 B.C. and the Birth of Christ). The Rendswühren Man, Osterby Man and Windeby adolescent lived during the Early Roman Iron Age (A.D. 1 to A.D. 150). The Damendorf Man and Dätgen Man lived in the Late Roman Iron Age (A.D. 150 – 400).

Figure 99 shows a plot of the radiocarbon dates of several Danish bog bodies: Grauballe Man, the three bodies from Borremose, Tollund Man, Elling Woman and previously unpublished dates for the bodies from both Vester Thorsted and the Dønmose bog near Auning. With the exception of K-2877 (the calf skin cape with Elling Woman), all samples were taken directly from the human tissues, usually muscle. The use of tissue samples from the bodies means that the dates directly reflect the body and not the accompanying textiles or other materials that have been dated in several other cases, including several of the Schloss Gottorf bodies. The date of the calf skin cape in association with the Elling Woman is exactly the same as the date for the body. Unlike the textile associated with Rendswühren Man or the fur cape of Windeby I, there is no need to rely on a slight overlap at 2 σ to interpret the Elling body and cape as contemporary. This suggests that the dates on both the Rendswühren textile and Windeby I cape need to be reconsidered in relation to the dates for the human material; it is obvious

from the Elling case that it is possible to obtain au umabiguous match between human muscle tissue and animal hide from the same body. The apparent gaps between the dates on both the Schloss Gottorf bodies and their accompanying hide and textiles need further research, and possibly additional samples, to provide a complete explanation.

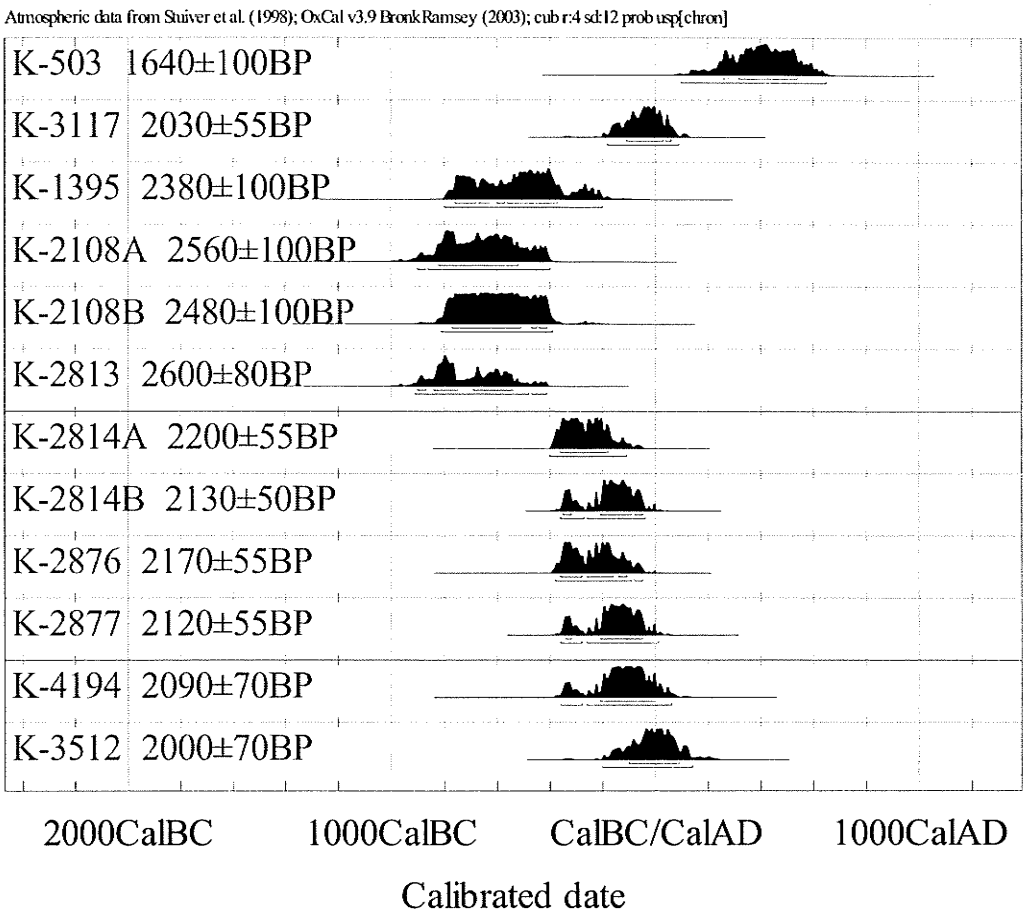


Figure 99: Plot of radiocarbon dates for several Danish bog bodies
Key: K-503 Grauballe – muscle*; K-3117 Grauballe – mix of muscle tissue and stomach contents (vegetable); K-1395 Borremose 1947 - muscle*; K-2108A Borremose 1948 - muscle*; K-2108B Borremose 1948 - muscle, second sample*; K-2813 Borremose 1946 - muscle*; K-2814A Tollund - muscle*; K-2814B Tollund - muscle*; K-2876 Elling - muscle*; K-2877 Elling - calf skin cape*; K-4194 Vester Thorsted – unspecified tissue**; K-3512 Auning – unspecified tissue** (Source: Samples indicated with * denotes data from Tauber 1979, Samples indicated with ** denotes data from Tauber, pers. comm.).**

THE SCHLOSS GOTTORF BOG BODIES IN AN ARCHAEOLOGICAL CONTEXT

Comparison with a Danish Iron Age skeletal collection

Previously published data listing the Iron Age skeletons of Denmark serve as a population comparison to the bog bodies of Schleswig-Holstein. Sellevold et al. (1984) provided selected specific measurements for the cranium, humerus, radius, ulna, femur and tibia for samples from periods of the Iron Age. Bennike (1985) also provided summary data for all periods in Danish prehistory. The data pertaining to the Iron Age was used as a partial comparison for this research. The Sellevold et al. (1984) volume used measurements and skeletal landmarks from Martin and Saller (1957), while the measurements for this research were based upon the guidelines in Buikstra and Ubelaker (1994). Not all of the measurements from this research were comparable to the metric data of Sellevold et al. (1984) and only data that were directly comparable between the two measurement systems were used to compare the Iron Age Schleswig-Holstein bog bodies to the Iron Age skeletons of Denmark. The landmarks used by Bennike (1985) were not explicitly identified, but Martin and Saller (1957) was referenced in the volume and it is likely that these measurements were used.

The chronology used in the comparative study (Sellevold 1984) is slightly different to the one chosen for this research, although they are similar enough to be compared easily (See Table 19). In the Nørgård Jørgensen (2003) chronology, the Migration period includes the time frames defined as Migration and Late Germanic in the Sellevold et al. (1984) chronology. All other differences between the chronologies are minor. While the bog bodies are assigned to their category via ^{14}C dating, most of the skeletons in the Sellevold

et al. (1984) research were assigned to their date category via artifacts, although 34 skeletons were ^{14}C dated to establish the age of a particularly cemetery location or to data a bog skeleton. Although bog skeletons were included in the Sellevold et al. (1984) publication, these were not immediately distinguishable from other skeletons in the catalogue, and have not been separated out. The present study compares the seven bodies in the Schloss Gottorf collection, to the overall Iron Age skeletal population presented in Sellevold et al. (1984). The Kühsen skeleton was not included in these analyses because it is undated. The Windeby II body and Damendorf Man were also excluded because osteometric analysis was not possible due to the severe bone demineralization. The Osterby skull was heavily reconstructed and comparison of measurements may be inaccurate, but those measurements that were available were compared. Of the remaining bog bodies in Schloss Gottorf collection, three are Early Roman (Rendswühren, Osterby and Windeby I), while the fourth, Dätgen, is Late Roman.

Chronology for this research (Nørgård Jørgensen 2003)		**Chronology of comparative study (Sellevold et al. 1984)**	
Pre-Roman	500 B.C. to 0	Pre-Roman	500 B.C. to 0
Early Roman	0 to A.D. 150	Early Roman	0 to A.D. 160/170
Late Roman	A.D. 150 to 380	Late Roman	A.D. 160/170 to 400
Migration	A.D. 380 to 800	Migration	A.D. 400 to 550/575
		Late Germanic	A.D. 550/575 to 800

Table 19: Comparison of chronologies used in comparative analyses

The specimens in the comparative Iron Age skeletal sample have been subdivided by age category. Table 20 shows the age classifications (Sellevold et al. 1984:270).

Categorization	Age Range
Infans I	0 to 6 years
Infans II	6 to 12-14 years
Juvenis	12-14 to 17-19 years
Juvenis/Adultus	17-21 years
Adultus	20-35 years
Adultus/Maturus	25-40 years
Maturus	35-55 years
Maturus/Senilis	50-65 years
Senilis	Over 60 years

Table 20: Definition of age categories

Figure 100 shows a comparison of stature, based on mature femora, in Early Iron Age individuals of the *juvenis* and *juvenis/adultus* categories. Windeby I is in the lower end of the *juvenis* range, so these femora are the most comparable. Stature for Windeby I was calculated using the same formula as used for the Sellevold et al. (1984) publication, Trotter and Gleser 1958). The first three individuals are male (circled in red and marked "A"), the second three individuals are female (circled in blue and marked "B"). Windeby I is the last individual on this graph. The stature of Windeby I is more similar to the females on this graph, but shrinkage of bone in bog bodies is common and may possibly account for some of the differences. Furthermore, the Windeby I individual is gracile. Finally, the presence of Harris Lines suggests that he may not have been healthy or properly nourished throughout his life. This may have affected his growth.

The same formula was used for the calculation of stature of the Windeby adolescent (approximately 165.15 cm), and approximate calculations for the Rendswühren and Dätgen bodies. It is acknowledged that the use of only a single bone for stature estimation

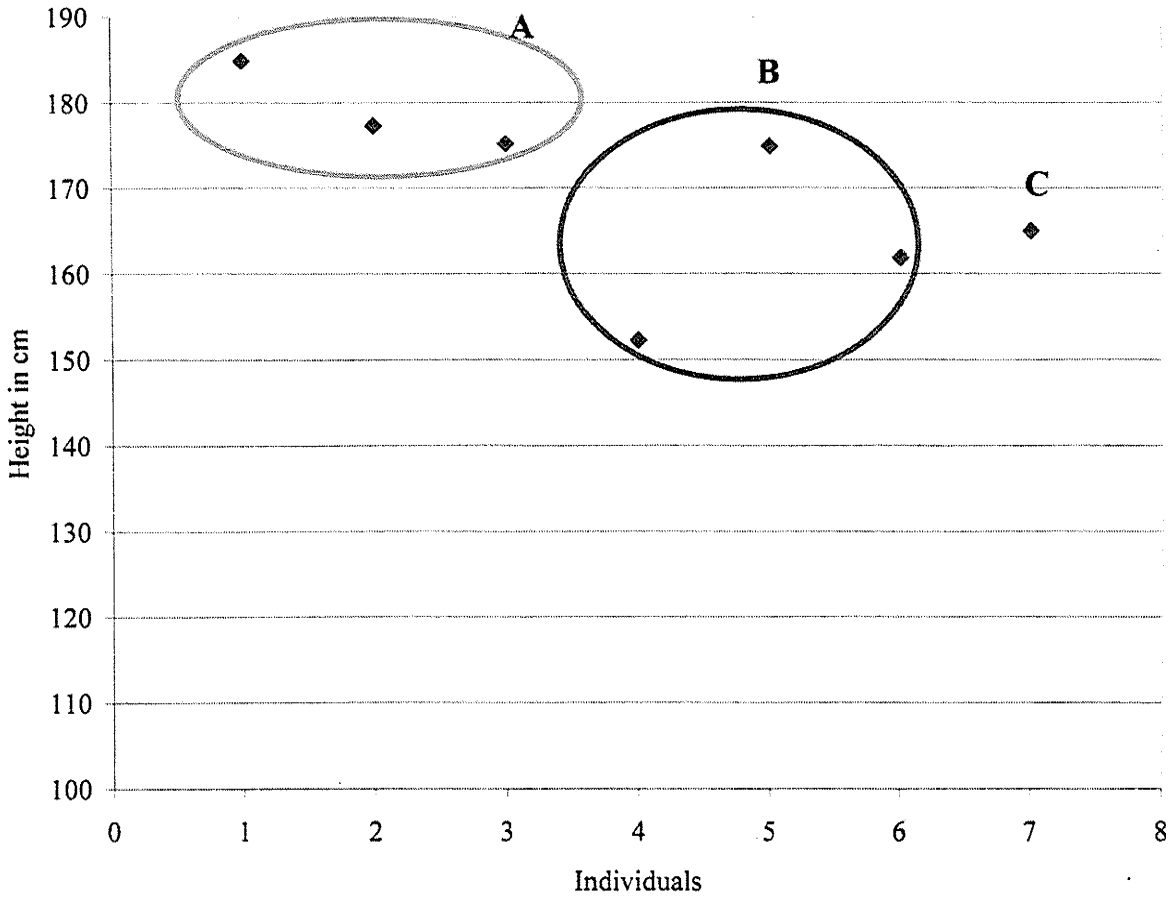


Figure 100: Comparison of Early Roman Iron Age stature (calculated by femur) (*juvenis* and*juvenis/adultus*). "A" circle = male individuals, "B" circle = female individuals, "C" = Windeby I

is limited and a more precise estimate may be achieved using additional long bone data, when available. Recent forensic research has confirmed, however, the accuracy of the greatest length of the femur for stature estimation (Hauser et al. 2005). Soft tissue on the body prevented a precise measurement of the femora of the Rendswühren male, but an approximation of living stature was of interest. Using the same formula as the Sellevold et al. (1984) data, the Rendswühren male measured approximately 163 cm. Although this stature is inexact because of the presence of soft tissue over the bone and the slight bowing of the bone, it still provides an approximate comparative measurement. Estimation of stature for Dätgen is based on the maximum length of the left femur taken from the CT images, since the fragile condition of the body prevented movement for measurement. Furthermore, there was a large amount of soft tissue remaining over the femur and the CT was provided the best opportunity to measure the bone without interference by the soft tissue. Figure 101 shows the stature of Windeby I, Rendswühren and Dätgen in comparison to Danish skeletons from the same period, the Early Iron Age. Summary data from two studies (Sellevold et al. 1984 and Bennike 1985) were used for comparison. The stature of Iron Age Danish individuals presented in Bennike (1985) was calculated using the same methods as those used by Sellevold et al. (1984). All three males (Windeby I, Dätgen and Rendswühren) are below the mean of stature for males in this Early Iron Age population from Denmark, although they do fit in the range of male stature. As indicated above, there are factors that may account for this discrepancy: taphonomy or health, as well as the presence of soft tissue on Rendswühren that prevented more accurate measurement. All three individuals are also slightly above the mean for female stature in the Early Iron Age.

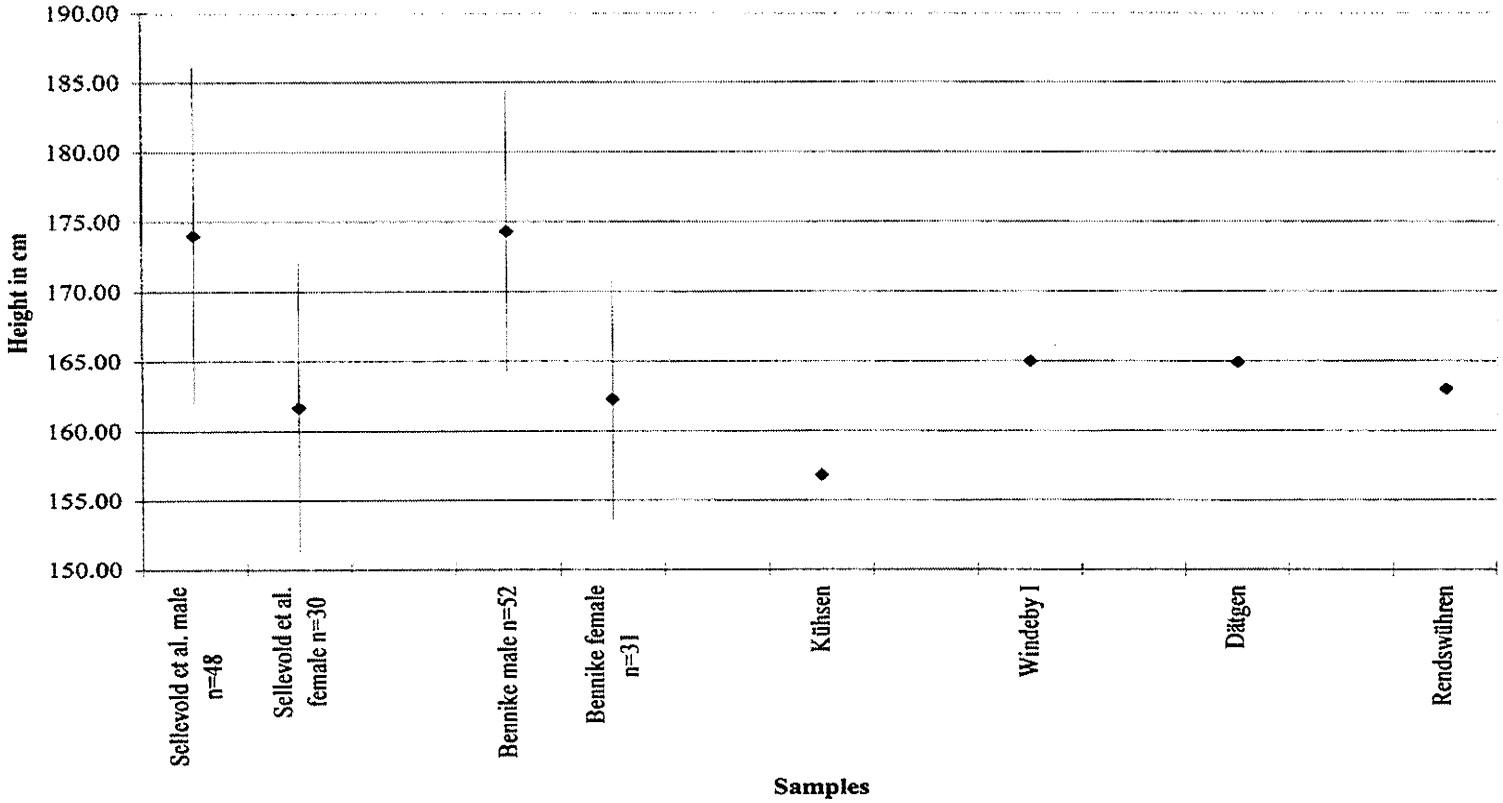


Figure 101: Summary comparison of Early Roman Iron Age stature for adults (calculated by femur)

A comparison was also made between the anterior-posterior (sagittal) subtrochanteric diameter of the skeletal collection and the Windeby I body. This comparison could not be made with the Rendswühren or Dätgen bodies. The Windeby I body is identified by an arrow on Figure 102. The measurement suggests that the femur is slightly more gracile than the skeletal specimens, perhaps with less muscle in the legs than the other individuals. Again, it is difficult to determine to what extent taphonomy may be involved in terms of shrinkage or other post-mortem alterations.

Finally, six facial measurements (see Table 21) from the Kühsen, Windeby I and Osterby skulls were compared with those from an Iron Age Danish skeletal population (Sellevold et al. 1984) and a Neolithic Danish population (Broste et al. 1956). A discriminant function analysis (DFA) was performed to classify the remains of the individuals from the Schloss Gottorf collection. As seen in Figure 103, the measurements show little discrimination between the Iron Age and Neolithic populations, but the Schleswig individuals fall outside of both those clusters. The DFA relays size information as the first function and shape as the second. The data seem to be translated on the x-axis relative to the other clusters, that is they are smaller, but within the shape range on the y-axis. It is likely that the Schleswig individuals fall outside of the clusters for the Iron Age and Neolithic populations as a result of taphonomic shrinkage of the bone. It might be expected that the Kühsen skull would have experienced less shrinkage, since it was recovered from an alkaline environment, but Kühsen still falls closest to the Schloss Gottorf bog bodies and outside of either the Iron Age or Neolithic skeleton clusters.

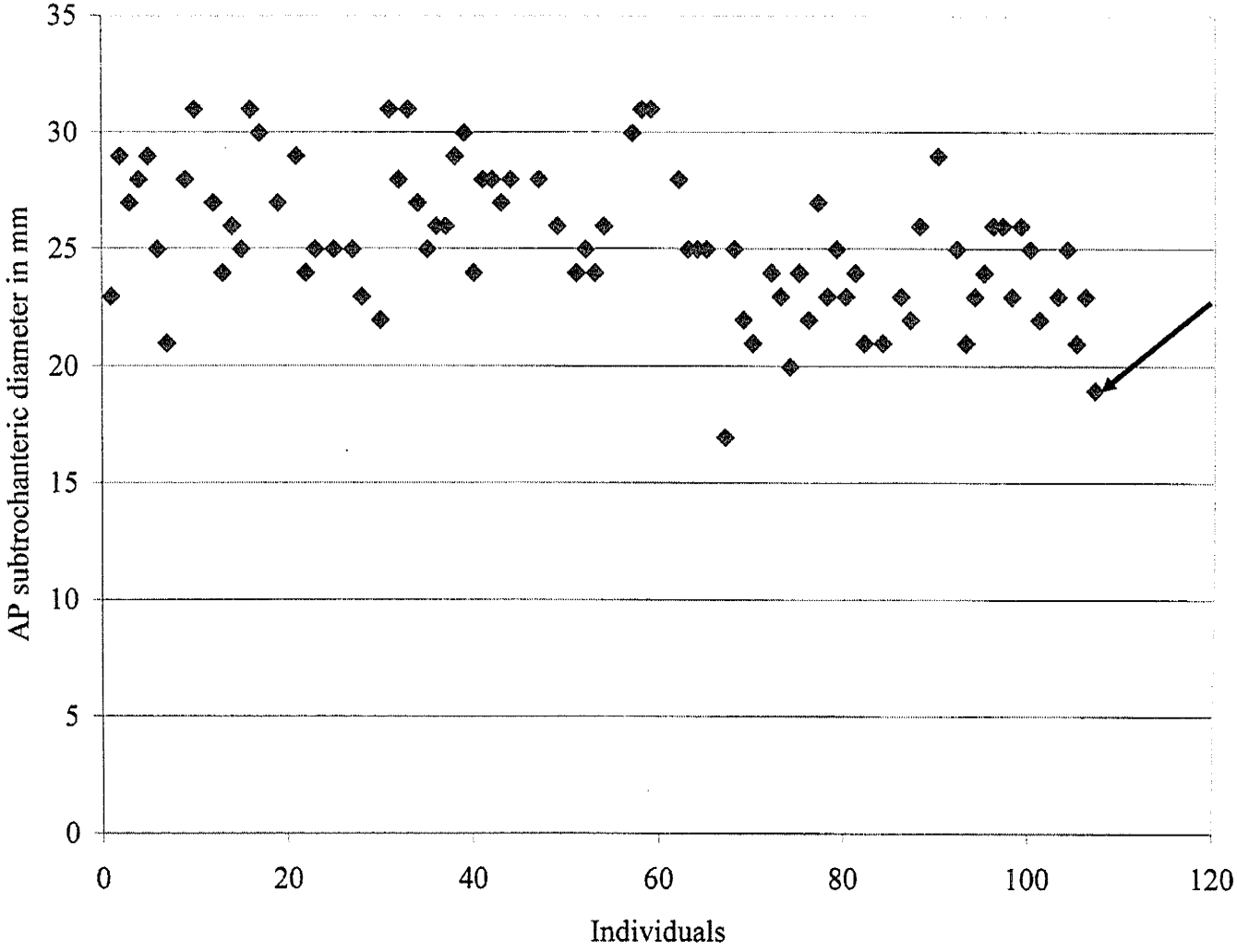


Figure 102: Comparison of anterior-posterior (sagittal) subtrochanteric diameter. Windeby I is marked with an arrow an arrow.

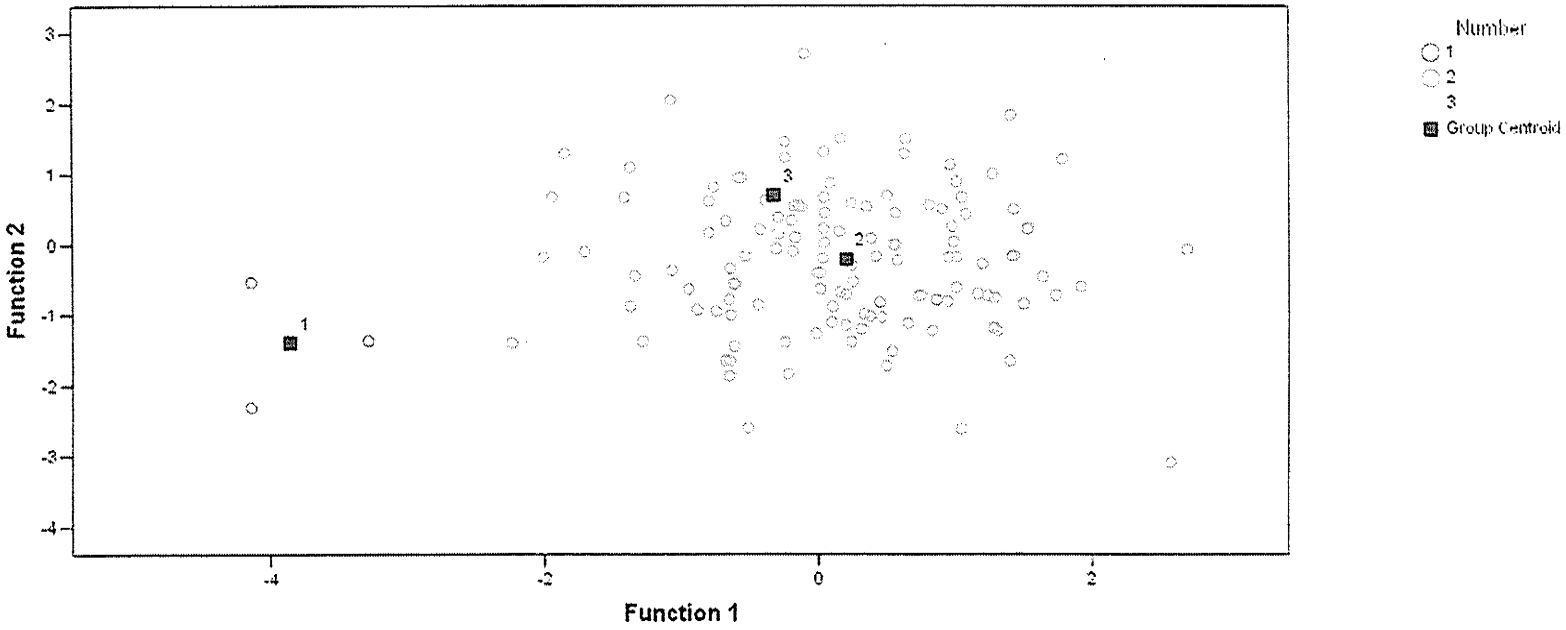


Figure 103: Discriminant function analysis performed to classify the Schleswig remains (1) with Neolithic remains from Denmark (2) and Iron Age remains from Denmark

Measurement	Buikstra and Ubelaker (1994)	Sellevold et al. 1994 (based on Martin and Saller 1957)
Upper facial height	n-pr	M48
Nasal breadth	al-al	M54
Nasal height	n-ns	M55
Interorbital breadth	d-d	M50
Orbital breadth	d-ec	M51
Orbital height	Orbital height	M52

Table 21: Facial measurements used for comparison

As discussed earlier, the bog bodies from Schloss Gottorf represent the majority of the three-dimensional human remains still in existence from the Iron Age in Schleswig-Holstein. The overwhelming predominance of cremation as the main method of disposal of the dead during this time period and in this region vastly reduces the amount of human remains available for study. Although there have been more than 30,000 cremation graves excavated from this region, it is unknown exactly how much of the cremated bone material was retained following excavation. There have been very few skeletons from this time period in the area and so the six bog bodies of this project provide a substantial amount of information about life in Iron Age Schleswig-Holstein that has not been achieved with the cremated remains.

The Kühsen skeleton was originally selected for comparison with Windeby I. It was believed that the Kühsen skeleton was an Iron Age young adult female from an alkaline peat environment, while Windeby I was believed to be an adolescent female from an acidic peat environment. Near the conclusion of this research it was learned that the Kühsen skeleton had not been radiocarbon dated and there is no assessment of the period of the skeleton; it may not be from the Iron Age. The vast majority of dated skeletal and

soft tissue material recovered either alkaline or acidic bogs from Schleswig-Holstein is from the Iron Age and it generally assumed that the Kühsen skeleton is also likely from that time period. It is not wise, however, to compare the skeleton to the Danish Iron Age skeletons, since there is no confirmation of the date of the Kühsen skeleton. The primary reason for the inclusion of the Kühsen skeleton in this research was the consideration of the differences in bone preservation between the alkaline bog skeleton and the bodies from the acidic peat environment, which were discussed above.

Cremation cemeteries in Schleswig-Holstein

There are several large Iron Age cremation cemeteries in Schleswig-Holstein, as seen on Figure 104, including Neumünster-Oberjörn II, Timmendorf I and II and Nettlsee (Schutkowski and Hummel 1991), although many of them have not undergone anthropological analyses. A comprehensive study of 10 Iron Age cremation cemeteries from Middle and East Holstein was undertaken by Schutkoski and Hummel (1991), as part of a larger project. Table 22 lists the cemeteries and the number of individuals examined from each cemetery. In several cemeteries, the number of individuals is greater than the number of urns. In most cases, more than one person was placed in each urn prior to burial. Although the urns with multiple individuals most often contained a woman with a child, in one case a woman was interred with two children and in another case both a man and woman were interred (Schutkowski and Hummel 1991, 146). It is likely that a family relationship can be inferred in these circumstances.

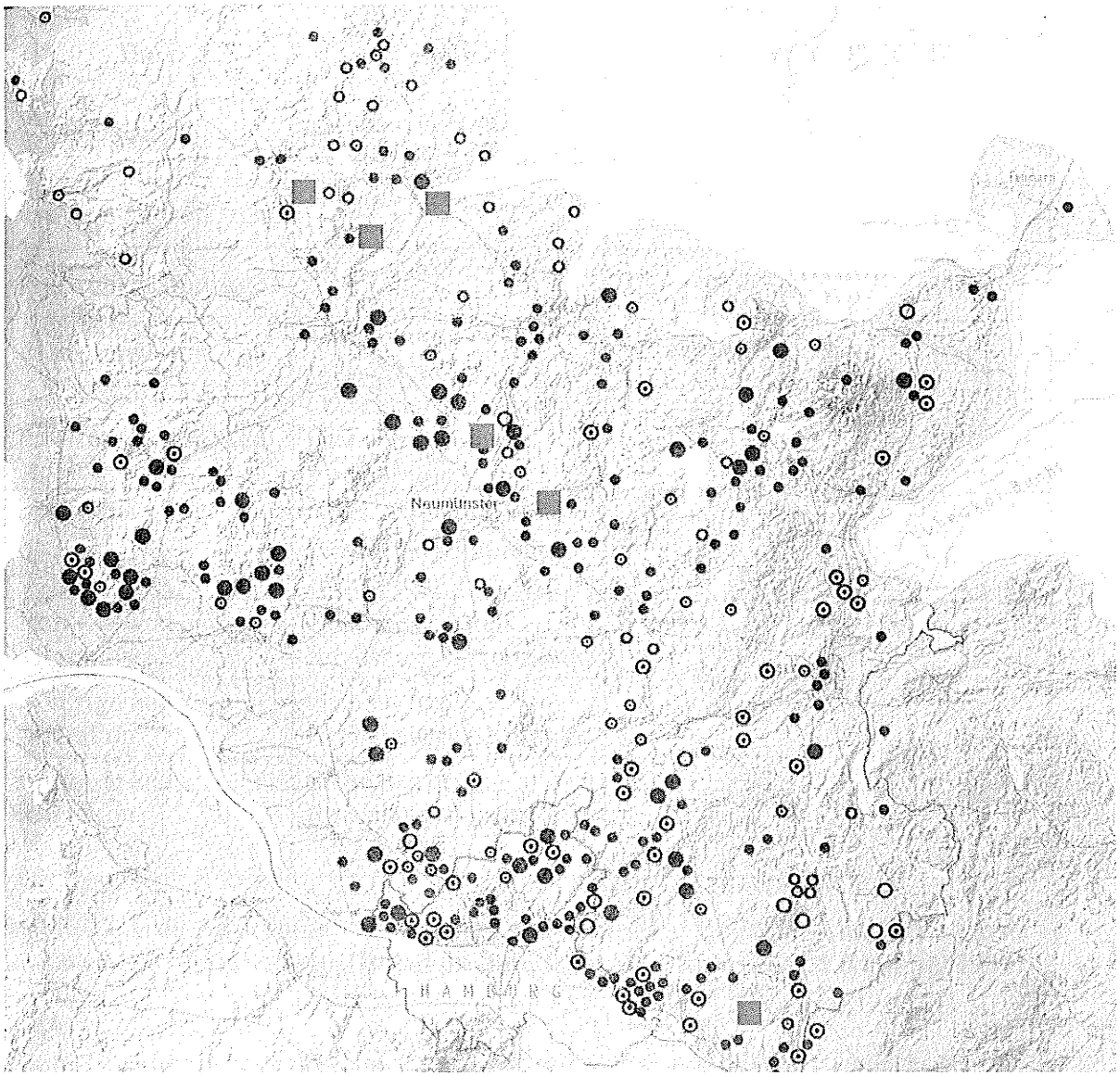


Figure 104: Map of Iron Age cremation cemeteries in Schleswig-Holstein (Source: Hingst 1983, between pages 10-11) Key: solid dot = Early Pre-Roman Iron Age; target=Early Pre-Roman to Late Pre-Roman Iron Age; open circle=Pre-Roman Iron Age to Roman Iron Age – Large dots are indicators of large cemeteries. Small dots are indicators of small cemeteries or settlements. The approximate locations of the bog bodies are marked with squares. Reprinted with permission, 2005.

Date	Cemetery	Number of Urns	Number of Individuals
Pre-Roman Iron Age	Juvenstedt, Kreis Rendsburg-Eckernförde	218	229
Pre-Roman Iron Age	Neumünster-Oberbjorn II	184	187
Pre-Roman Iron Age	Timmendorf I, Kreis Ostholstein	310	318
Pre-Roman Iron Age	Timmendorf II, Kreis Ostholstein	104	104
Pre-Roman Iron Age	Owschlag-Ramsdorf, Kries Rendsburg-Eckernförde	109	109
Pre-Roman Iron Age	Nettelsee, Kreis Plön	167	174
Pre-Roman Iron Age	Bösdorf-Kleinmühlen, Kreis Plön	48	50
Iron Age and Migration	Quarnbeck, Kreis Rendsburg-Eckernförde	42	43
Iron Age and Migration	Gettorf, Kreis Rendsburg-Eckernförde	74	76
Iron Age and Migration	Schmalstede, Rendsburg-Eckernförde	295	312
		1552	1603

Table 22: Iron Age cremation cemeteries in Schleswig-Holstein – number of urns and number of individuals (Based on data from Schutkowski and Hummel 1991)

Table 23 shows the age division categories used for the analyses of 10 Iron Age cremation cemeteries. Estimation of subadult age was based on dental eruption, "skeletal maturity" and histological analyses for the children (Schutkowski and Hummel 1991, 134). For adolescents, dentition, epiphyseal fusion and histological analysis were used. Age for younger adults was estimated by ephiphyseal fusion, cranial suture closure and histology. For the older adults, cranial suture closure and histology were used for age estimation (Schutkowski and Hummel 1991, 134). Estimation of stature was also made, where possible, and this data will be included as part of this discussion.

Age category	Age range
Infans I	0-6
Infans II	7-12
Juvenis	13-18
Young adult	19-25
Middle adult	26-32
Late adult	33-39
Early mature	40-46
Late mature	47-53
Senilis	54+

Table 23: Age category and age range for Iron Age cremation cemetery research (based on data from Schutkowski and Hummel 1991, 138)

The average stature for males and females in each cemetery is shown in Table 24 and Figure 105. As seen in Figure 106, the estimated stature of Windeby I, Rendswühren and Dätgen are only slightly below the average male stature in nine Iron Age cremation cemeteries in Schleswig-Holstein. It is acknowledged that the statures for the cremation cemeteries were calculated using very small samples, sometimes one individual, so that the stature shown may not be entirely representative of the entire cemetery populations, but is does provide a feasible basis for comparison. The bodies do not seem to be physically different from other individuals that were either buried or cremated in northern Europe, based on the data from the Danish skeleton sample and the cremation cemetery data discussed above. It is interesting that while all three male skeletons were only very slightly below the average male stature of the Schleswig-Holstein cremation cemeteries, they were several cm shorter than the Iron Age Danish skeletal populations of both Sellevold et al. (1984) and Bennike (1985).

All of the bog bodies, with the exception of the Kühsen, were found in the same areas as Iron Age cremation cemeteries in Schleswig-Holstein. The sites do not seem to be

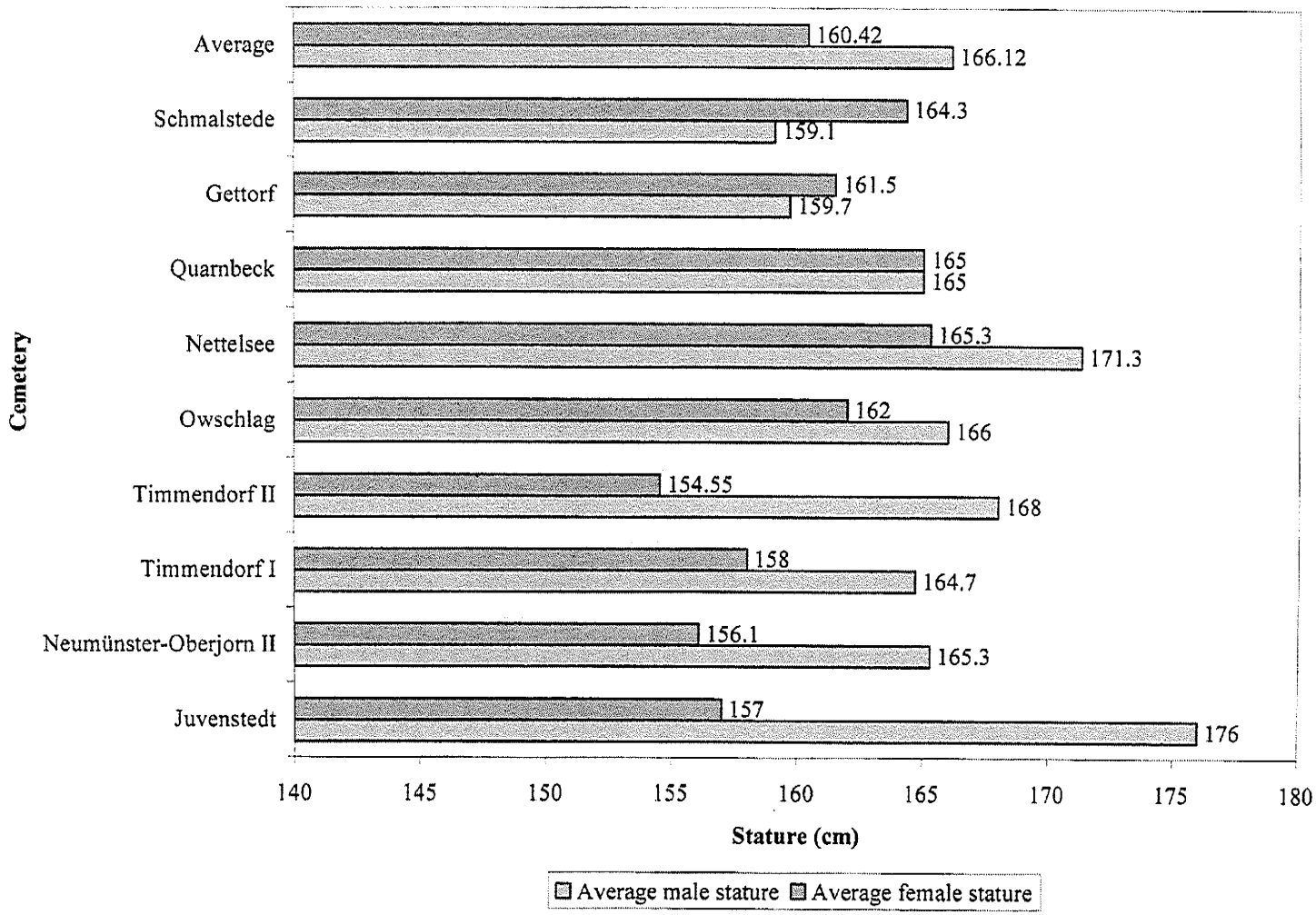


Figure 105: Average stature of males and females in 9 Schleswig-Holstein cremation cemeteries (based on data from Schutkowski and Hummel 1991)

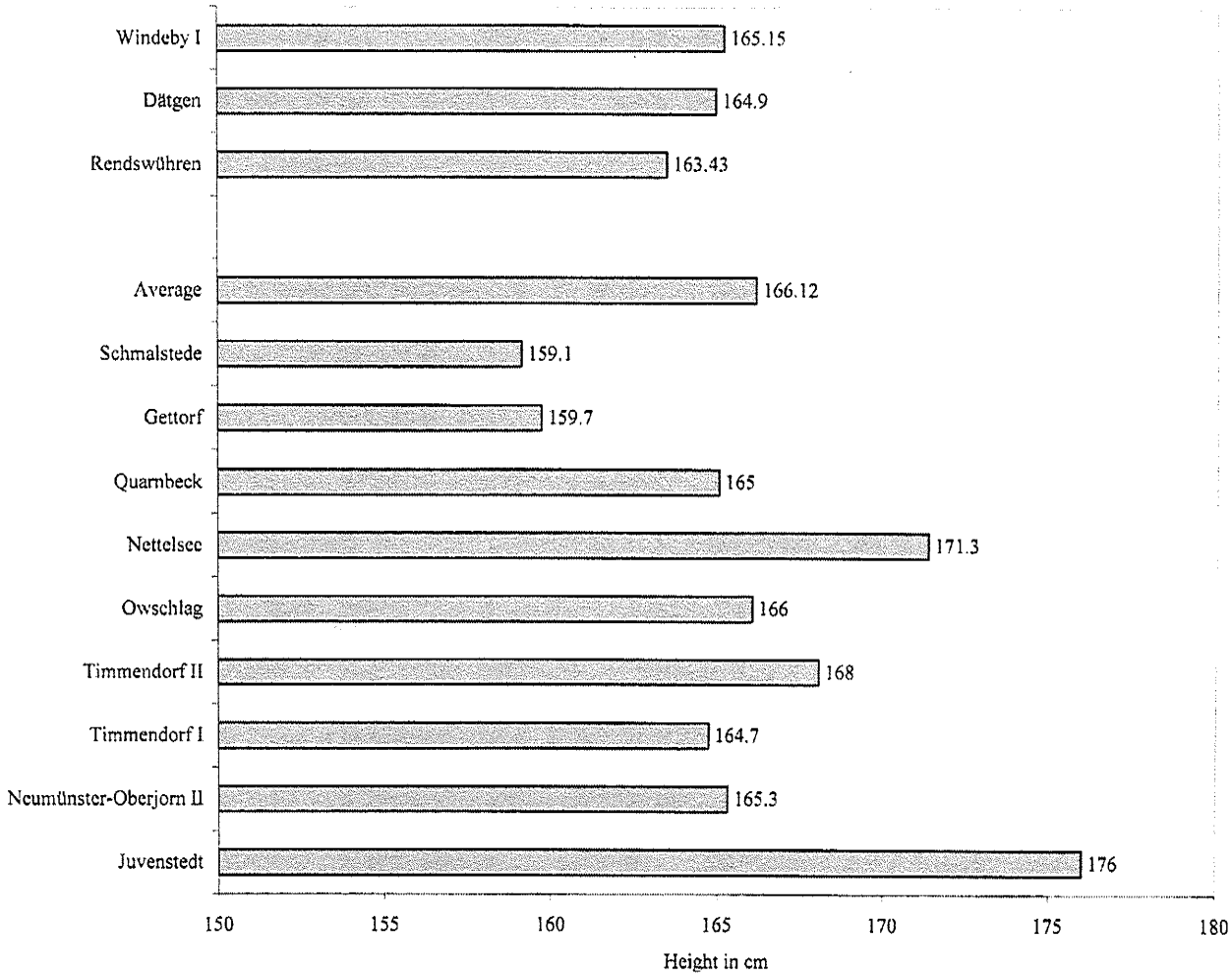


Figure 106: Comparison of the average stature of males in nine Iron Age cremation cemeteries, plus Windeby I, Dätgen and Rendswühren (based on data from Schutkowski and Hummel 1991)

Date	Cemetery	Male stature (cm)	Female stature (cm)
Pre-Roman Iron Age	Juvenstedt, Kreis Rendsburg-Eckernförde	176	157
Pre-Roman Iron Age	Neumünster-Oberbjorn II	162.74-167.86	154.35-157.85
Pre-Roman Iron Age	Timmendorf I, Kreis Ostholstein	161.9-167.5	153.1-162.9
Pre-Roman Iron Age	Timmendorf II, Kreis Ostholstein	165.55-170.45	150.4-158.7
Pre-Roman Iron Age	Owschlag-Ramsdorf, Kries Rendsburg-Eckernförde	166	162
Pre-Roman Iron Age	Nettelsee, Kreis Plön	166.1-176.5	161.01-169.59
Pre-Roman Iron Age	Bösdorf-Kleinmühlen, Kreis Plön	Not available	Not available
Iron Age and Migration	Quarnbeck, Kreis Rendsburg-Eckernförde	1.65	1.65
Iron Age and Migration	Gettorf, Kreis Rendsburg-Eckernförde	159.12-160.28	154.26-166.74
Iron Age and Migration	Schmalstede, Rendsburg-Eckernförde	155.78-162.42	162.32-166.28

Table 24: Average stature of males and females in each cemetery (based on data from Schutkowski and Hummel 1991)

isolated or otherwise separate geographically from sites where the usual burial practices were carried out. In fact, an Iron Age cremation urn with a wooden lid was found in the bog, although the distance from bog body, or the head, was not specified (Struve 1967). In 1976, three cremation urns were found 500 m west of the town of Dätgen, only a short distance from the bog body . At Osterby, a Pre-Roman Iron Age cremation urn was found in 1955, just a short distance from the location of the skull. Although two other cremation urns and a possible cremation pit were not found in peat, they were excavated from close the Osterby peat site at Köhlmoor.

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Habitation and work sites near the bog body sites

Although not all bog bodies can be linked to habitation, some bodies may be related to human activity in an area. Three bodies were found at the site of Borremose, in Denmark. In the same area a fortified Iron Age village site was found. When the site is considered over all its phases of occupation, it consisted of "...about 32 houses, one stone-paved street, one village pond, one pit with bog iron ore plus several puts and stone pavements without obvious connections to any of the major features" (Martens 1990:162), which suggests long term occupation of a large settlement.

With the Schloss Gottorf bog bodies, there is also some evidence for settlement and work sites near the find sites. Just east of the town of Dätgen, an area classified as a "work site" was found (Schäfer 1970). The site included a both iron production slag and kiln, as well as a number of pottery vessels. Clearly both iron and ceramic production was undertaken at the site, which is only a short distance from the bog. There is a known Iron Age settlement site close to the find location of the Windeby I and II bodies. The bog site is marked with a square in Figure 107. On the same map, the Iron Age shell middens, which are discussed in more detail below, are marked with solid black dots. Although there are no other settlement or working sites specifically near the Windeby bodies, Figure 106 also shows that there are a number of settlement sites, cremation urns and iron working sites within 10 km of the site of the bog bodies.

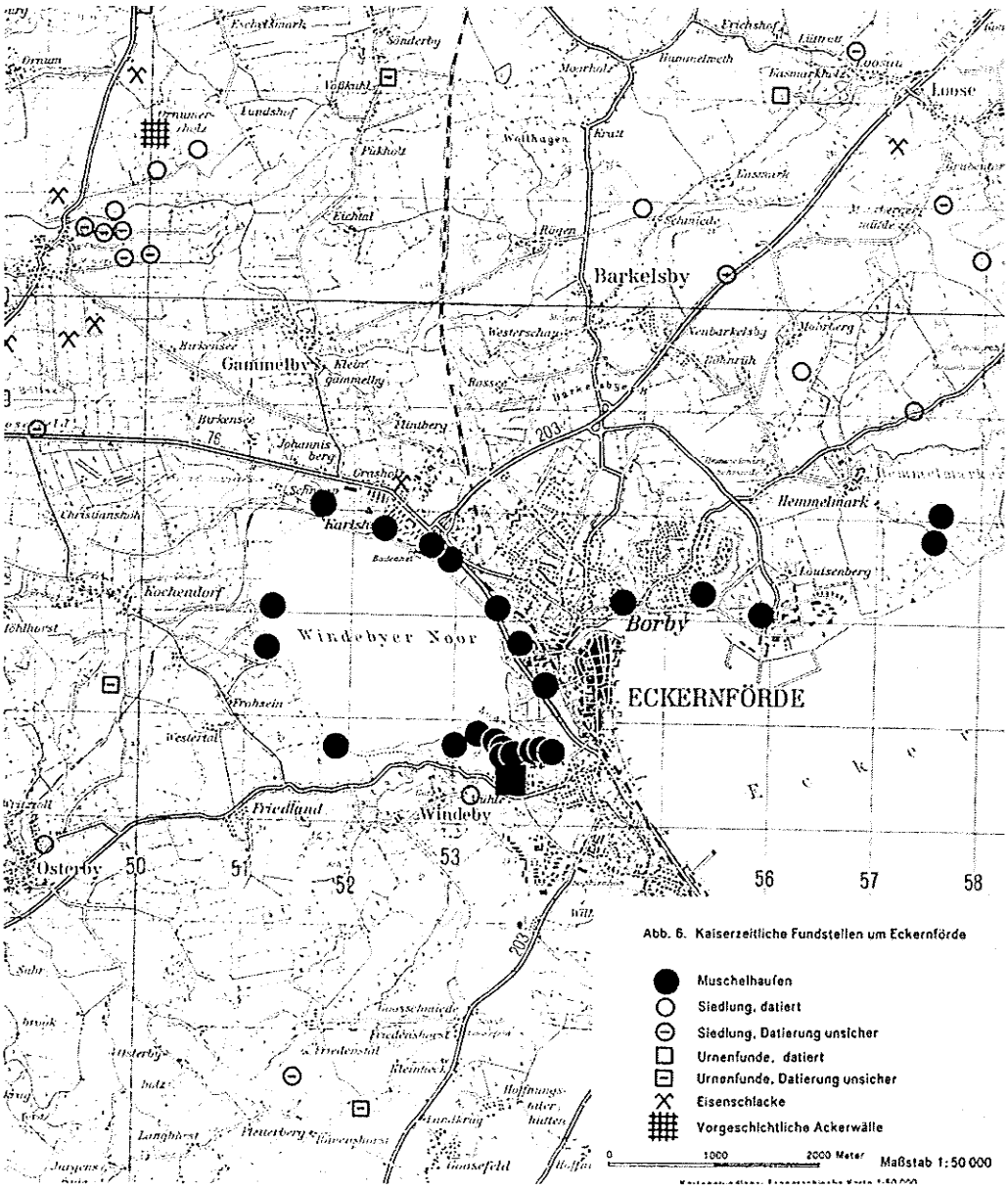


Figure 107: Map of the Windeby area showing the location of the bog bodies (solid square) shell middens (solid circle), dated settlements (open circle), undated settlements (open circle with bar), dated cremation urn sites (open square), undated cremation urn sites (open square with bar) and iron working sites (crossed axes). (Source: Harck 1973: colour map insert). Reprinted with permission, 2005.

Windeby shell middens

Several Iron Age shell middens have been found in Schleswig-Holstein (Anger 1973; Harck 1973). One letter (Reimers 1904) and one report (Reck 1904) in the Windeby archives compare middens found near Windeby Noor, a bay near the Windeby site, to similar middens from the "Stone Age"; they make direct reference to the køkkenmødding from Denmark. The Danish køkkenmødding, which translates to "kitchen midden" are associated with the Late Mesolithic Ertebølle (about 5000 B.C.) and Early Neolithic Funnel Beaker (approximately 4000 to 3000 B.C.) cultures (Andersen 1989, 1991). Køkkenmødding may be very large – one midden was 140 m long, 20 m wide and nearly 2 m deep (Andersen and Johansen 1986). There are several sites in Denmark, particularly in the area of the Limfjord, which separates the uppermost region of the Jutland peninsula from southern Jutland. Several species of oyster, cockle, mussel and marine mollusc are common (Petersen 1986). Terrestrial species, including deer, pig, seal, elk and rodents have also been identified (Andersen 1989; Andersen and Johansen 1986; Bratlund 1991). There is evidence of Mesolithic habitation near the middens and it was suggested the middens represent a mixture of food waste and clearly defined activity areas, including areas where tool making was undertaken (Andersen and Johansen 1986). Aside from the Windeby Noor sites, there are no other Iron Age middens known in northern Europe.

The presence of very large shell middens around the habitation sites suggests the consumption of a large amount of shellfish in this region during the Iron Age. Since the two bog bodies from the Windeby area are only a short distance from the habitation site, and therefore the shell middens, it seemed plausible that both individuals may have consumed marine food as part of their diet. As discussed above, the preliminary data

from the isotopic analysis, however, indicates that Windeby I likely consumed little or no marine-based foods, despite the presence of the shell middens. The stable isotope data linked to the most recent radiocarbon dates, done in 2003, indicate a purely terrestrial diet (Grootes 2002c), with no evidence of marine-based resources. If Windeby I consumed shellfish or other marine foods it must have been in trace amounts.

Reconstruction of the life of an individual

In physical anthropology, skeletal remains are often used, among other things, to determine the demographic characteristics of a specific population (Chamberlain 1994). The main focus in the study of human remains in recent decades has generally shifted from descriptive studies of individuals to the study of populations (Mendonça de Souza et al. 2003), although there are still many individual-based research projects (Waldron 1994), including this study. The development of the field of palaeoepidemiology, which considers the "...distribution and determinants of health-related states or events in specified populations" (Mendonça de Souza et al. 2003:22), is a substantial contribution to the analysis and interpretation of human remains. Palaeoepidemiology, however, requires a population and there are never enough bog bodies found in a single area from the same time period to constitute a distinct population sample, although aggregated samples may contribute data to broader population assessments; in this case, Iron Age Schleswig-Holstein. Given the geographic, temporal and cultural variation of the bog bodies of northwestern Europe, it is not possible to interpret the Schloss Gottorf collection of individuals as a population.

It is generally acknowledged that palaeoepidemiology is constrained by "...the limits conditioned by the nature of the available data, and although sharing common principles, the research in archaeological material imposes the development of new methods and techniques or adaptations of existing ones" (Mendonça de Souza et al. 2003:22). The value in the re-examination of individual bog bodies is not necessarily their contribution of data regarding a specific population, but the gathering of substantial data about the few specific individuals that have been preserved and the development of new techniques appropriate to the analysis and interpretation of these uniquely preserved humans. There is an acknowledged risk in using a small group of individuals, such as the bog bodies, to make generalizations about the potential living population from which those individuals were drawn, in this case, Iron Age populations in Schleswig-Holstein. It may not be appropriate to use these individuals to draw conclusions about the population as a whole, but in this situation, where only limited osteological evidence is available due to the use of cremation as the primary means of the disposal of the dead in this time period and in this region, the bog bodies represent a reasonable proportion of the human remains available for investigation and interpretation. Although many Iron Age cremation graves from this region have been excavated, only a limited number have undergone anthropological analyses. Several thousand cremations still await analysis. Once this material has been fully analysed and interpreted, it may be possible to place the individuals (the bog bodies) within the regional Iron Age society even more accurately.

Waldron (1994) specifies several extrinsic and one intrinsic factors which are important in the epidemiological interpretation of a group of bodies. The extrinsic factors include the cultural patterns of disposal of the dead, taphonomic processes and actual amount of

human material recovered for analysis. The intrinsic factor refers to the death of individuals from non-random social or cultural disease patterns. In the case of the bog bodies, the extrinsic factors are of particular interest.

The disposal of the dead in Iron Age Schleswig-Holstein was primarily through cremation and inhumation of the cremation urns. For bodies to not have been cremated at this time was unusual. This alone means that the bog bodies are not representative of a typical population from Iron Age Schleswig-Holstein and may not be interpreted as typical individuals from that society. Secondly, taphonomy plays a crucial role in the preservation and interpretation of the bog bodies. For example, the presence of pseudopathologies may have led to misinterpretation of the body, which was discussed earlier in this thesis. The taphonomy of the acidic peat often leads to the demineralization of skeletal material, sometimes severe, which also reduces the possibility of using standard methods for osteological assessment and interpretation of palaeopathology. Finally, the amount of human material recovered for analysis is also a key issue in bog body interpretation. Bog bodies are seldom discovered intact, are often damaged during discovery and excavation and may have experience decades of neglect prior to examination and analysis. All of these factors contribute to the potential interpretation of a bog body. As stated in Mendonça de Souza et al. (2003) "...most archaeological data is residual, scarce and incomplete and cannot be reproduced by experimentation, very few data allow conclusive inference, and the limits and uncertainties have to be clearly defined and accepted" (Mendonça de Souza et al. 2003:26). This is particularly true when applied to bog bodies.

Throughout the Iron Age there was a stratified social structure that is usually reflected within the grave goods (Ethelberg 1995). For those who were buried or otherwise placed in a bog, that social hierarchy was altered. There was something unusual about the manner of disposal of the bodies. Furthermore, bog bodies were seldom buried with any grave goods, although grave goods featured prominently in both cremation and inhumation burials of the time. Even though it is impossible to know the specific reasons for this change in burial practices with these individuals, it must have been of great importance for the usual customs to have been ignored, particularly in a society where cremation dominated as a method of burial. We cannot be certain of the social status of those found in the bog. There are no grave goods, clothing or other indicators of their place or role in the society, with the exception of the fur cape of Windeby and the possible associated clothing with the Damendorf and Dätgen bodies (see discussion above regarding the clothing of the Damendorf body). Furthermore, many of the cemeteries in Schleswig-Holstein were separated by gender (Gebühr 1997) and it is possible that was also extended to the bogs. The Windeby II adult is likely male, as is the Windeby I adolescent. The bodies were buried in the same bog, although the radiocarbon dates for these bodies do not overlap.

INTERPRETATION OF BOG BODIES

The popular perception of bog bodies as gruesome victims of violence and ritual sacrifice is common. For example, one science-based magazine offered the following explanation for the bog bodies: "For some reason, from 2,500 to 2,000 years ago, the Germanic tribes of Iron Age northwestern Europe had a habit of killing people and leaving their bodies in bogs" (Menon 1997:62). In fact, the reality of bog body interpretation is far more

complex. As expressed by Munksgaard: "The find group is therefore unified only by a common means of preservation, and the term [bog bodies] implies nothing about date, nor about how the people ended up in the bogs" (Munksgaard 1984:120).This is echoed by Parker Pearson (1999): "There is no doubt that the circumstances behind each death and deposition preclude their interpretation as being due to a single set of causes" (Parker Pearson 1999:70). There are actually numerous possible interpretations for bog bodies, which will be discussed in more detail below.

There are two primary theories that are usually offered as potential explanations for bog bodies: punishment burials and ritual offerings (Munksgaard 1984). The first suggestion is that the bog bodies were those convicted and executed for criminal offences. The writings of the Roman historian, Tacitus, are often cited as evidence of bog bodies as punishment burials (eg. Aldhouse Green 2001b). Tacitus recorded that that some criminals were punished by immersion in wetlands (Tacitus n.d.; Rives 1999:175). Tacitus' *Germania* is considered by some to be almost an ethnographic account of the populations north of the Limes, but there are many critics of this interpretation of Tacitus. Instead it is felt that his work may represent more of a political or propaganda document for the Romans (Bazelmans 1991). In the case of the bog bodies, the section of interest is Chapter 12. In that section, Tacitus describes several crimes that lead to capital punishment, defined by some as "abominations" (Ström 1986:225). In some cases the punishment was to be submerged in a wet, marshy area under a barrier. This has been associated with the bog bodies, particularly those that appear to have been "pinned" into the bog with sticks, branches or stones. It seems, however, that many of the bog bodies were not deposited directly into marshy places, but into lakes that later filled in with

vegetation and became bogs; this, therefore, contradicts Tacitus' statement (Munksgaard 1984; Ström 1986). It has also been noted that the translation of the word "crates", which is normally taken to mean the wooden branches or poles found with bog bodies, can also be interpreted as "fascines", the term for poles of bunches of sticks often carried in battle (Ström 1986:228). There has been some confusion surrounding the crimes that might have been considered "abominations". In other sections of Tacitus, he refers to cowardice, for example, as an offence and indicates that "Many that have escaped battles alive have with a rope put an end to their disgrace" (Ström 1986:226). If there is need to draw a link between Tactitus and the bog bodies, perhaps a connection should be made to those that have been found strangled or hanged, such as the Tollund Man, especially since suicide by hanging was also reported in Tacitus. It has further been noted that Tacitus' discussions of capital punishment refer to crimes that have a connection to war, including treason, desertion and cowardice. One author has suggested that since Tacitus himself was a lawyer, he was unlikely to exclude other offences for which capital punishment applied, if they existed (Ström 1986:228).

There may, however, be a link between women and criminal punishment in wetland areas. For women, adultery and/or abandonment of a husband were serious offences that were punishable by death. More specifically, these women were to be punished by drowning. Prostitution was another offence for which a woman might be punished in this manner. It is possible that at least some of the female bodies were punishment burials (Munksgaard 1984, Ström 1986). It has also been suggested that the crime of "unmanliness", often interpreted as homosexuality, may also have required the same punishment as that meted to women: drowning in a marsh (Ström 1986); since they were

not considered "manly", homosexuals may have been treated in the same manner as women. Since part of the punishment may have included cutting or shaving of head hair and stripping of clothing (Munksgaard 1984), the high number of naked bog bodies overall and the apparently shorn heads of bodies such as Huldremose Woman and the Windeby I body, are interesting. The Huldremose Woman was, however, fully clothed (Brothwell et al. 1990) and the Windeby I body, although naked, was wearing a cape. If these were both punishment burials in the strictest sense, they should not have been clothed.

The great variation in the manner of deposition of the bodies is also problematic. As has been discussed earlier, there is no identifiable pattern for method of burial. Some bodies were placed in watery areas, others in areas of peat that had been cut for fuel. In the case of the Windeby I body, a clear grave, lined with ericaceous plants, was evident. All of these things seem to contradict Tactitus' statements that people were drowned in marshy places with restraints placed over top. The high degree of dissimilarity in all aspects of the bog bodies and the lack of a discernable pattern of repeated behaviour (see Gill-Robinson 2002, 2003) means that interpreting all bog bodies as ritual offerings is dangerous and misleading. The deposition of people at wet sites did not originate in the Iron Age; many Neolithic skeletons have also been recovered from peat sites (see, for example, Bennike 1985 and 1999). The Neolithic skeletons, however, appear to represent a different pattern of behaviour than the Iron Age bog body depositions.

Munksgaard (1984) indicates that children are rarely found as bog bodies, but children's bones are frequently found within skeletal remains of sacrificial bog sites; her statement

that the few children that are bog bodies were "undoubtedly cases of accidents" (Munksgaard 1984:122) is, however, incorrect. The Kayhausen Boy's death was clearly not an accident (Pieper 2003), especially given that he went to his death tightly bound.

It is commonly reported that bog bodies, as well as many artifacts, are votive offerings (Aldhouse Green 1999, 2001b; Coles 1988; Glob 1969; Hansel 2000; Magilton 1995; Menon 1997; Ross and Robins 1989; Schäfer 2003; Turner 1995a; van der Sanden 1996). "The human sacrifices which are known from the early Iron Age are essentially different from the bog bodies in that they are always accompanied by domestic animals, pottery, or sometimes parts of wagons" (Munksgaard 1984:122). The sites of Rappendam and Valmose are examples of votive offering sites that also had some human remains. The site of Valmose in Denmark had a range of domestic animal bones, as well as two nearly complete human skeletons and a few other isolated human bones, pottery sherds and a spindle whorl (Ferdinand and Ferdinand 1962). Although dating has established that some of material is from the 4th to 5th century A.D., it has not been ascertained if that was the only period of use, of if some material was deposited either earlier or later. The peat environment was clearly alkaline, since only skeletal material was recovered and botanical evidence suggested the site had been a reed swamp at the time of the deposition of the animals and humans. There were many branches that showed evidence of "hacking or felling" (Ferdinand and Ferdinand 1962:83) and many stones of various sizes, which indicate human activity and not natural deposition. It was noted that the stones and branches were consistently at a higher level than the bones and it was suggested that the humans and animals were covered at the time of deposition, perhaps to reduce predation. Two adult female skeletons, some bones from a sub-adult, an isolated adult talus and two

teeth were discovered at the site. The bodies disarticulated in the wet environment and the bones are scattered throughout the site. There was no evidence of cut marks or other signs of violence; both humans and animals appear to have been deposited in the same manner and location (Ferdinand and Ferdinand 1962). The circumstances of the bog bodies of Schloss Gottorf, aside from the soft tissue preservation, are very different that seen at Valmose. With the exception of Windeby I, none of the bog bodies had artifacts, particularly pottery. There was no evidence of animal sacrifices at any of the sites. It seems logical, however, that if stones and branches were being used to cover animals in votive bogs, that they would be used to cover the bodies in peat cuts, and possibly for the same reason – to reduce the possibility of predation. This again supports the notion that the branches, poles and stones were not used in an attempt to drown an individual or pin them into the bog. There is a logical reason for their presence.

Offerings to Nerthus, the goddess of fertility and the earth, are well known from the Iron Age (Aldhouse Green 2001b; Glob 1969; Menon 1997). These offerings, however, are different in both form and context when compared to the bog bodies. Annual festivals honouring Nerthus existed and during these festivals the goddess was often paraded between villages on a cart (Glob 1969; Menon 1997). It is believed that the wagons discovered in the wetlands of Denmark can be linked to Nerthus. Wagons have, however, also been found in the context of Iron Age cremation burials at Langå on the Danish island of Fyn and Kraghede in northern Denmark (Hedeager 1992b). The presence of these wagons in non-wetland locations calls into question the interpretation of the wagons as offerings to Nerthus. The votive offerings are most often found in alkaline, not acid peat. Although animal bones are commonly recovered from these sites, human remains

are rare and often incomplete. Rappendam, in Denmark, is a clear example of a votive site. At this location many artifacts, including a piece of plough and a wagon, were discovered in a fen. The bones of several domestic animals and one adult male were also found (Glob 1969; Kunwald 1970).

The meaning of the many wooden anthropomorphic figures found in peat in northwestern Europe is not known. They are often interpreted as representations of deities (Capelle 2003; van der Sanden and Capelle 2001). It may be that the figures represented human sacrifices to the bogs, without having to sacrifice a human. The large figures from Braak (Dietrich 2003), for example, were not created for display, but appear to have been buried immediately after construction; the usual explanation of worshipping at these figures is unlikely. These figures may represent a human sacrifice. Although there is no archaeological evidence to support this latter hypothesis, it is no less plausible than other explanations for these figures.

Although a popular interpretation of bog bodies is that they met a violent death before their deposition in the peat, this researcher has always believed that this belief was vastly overstated and lacked sufficient data for confirmation. The bog body database created during earlier research (see Chapter 3) suggested that the majority of bog bodies had not met a violent end and that there was inadequate evidence for the interpretation of ritual as the primary reason for all bog bodies to be in the peat (Gill-Robinson 2000, 2003). This is not a new perspective (Ström 1986:229), but it is also not a commonly held belief.

There are several other possible explanations for the bog bodies. Certainly some of the bog bodies were accidental. Walking on bog areas, especially in the dark and when without benefit of a track, can be treacherous (Briggs 1995). It is possible that people came off the safe, dry route through the bog inadvertently, sunk in the peat and became mired or drowned when trying to extricate themselves. Some individuals may have been hastily hidden victims of robbery or murder (Briggs 1995). Although Parker Pearson (1999) indicated that most of the cremation urns were "...on high and dry land generally about half a kilometre from water, in contrast to the close proximity of settlements to water sources" (Parker Pearson 1999:70), this may not always be the case. As discussed earlier, cremation urns have also been found in some bogs. This may indicate that a bog was normal burial site, in some cases. It is also possible that the peat areas that were unsuitable as agricultural land were used for burials in areas where arable land was too valuable to waste on the dead (Munksgaard 1984). By far the most logical interpretation is, perhaps, a combination of the various possibilities. It is impossible to clearly define all bog bodies as ritual sacrifices, or by any other explanation, at this point in time. In fact, the temptation to define the bog bodies as a single group based on one possible interpretation must be avoided.

Prior to his death in 1991, a respected bog body researcher, Hajo Hayen, expressed concern over the trend towards a single interpretation of bog bodies, usually with regards to ritual. Although much of his work was still in preparation at the time of his death, he expressed the following opinion in relation to the bog bodies: "...there is no universal explanation. Each body must be considered separately to decide whether it represents the remains of a punished individual, a sacrificial victim, the victim of a sex crime, an

accident or violent attack..." (van der Sanden 1995c). The current research supports Hayen's perspective: each bog body must be interpreted as an individual and based upon the archaeological, environmental and potential cultural evidence accompanying the body. A holistic approach to the study of bog bodies must be adopted.

SUMMARY

The Iron Age bog bodies of the Archaeologisches Landesmuseum Schloss Gottorf are, in general, fairly typical of other bog body finds in northern Europe. The clothing and diet of the individuals in this research group were similar. Comparison of the bog bodies to skeletal data from Iron Age Danish populations, and cremated individuals from Schleswig-Holstein, showed that there were no specific physical features that distinguished the bog bodies from others that died in the Iron Age. The bodies were not geographically isolated from cremation urn sites and, in several cases, cremation urns were found in the same bog as the bodies. This suggests that the two practices were not always completely different.

A range of methods was used in the re-investigation of these bog bodies. Although some of the methods used in this research had been applied to other bog bodies, the use of trace element analysis from hair to determine a possible occupation, and stable isotope analysis from hair to determine diet is unique. The use of imaging, particularly CT scanning and the use of CT images for three-dimensional modeling is an important aspect of this research. Finally, interpretations of the Schloss Gottorf bog bodies were presented, both in the context of their Iron Age environment and in terms of all bog bodies in northwestern Europe.

CHAPTER 14
CONCLUSIONS

The purpose of this research was to undertake a complete anthropological analysis of five bog bodies, one skull with mandible and traces of soft tissue and one skeleton. All bodies were from peat environments in Schleswig-Holstein and all bodies are currently curated at the Archäologisches Landesmuseum at Schloss Gottorf in Schleswig, northern Germany. Most of the bodies date to the Iron Age, approximately 500 B.C. to A.D. 800; the skeleton is undated. The bog bodies display varying levels of preservation, but extensive soft tissue remains in all cases, except the isolated skull from Osterby and the bog skeleton from Kühsen. A complete review of the archival material associated with each of the bodies, followed by physical analysis of each formed the basis of this research. In addition, six of the bodies were subjected to medical imaging and tissue samples were taken for ancient DNA, stable isotope and trace element analysis.

METHODOLOGICAL AND ARCHAEOLOGICAL IMPLICATIONS OF THE RESEARCH

This research sets an example for other bog body re-investigation projects. During this research, several new methods of analysis were applied to bog bodies. The data obtained from these analyses contributed substantially to the interpretation of these seven individuals. This is the first bog body project to incorporate the use of the both archival documentation and physical analyses. The use of any available archival data is strongly encouraged for any bog body future research.

The importance of these bodies was as individuals living in a specific area at a specific point in time; they should not be considered a population. Through the various analyses used in this research, each of the bodies could be successfully placed within the context of Iron Age Schleswig-Holstein. When compared with Iron Age skeletal samples from Denmark and Iron Age cremation material from Schleswig-Holstein, it was apparent that there were few differences between populations living in the region and the individual bog bodies. The new analyses also made it possible to address previous interpretations of each of the Schloss Gottorf bog bodies and offer new explanations based on new data.

Although a complete interpretation of peatland taphonomy and wetland archaeology was not within the scope of this particular research, through a comparison of the skeletal material from the Kühsen and Windeby I bodies, it was possible to examine the differences in preservation of human bone in acidic and alkaline environments. Further examinations of skeletal material from alkaline environments, and additional comparison with three-dimensional images of bone from acidic bog environments, should be undertaken to allow continued development of an understanding of taphonomy in peat environments.

This research also used trace element and stable isotope analysis of bog body hair. The is the first time that trace element analysis from hair has been tried with bog bodies and one of the first to use stable isotope analysis of hair in the re-examination of a collection of bog bodies. The data from these examinations were critical in the interpretation of these bodies. To be able to determine that the diet of four individuals was not rich in meat is an important contribution. In particular, there is now evidence that Windeby I probably did

not consume shellfish, despite the presence of substantial contemporary shell middens, which may suggest the individual's social status. Finally, to be able to determine a possible occupation for a body that is less than 1 cm thick, on the basis of the presence of trace elements in his hair, opens the way for further investigations with other bodies. It is not currently known if gilded objects were imported or locally worked; the identification of Damendorf Man as a possible sliver gilder may be the first confirmed recognition of this occupation in northern Germany. Although destructive sampling of the hair was necessary, the data obtained from the isotopic and elemental analyses justifies the use of this method in future research.

In cases where sexing of an individual may be ambiguous, such as the case of Windeby I, DNA may make an important contribution. The use of DNA analysis in bog body research is not common and requires further development, but the samples from this research assisted in refining the methodologies used in DNA analysis for bog bodies. DNA analysis, while requiring destructive sampling, was able to provide molecular evidence to support the morphological reassessment of Windeby I.

Complete physical re-examinations of all of the bog bodies allowed identification of trauma to the bodies as antemortem, perimortem or postmortem. For example, apparent antemortem and perimortem wounds on the foot and thorax of the Rendswühren Man and a re-evaluation of some fractures of the Dätgen Man. Physical examinations were enhanced by the use of digital imaging and three-dimensional reconstruction. Imaging made a substantial contribution to the analysis of the bog bodies. In the case of Rendswühren Man, for example, it would never have been known that the head had been

completely reconstructed, with no remaining bone. For Damendorf, there would have been no identification of skeletal material or internal organs, without the use of MSCT scans and high-quality image analysis software. The use of rapid prototyping of specific skeletal elements allowed additional review of the bodies in a research laboratory in Canada, after completion of fieldwork in Germany. Finally, digital imaging of all bodies, except Windeby II, has provided a complete three-dimensional record of the six bodies at this specific point in time. The museum now has a complete record of those bodies, which can re-examined periodically and aspects of deterioration or other changes noted. Furthermore, it should not be necessary to expose those bodies to MSCT scanning again, or additional physical examinations, since future researchers will be able access all of the digital data without risk of damage to the bodies. Digital X-ray did not provide any additional data than what could be achieved with MSCT. For future projects it is unlikely that digital X-ray will be necessary.

FUTURE DIRECTIONS

There are two aspects the future directions of this research: future investigations of the Schloss Gottorf bog bodies and work with bog bodies in general. This research successfully provided substantial new data for the general interpretation of the Schloss Gottorf bog bodies, but additional analyses are still possible and contribute even more information.

Additional image editing may allow the definition of the brain and intestinal tract of the Damendorf body. It may also be possible to segment out the pelvis of the Dätgen and Rendswühren, which may allow for more precise estimation of age. Estimation of age of

Windeby II and Damendorf may be possible through amino acid racemization of small samples of skeletal material, but this test is destructive and its use with bog bodies has not yet been evaluated.

Once DNA analysis techniques are refined, it would be useful to test the Dätgen body and the head that is associated with that body to conclusively determine whether or not they belong to the same individual.

It would be beneficial to obtain a conclusive date for the Kühsen skeleton. If this skeleton is confirmed to be from the Iron Age, further comparison of this skeleton with other Iron Age material from Schleswig-Holstein would be appropriate. If other human skeletal material from alkaline peat is also identified, dating and analysis of that material would provide a new body of data for comparison with bog bodies and other skeletal material from northern Europe.

Analysis of the skin of Windeby I, Damendorf and Rendswühren should be undertaken in an attempt to determine if any materials were used in the conservation of the bodies, perhaps even at the time of death. For example, it is unknown exactly what method was used in the conservation of the Windeby I body. The chemical recipe should be identified so that appropriate strategies for the long-term monitoring and maintenance can be put in place for the body.

In terms of general bog body studies, there are several recommendations from this research. All bog bodies that are currently curated in museums need to undergo complete

re-analysis and documentation to prevent the loss of valuable data. DNA analysis, where appropriate, may contribute to the interpretation of some bodies, but samples for DNA should be taken prior to imaging. Extensive imaging of every existing bog body through computed tomography is imperative, even if this is not part of a larger re-examination initiative. It provides not only a means of documenting the bodies in the three dimensions, but also allows researchers the opportunity to examine the body in detail with very limited physical invasiveness. It would be particularly useful for a central repository of bog body images to be established. These should be accessible in a digital form and would allow researchers the opportunity to examine and compare bodies without having to physically access individual bodies.

The success of studies such as the stable isotope and trace element analyses undertaken with the Schloss Gottorf bog bodies should demonstrate the value of analyses to future bog body re-examination projects. Once these analyses are undertaken on a wide range of bog bodies, it may be possible to compare individuals and begin to draw conclusions about bog bodies on a regional scale.

Additional taphonomic research needs to be conducted in order to understand the complex processes affecting the preservation of soft tissue and bone and peat bogs. Long- and short-term experimental archaeology projects need to be designed and carried out in several regions: northern Germany, Denmark, the United Kingdom, Ireland and the Netherlands, for example, since much of the taphonomic data is site specific and may not be widely applicable to all bog bodies. The use techniques such as Small-Angle X-ray Scattering (SAXS) to attempt to quantify levels of demineralization in bone may be of

use. Before that technique can be attempted with bog body bone, it must be tested through an experimental archaeology project.

CONCLUSION

This research has demonstrated the unique nature of every individual bog body and has served to emphasize the importance of the re-examination of existing bog bodies. The research also identified the value of several new methods for the analysis and interpretation of bog bodies and is an excellent example of the collaborative multidisciplinary research necessary in the study of human mummies. This research has, in general, made several contributions to the anthropological study and interpretation of bog bodies through detailed analyses and consideration of the five Iron Age human mummies, one skull and skeleton from the peat of northern Germany.

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APPENDIX A

BOG BODY	CURRENT LOCATION
	GERMANY
Damendorf	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Datgen	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Osterby	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Rendswuhren	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Windeby I	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Windeby II	Archaeologisches Landesmuseum, Schloss Gottorf, Schleswig
Bareler Moor Girl	Landesmuseum für Natur und Mensch, Oldenburg
Husbäke Man	Landesmuseum für Natur und Mensch, Oldenburg
Kayhausen	Landesmuseum für Natur und Mensch, Oldenburg
Neu-England Man	Landesmuseum für Natur und Mensch, Oldenburg
Bentstreek foot	Niedersächsisches Landesmuseum, Hannover
Bockerhornerfeld Man (aka Jührdenerfeld Man)	Niedersächsisches Landesmuseum, Hannover
Hunteburg foot (1938)	Niedersächsisches Landesmuseum, Hannover
Hunteburg I	Niedersächsisches Landesmuseum, Hannover
Hunteburg II	Niedersächsisches Landesmuseum, Hannover
Hunteburg III	Niedersächsisches Landesmuseum, Hannover
Johann Spieker	Niedersächsisches Landesmuseum, Hannover
Neu Versen Man	Niedersächsisches Landesmuseum, Hannover
Obentaltendorf Man	Schwedenspeicher-Museum, Stade
Body name unknown (Peiting?)	Archäologische Staatssammlung, München
	NETHERLANDS
Emmer-Erfschidenveen Man	Drents Museum, Assen

Exloërmond	Drents Museum, Assen
Weerdinge I	Drents Museum, Assen
Weerdinge II	Drents Museum, Assen
Wijster	Drents Museum, Assen
Yde	Drents Museum, Assen
Zweeloo	Drents Museum, Assen
	DENMARK
Grauballe Man	Forhistorisk Museum, Moesgård, Højbjerg
Borremose I	National Museum of Denmark, Copenhagen
Borremose II	National Museum of Denmark, Copenhagen
Borremose III	National Museum of Denmark, Copenhagen
Huldremose	National Museum of Denmark, Copenhagen
Stidsholt Woman	National Museum of Denmark, Copenhagen
Haraldskaer Woman ("Queen Gunhild")	Sct. Nicolai Kirke, Kirketorvet, Vejle
Elling Woman	Silkeborg Museum, Silkeborg
Tollund Man	Silkeborg Museum, Silkeborg
	IRELAND
Bollivor (found Feb 2003)	National Museum of Ireland, Dublin
Clonearl (found May 2003)	National Museum of Ireland, Dublin
Mountdillon (found Jan 2005)	National Museum of Ireland, Dublin
Gallagh Man	National Museum of Ireland, Dublin
Meenybraddan Woman	National Museum of Ireland, Dublin
Tumbeagh	National Museum of Ireland, Dublin
Baronstown West (Clongownagh)	National Museum of Ireland, Dublin
	UNITED KINGDOM
Lindow I	British Museum, London
Lindow II	British Museum, London
Worsley Man	Manchester University Museum, Manchester

APPENDIX B

RENDSWUHREN

AUTHOR	DOCUMENT	DATE	# OF PAGES
Handelmann	Typed transcribed detailed report about the first examination of the body and clothing - section on the autopsy	6.6.1871	5
Bulk, Detlev	Typed transcribed detailed report about the body	6.6.1871	3
van der Sanden, Wijnand	Letter to Herr Brandt re: radiocarbon dates for this body, Damendorf 1900 and Osterby 1948	27.7.1995	1
Handelmann	Typed transcribed report of body discovery	4.6.1871	1/2
- (possibly in Handelmann's handwriting)	Typed transcribed memo briefly describing the find site	-	1/3
Schutze/Pansch	Typed transcribed written discussion about the body	-	1/3
Handelman	Typed transcribed summary report of the find of the body	7.6.1871	1
Handelmann	Typed transcribed letter about the find of the body and status of the examinations - written to the "Oberpresidenten"	9.6.1871	1
Mielck, E.	Typed transcribed description of the head and body	7.6.1871	1
Handelmann	Typed transcribed letter regarding the leather/hide that wrapped the head	9.6.1871	1/2
Handelmann	Typed transcribed brief memo regarding the pelt	13.6.1871	1/3
Mielck, E.	Typed transcribed letter/report on the pelt/skin	13.6.1871	1

Moller	Typed transcribed report of body discovery and overall appearance of the body	28.6.1871	2 1/3
Kaestner	Typed transcribed notes about the "fabric" - most of the note could not be conclusively transcribed	15.?.1871	1/2
Moller, D.	Typed transcribed detailed report of body discovery and appearance	4.8.1871	1 1/2
Lensch/Handelmann	Typed transcribed note about the textile(?) - complex language, some of which could not be conclusively translated	12.8.1871	1/2
Carsens/Bulk	Typed transcribed note about the finder of the body (Hans Claus Lensch)	-	1/2
Buttel, P.	Typed transcribed report of the location of the body in the peat	19.7.1871	2/3
Buttel, P.	Handwritten report (illegible)	19.7.1871	1
Danger, L.	Typed transcribed letter to Professor Handelmann regarding another find in the same general area?	11.4.1882	1
Bulk, D.	Typed transcription of a public report on the body - Schulchronik Schopphorst	1895	1
Blunk, Chr.	Typed transcribed report of the body in either Dutch or German dialect		1/3
-	Newspaper report - Hamburger Nachrichten - "Anthropologische Gesellschaft" - in old German print (very difficult to read)	14.6.1871	1
Virchow	Journal article on the bog body	1871	2 1/2
	"Monats-Sitzung"	October 7, 1872	1
Mehn?	Newspaper report - Itzehoer Nachrichten No. 840 (attached to handwritten letter)	18.7.1871	1

	Newspaper report - Kieler Zeitung No. 2104 (attached to handwritten document)		1/2
	Newspaper report - Itzehoer Nachrichten No. 64 (attached to handwritten document)	8.Juni.1871	2
	Newspaper report - Hamburger Nachrichten - No. 133	8.Juni.1871	1/2
	Newspaper report - Itzehoer Nachrichten No. 64 and 65	5.Juni and 8 Juni 1871	1
	Report of purchase of piece of textile from person in Berlin on 6.3.1961	1973	1/2
	Handwritten documents (illegible) - approximately 25 documents		80
			114 1/3
ILLUSTRATIONS			
	photograph of the body standing up	June 1871	3
	photograph of the body on display		1

DAMENDORF

AUTHOR	DOCUMENT	DATE	# OF PAGES
Robbert, N.	Handwritten letter	29.5.1900	2
	Handwritten transcription of Robbert letter - report of the find	29.5.1900	1
Sye, H.	Handwritten letter	3.6.1900	1
	Handwritten transcription of Sye letter - quick overall analysis of the body	3.6.1900	1
Jessen, W.	Handwritten report	9.6.1900	4
	Handwritten transcription of Jessen report - report to J. Mestorf with description of body	9.6.1900	3
Sye, H.	Handwritten letter to Professor J Mestorf	8.6.1900	3
	Handwritten transcription of letter to J Mestorf - about the find and the clothing	8.6.1900	1 1/4
Jessen, W.	Handwritten letter	14.6.1900	3
	Handwritten transcription of Jessen letter - discusses pieces of the body sent away for analysis	14.6.1900	1 1/2
Jessen, W.	Handwritten document plus sketch of area		4
	Handwritten transcription of document - summary of area of find - surrounding geographical features		3
Sye, H.	Handwritten document	6.8.1900	1
	Handwritten transcription of Sye document - letter to Professor J Mestorf - re. depth of body in peat	6.8.1900	1/2
Robbert, N.	Handwritten document		3 1/3

	Handwritten transcription of Robbert document - discussion of possible weather conditions that would have caused the man to use the cape		2
Unknown	Handwritten document	13.7.1911	4
	Handwritten transcription of 13.7.1911 document - original document is very difficult to read and the transcription has blanks in the text and is also incomplete - document mentions Nydam find and the some analysis of the fabric with the Damendorf body	13.7.1912	1 1/2
Rottger, W.	Handwritten document	2.6.1911	2
	Handwritten transcription of Rottger document - basic forensic/legal report	2.6.1911	1
Runde	Handwritten document	20.4.1900	4
	Handwritten transcription of Runde document - summary of clothing with body	20.4.1900	2 1/4
Jordt	Handwritten document	29.7.1900	1
	Handwritten transcription of Jordt document - gaps in transcription make the document difficult to translate, but it relates to a publication	29.7.1900	1/2
Runde	Handwritten document with small sketch	27.8.1900	4
	Handwritten transcription of Runde document - summary of textiles, particularly the cape, including a sketch	27.8.1900	2
Reimers	Handwritten document	9.7.1900	1
	Handwritten transcription of Reimers document - regarding a bog body from Etzel in East Fresia	9.7.1900	1/2
Benzon, Fischer Provinzial Museum	Handwritten document	28.6.1900	2

	Handwritten transcription of Benzon document - re: clothing	28.6.1900	1 1/3
Winkler	Handwritten document	10.6.1900	1
	Handwritten transcription of Winkler document - re: samples from the clothing	10.6.1900	1/2
Direktor, Westpr. Provinzial-Museums	Handwritten document	13.6.1900	2
	Handwritten transcription of letter from Direktor - some gaps in transcription - re: publication	13.6.1900	1
Becke	Handwritten document	16.6.1900	3
	Handwritten transcription of Becke document - re: hair sample	16.6.1900	2/3
	several documents could not be transcribed and therefore were completely illegible		6
Mestorf, J	Typed transcription of letter to Sophus Muller at the National Museum of Denmark	27.6.1900	1
Mestorf, J	Typed transcription of letter to Sophus Muller at the National Museum of Denmark	9.6.1900	1
Mestorf, J	Typed partial transcription of letter - the first part of the letter is missing - a brief summary of aspects of the body	14.6.1900	1/2
	Handwritten archive ledger list of local finds - some parts difficult to read		1 1/2
van der Sanden, Wijnand	Letter to Herr Brandt - re: radiocarbon date of Damendorf, Osterby and Rendswuhren	27.7.1995	1
Kersten, Karl (?)	Handwritten document - illegible	28.8.1941	2/3
	Newspaper Report - Kieler Neueste Nachrichten, Kiel - re: find of a cow horn	28.3.1941?	1/4
Rothmann	Typed list of finds from the area	1942	1/2

Kersten, Karl (?)	Typed report - "Fund einer Moorleiche im Ruchmoor im Jahre 1947" - with illegible handwritten postscript	25.7.1947	2
	Newspaper Report - Flensburger Tageblatt - "Neuer Moorleichenfund in Dahmendorfer Moor" - reporting new bog body find in 1947	5.7.1947	1/2
Thomsen, Detlef	Typed note to Karl Kersten - re: material for publication on the 1934 Ruchmoor body	10.7.1947	1
Kersten, Karl	Typed letter to Dr. Schmidt - re: an error in the newspaper report listed above (Damendorfer spelled with an "h")	16.7.1947	1
Kersten, Karl	Typed note to Herr Kroeger - re: a piece of leather found in the area	6.8.1947	1/2
Kersten, Karl (?)	Typed note to Herr Hoffman - re: Herr Kroeger's report of a piece of leather		1/2
Thomsen, Detlef	Typed note to Dr. Kertsen - re: piece of leather that may be human skin (see notes to Herr Hoffman and Herr Kroeger)	12.6.1948	1/2
Thomsen, Detlef	Typed file record - re: a finds at Ruchmoor by Damendorf and a paragraph on the Osterby find		1
Signature illegible	Typed letter to Herr Kroeger - re: 1947 Ruchmoor body	14.6.1949	1
Kersten, Karl (?)	Typed report of 1948 finds from the area and the 1947 Ruchmoor body		1
Thomsen, Detlef	Typed note to Dr. Hingst - re: 1947 find in Ruchmoor	16.9.49	1/2
Schlabow, K.	Typed draft manuscript for publication - "Fund einer Opfergrube im Ruchmoor aus der Zeit um Chr. Geb." - Report of a find that was an "offer pit" from the time of Christ	30.6.1951	3 1/3
	Typed report on the find of a skull in the Ruchmoor (KS 22416)		1

Wilczek	Typed notes on the skirt from Damendorf (found 1918) - KS12313	15.12.1958	1
	Postcard - writing illegible		1
Schlabow, K.	Typed basic description of clothing sample	3.6.1934	2/3
Jankuhn	Typed summary of 1934 Ruchmoor bog body find	26.6.1934	3 1/3
	Typed statement about the 1934 find		3/4
Petersen	Handwritten document - very difficult to read	1.6.1934	1
Jankuhn, H.	Typed note accompanying copies of newspaper reports from three local papers - re: the latest find	6.6.1934	1/3
	Newspaper report - Eckernforde Zeitung - report of 1934 body find	6.6.1934	1/4
	Newspaper Report - Kieler Neueste Nachrichten, Kiel - re: 1934 bog body find	29.6.1934	1
Tidelski	Typed note to Herr Jankuhn -in response to letter from Jankuhn	23.2.1940	1/3
	Typed letter to Dr. Tidelski - re: pollen analysis/profile	5.3.1940	1 2/3
Jankuhn, H.	Typed note to Dr. Tidelski - re: possible publication of data	23.3.1940	1/2
Tidelski	Typed note to Dr. Jankuhn - re: copy of a letter from Herrn Gross	26.3.1940	1/3
Tietze?	Handwritten letter to Herr Jankuhn - very difficult to read - re: a bog body from Drobnitz	11.12.1940	1 1/2
Jankuhn, H.	Typed letter to Herr Tietze - re: answering general questions about bog bodies	4.1.1941	1
Jankuhn, H.	Typed note to Dr. Dieck - re: cannot send a copy of the publication about Damendorf	29.4.1941	1/3
Jankuhn, H.	Typed note to Herr Rathje - re: the Damendorf finds	7.6.1934	1/2

Jankuhn, H.	Typed note to Herr Petersen - re: last publication of J Mestorf about the bodies	7.6.1934	1/2
Jankuhn, H.	Typed note to Professor Henneberg - re: leather vessel filled with peat	11.6.1934	1/2
Jankuhn, H.	Typed to note Dr. Columbo, plus handwritten postscript - re: soil sample	11.6.1934	1/2
Jankuhn, H.	Typed note to Herr Petersen - re: photos to follow	14.6.1934	1/2
Intutitsdirektor, Bakteriologisches Institut	Typed letter to Dr. Jankuhn - re: peat sample from the leather vessel	30.6.1934	1
Chemisches Laboratorium	Typed letter to the museum, with handwritten opening comment - re: leather "saucer" with hair	13.8.1934	1/2
Jankuhn, H.	Typed letter to Herr von Stocker - re: the bodies and textiles	2.2.1939	1
Vorgeschichtliches Institut der Universitat Koln	Typed summary of the research of the leather vessel from the Ruchmoor find	24.2.1939	1
Gross?	Handwritten letter to Herr Jankuhn - very difficult to read - re: Damendorf bog bodies	11.1.1940	2 1/2
Jankuhn, H.	Typed letter to Doktor Gross - re: summary and explanation of the Damendorf bodies	24.1.1940	1 1/3
Jankuhn, H.	Typed letter to Dr. Tidelski - re: dating of the Damendorf bodies	24.1.1940	1/2
Gripp?	Handwritten document - difficult to read - re: Tidelski and the dating of the bog bodies		1
Gross?	Handwritten letter to Dr. Jankuhn - difficult to read - re: Damendorf bodies	30.1.1940	4
	Typed report to Dr. Gross - refers to sketches of the site and the pollen sampling - dating via pollen	22.2.1940	6

Koehler, Paul	Typed letter - addressed generally to the museum - re: 1938 Offa article on the Ruchmoor body	25.9.1976	2/3
Kersten, K.?	Handwritten note to Paul Koehler - re: copies of documents from Ruchmoor file	6.10.1976	1
Sandberg, J.?	Handwritten letter re: find of leather belt and other objects - illegible (pencil note with letter mentions leather belt)	26.6.1884	1
Signature illegible	Handwritten postcard re: find of wool skirt in the Damendorfer Moor	23.6.1918	1/4
Signature illegible - Schmidt?	Typed ketter to Herr Wilczek re: wool skirt found in bog in 1918 (details to be passed to Margarthe Hald in Copenhagen)	29.11.1958	1/2
Farke, Heidemarie	Typed report indicating that two leg bindings/leggings (S 10924/C) were received into the climate controlled storage unit (plus photocopy of photograph)	16.09.1998	1
	Invoice from the Historisk-Arkaeologisk Forsogcenter, Lejre re: reconstruction of the Damendorf trousers (original trousers KS 10924, reconstruction KS C627)	16.1.1996	1
Jockisch, Hans	Typed report on an Iron Age site near Damendorf	5.Okt.1961	9
Signature illegible	Typed letter to Herr Jockisch re: pottery found during 1961 excavation	12.1.1962	1
Signature illegible	Handwritten notation from Orthopedic Shoe Expert, Herrn Clausen, that the Damendorfer shoes are approx. 25.5 cm long and a modern shoe size 38 - body size is 163-165 cm.	2001	1
			148 5/6
ILLUSTRATIONS			
	Sketches of Ruchmoor offer pit with urn	May-51	2

	Sketch map of Damendorf/Ruchmoor find site	May-51	1
	B&W photograph of 1900 body on display		1
	map of the 1934 find site (for Offa article)		1
	map of the 1934 find site		1
	B&W photos of fabric with wood, leather vessel and the wooden stake 1934		4
	B&W photo of the site (glassine envelope) 1934		1
	B&W photos of excavation 1934		4
	B&W photo of textile with sketch of weave pattern 1934		1
	sketch map of the find site of the 1947 Ruchmoor body		1
	sketch of the depth of the 1947 Ruchmoor body		1
	sketch of 1961 site excavation		1
	small B&W photos of pottery sherds/sketches mounted on 4 sides of cardboard		21

OSTERBY

AUTHOR	DOCUMENT	DATE	# OF PAGES
-	Handwritten archive listing indicating a cremation grave near the area where the body was found	-	1
-	Illustrations of Suebian knots found on sculpture, similar to that of the skull	-	1
-	Newspaper report - Kieler Nachrichten - "Wie die Germanen ihr Haar knoten"	9.7.1949	1
-	Newspaper report - Kieler Nachrichten - "Erstes Original eines swebischen Haarknotens"	19.5.1949	1/2
-	Newspaper report - Flensburger Tageblatt - "Wetvoller Moorleichenfund bei Osterby"	19.5.1949	1/2
Kersten, Karl	Newspaper report - Schleswig-Holsteinische Volkszeitung - "Der Haarknoten am Swebenschadel"	21.5.1949	1
-	Newspaper reports - "Blick in ein 2000 Jahre altes"/"Mannerkopf mit Haarknoten"		2
Bogner, Gustav	Typed report of a piece of iron found in peat on June 1, 1951	22.6.1951	1
Illegible initial (probably "K")	Typed letter to Herr Thomsen about the find of a cremation urn dating to the Iron age	11.2.1955	1/2
Juergensen, Johann Christoph	Handwritten note with detailed sketch of a bronze dagger found in 1805		1

Kersten, Karl	Der Swebenkopf von Osterby - typed summary of the unusual hair knot	-	1
Peters, B.	Typed letter to Dr. Schlabow about a future meeting in Heidelberg	23.8.1948	1
Schlabow	Handwritten report about the Osterby skull	22.11.48	1
Schlabow?	Moorleiche Osterby (Kreis Eckernforde) - handwritten report on the skull and accompanying animal hide	-	2
Schmidt, Harry	Newspaper report - Flensburger Tageblatt - "Neue vorgschichtliche Entdeckungen"		1
Schmidt, Harry	Newspaper report - Tagespost - "Einzigartiger Fund im Osterbyer Moor"	11.1.1950	1
Signature illegible	Typed note regarding the similarity of the knot on the skull to those seen on Trajan's column in Rome	29.8.1949	1/2
Signature illegible	Typed document noting the handwritten letter re: bronze dagger		1/3
Signature illegible (probably K. Kersten)	Fund einer Moorleiche im Koehlmoor am 26. Mai 1948 - typed report of the find of the skull	14.6.1948	1
Struve	Osterby- Kreis Eckernforde - typed report about a Herr Mahrt of Cuxhaven, who reported seeing another bog body at his aunt's home	-	1
Struve	Typed report and pencil sketch of a stone axe found in peat		1
Telling, Soren	Newspaper report - Jyllands-Posten - "Manden med Haarslojfen" (in Danish)	9.7.1949	2
Thomsen, Detlef	Typed note acknowledging the find of the skull	16.9.1949	1

Thomsen, Detlef	Typed report with small map and 2 small B&W photos re: Stone Age axes	13.7.1963	1
Thomsen, Thomas	Typed report of a find of a burn-site and 2 cremation urns from the same area	30.12.1953	1
van der Sanden, W.	Letter to Herr Brandt re: radiocarbon date for the Osterby skull	27.7.1995	1
Tidelski?	Handwritten letter to Dr. Kersten - possibly re: pollen profile of the site - quite difficult to read	26.7.1948	1
Signature illegible (Struve?	Typed letter to Dr. Weinart re: the skull find	13.8.1948	1
Initial only (K?)	Typed note to Albert Johannsen re: Suebian knot	6.Sept.1948	1/2
Initial only (K?)	Typed note to Herr Jessen re: reference (on back of previous note)	6.Sept.1949	1/2
Jessen, Willers	Handwritten note/postcard re: reference in "Heimat"		1/2
Signature illegible	Handwritten letter re: Suebian knot - very difficult to read	25.9.1948	1/2
Initial only (K?)	Typed note to Dr. Weinert re: arranging meeting	27.9.1948	1/2
Initial only (K?)	Typed note to Herr Thomsen re: cremation urn site	11.2.1955	1/2
Peters, B.	Typed note to Dr. Kersten re: arranging meeting with Prof. Weinert	11.11.1948	1/2
	Handwritten note in ledger re: iron lance head (KS 20807) found in peat	1951	1/3
	Handwritten ledger list of other artefacts from the area		1

	Handwritten note re: KS 22284 pot sherds: addendum (1992) indicates photo in the Mense at B74.34		1
Knuth, Dieter	Typed report and B&W photos of Stone Age tool	1971	1
Signature illegible	Typed letter from school re:collection	12.9.1975	1
			36 1/6
ILLUSTRATIONS			
	Aerial photograph of area	1939	1
	pencil sketch map of find site		1
	map of find region		1
	template of cape		3
	sketch of cape		1
	black and white photos of skull (mounted)		5
	black and white photos of skull (glassine envelope)		4
	back and white photo of cape		1
	black and white photos of sketches of skull		3
Schlabow, Karl	pastel drawing of skull	1948	1
Schlabow, Karl	pencil drawing of skull		1
	line drawings of Suebian knots on sculptures		1
Boetel?	pencil drawings of stone axe	5.5.1971	2

WINDEBY I AND II			
AUTHOR	**DOCUMENT**	**DATE**	**# OF PAGES**
Behre K.E.	Typed letter to Michael Gebuehr re: pollen dating from the site and sampling from clay pots	16.10.1979	2
Buck, Mary	Typed letter acknowledging receipt of photos and settlement of account	21.1.1954	1/2
Caselitz, P.	Typed summary of skull measurements for possible sex determination	9.12.1978	1 1/2
Caselitz, P.	Typed letter to Michael Gebuehr re: future publication of the Windeby data	15.11.1978	1
Cordes, August	Typed Letter to "Die Zeit" re: errors in recent article on the Windeby bodies	19.10.1954	1
Cox, H.L.	Typed letter to Michael Gebuehr re: lack of map of grave goods for the area	26.6.1979	1
Dittmar, Heinrich	Newspaper report - Welt am Sonntag - " 2000 Jahre lag sie so im Moor"	03-Jan-54	1
Editor, Illustrated London News	Typed letter acknowledging receipt of article and photos, which were published in the 19 Dec 1953 edition of Illustrated London News	22.12.1953	1/2
Eibsenstein, Sorry	Typed letter to acknowledge letter of 26.1.1956	30.1.1956	1/2
Falcke, R.	Typed letter from United Press Association re: Windeby photos	3.Feb.1954	1/2
Gebuehr, M.	Typed summary of conservation/radiocarbon possibilities/questions for various Iron Age samples	4.7.2002	1

Gebuehr, M.	Typed letter to Paul Koehler re: Koehler's questions on the bodies (typed on tissue paper - very difficult to read)	6.9.1976	3
Gebuehr, M.	Typed list of questions for Karl Schlabow plus typed responses from Dr. Schlabow	12.10.1978	3
Gebuehr, M.	Typed letter to Dr. Schlabow requesting additional information on the original work on the bodies	15.10.1978	1
Gebuehr, M.	Typed letter to Dr. Schlabow re: interpretation of the Windeby I body	12.12.1978	1
Gebuehr, M.	Typed list of questions for Wilczek und Hofmann re: finding of the bodies, plus typed reponses to the questions	12.12.1978	4 1/3
Gebuehr, M.	Handrwritten responses to questions posed by M Gebuehr to Wilczek and Hoffman(?) - very difficult to read - inlcudes sketch of site		2
Gebuehr, M.	Typed letter to Herr von Kameke-Streckenthin re: the peat around the bog bodies and orientation of the bodies	19.3.1979	1 1/2
Gebuehr, M.	Typed draft of paper "Das Kindergrab von Windeby: Versuch einer 'Rehabilitation'" - later published in Offa 1979		36
Gebuehr, M.	Typed list of footnotes/references and illustrations for 1979 Offa paper		19 1/2
Grootes, P.M.	Typed letter to Herr Aniol re: radiocarbon dating - sample KIA 15912 - cape hair	28.3.2002	1
Grootes, P.M.	Letter to Herr Aniol re: radiocarbon dating of samples KIA 15911, KIA 15912(Windeby I cape hair), KIA 15913 (Windeby II throat root) and KIA 15914 (Windeby I wooden pole)	21.01.2002	2

Hage?	Handwritten report/summary/commentary by Dr. Hage? - very dificult to read	9.11.1976	2
Helmer, Richard	Typed preliminary forensic comments on Windeby I and II	22.1.1979	2 1/3
Helmer, Richard	Typed report to Michael Gebuehr including ephipyseal measurements	30.8.1979	2
Helmer, Richard	Typed note to Michael Gebuehr summarising aspects of the research	8.8.1979	1/2
Helmer, Richard	Handwritten form of results of blood typing for Windeby I	24.7.1979	1/2
Helmer, Richard	Typed answers to questions from M. Gebuehr		10
Hinz, H.	Letter to Dr. Struve re: copies of photographs from Alfred Dieck (plus 2 photocopies of photogrpahs)	2.2.1977	1
Hoika, Jurgen	Typed letter to Paul Koehler providing contact information for the Textile Museum and for questions about the peat studies	11.6.1976	1
Huebener, W.	Typed letter to Michael Gebuehr with comments on manuscript	18.4.1979	1 1/2
Johnston, George H.	Typed letter to Professor Kersten: re photos used by Illustrated London News	30.12.1953	1
Johnston, George H.	Typed letter to Professor Kersten re: Windeby I photos	15.1. 1954	1
Jokisch	Handwritten note to Professor Kertsen(?) about the find (very difficult to read)	10.3.1956	1
Jokisch	Typed summary of the finds	14.3.1953	1
Kertsen, K.	Typed letter to Australian George Johnston re: photographs for Australian newspaper article	13.1.1954	1
Koehler, Paul	Typed letter to Dr. Gebuehr with comments on bog	27.5.1979	2

	bodies		
Koehler, Paul	Typed letter to Michael Gebuehr re: illustrations of the poles with the Windeby I body	17.6.1979	1
Koehler, Paul	Typed letter to Dr. Schlabow re: questions about the bog body publication	20.6.1976	2
Koehler, Paul	Typed letter to Dr. Schlabow re: questions about the bodies	4.Sept.1976	2
Koehler, Paul	Typed letter to Dr. Schlabow re: questions about the bog body publication (copy of letter very faded in parts and difficult to read)	4.Aug.1977	2
Koehler, Paul	Typed letter to Dr. Schlabow re: questions about the bog body publication (copy of letter very faded in parts and difficult to read)	20.12.1976	1 1/3
Koehler, Paul	Typed letter to Dr. Schlabow re: previous article on bog bodies	11.Juni.1979	1
Koehler, Paul	Typed letter to Michael Gebuehr re: comparison of Windeby and Datgen bodies	16.12.1976	1
Koehler, Paul	Typed letter to J. Wilczek re: the crossing of the wooden poles of Windeby I	14.12.19?	3
Koehler, Paul	Typed letter to Dr. Hoika with questions about the 1958 article	4.6.1976	2
Koehler, Paul	Typed letter to Dr. Hoika with questions about the 1958 article and the bog bodies	28.8.1976	2
Koehler, Paul	Typed letter to Dr. Hage with questions about the Windeby child (letter incomplete)	25.8.1976	1
Koehler, Paul	Typed letter to Dr. Hage with comments about the bog bodies	4.Okt.1976	1

Koehler, Paul	Typed letter to Dr. Schlabow re: earlier bog body article (plus pelvis diagram for male/female)	2.Juli.1979	2 2/3
Koehler, Paul	Typed letter to Michael Gebuehr re: photos of the Windeby I body	3.August.1979	1/2
Schlabow, Karl	Typed letter to Professor Sprockhoff re: publication on the Windeby bodies	25.11.1953	1
Schlabow, Karl	Typed letter to Paul Koehler - in response to questions from Herr Koehler about the 1958 publication	12.7.1979	1
Schlabow, Karl	Typed letter to Michael Gebuehr re: original documentation about the Windeby bodies	19.12.1978	1
Schlabow, Karl	Typed letter to Paul Koehler re: additional details on the bodies	31.12.1976	1
Schlabow, Karl	Typed letter to Paul Koehler re: additional details on the bodies	23.9.1976	1
Schlabow, Karl	Typed letter to Paul Koehler re: specific points about the bodies	14.8.1976	1
Schlabow, Karl	Typed letter to Paul Koehler re: specific points about the bodies	8.7.1976	1 1/2
Schlabow, Karl	Typed letter to Paul Koehler re: earlier bog body article	16.Juni.1979	1 1/2
Schlabow, Karl	Typed edited pages for 1958 article	16.10.1954	4
Schmidt, Max	Typed letter to Dr. Struve providing more details of the peat company	8.4.1956	1
Schmidt?	Typed letter to Australian George Johnston re: photographs for Australian newspaper article	19.1.1954	1
Signature illegible	Typed report of cremation urn found in Grote Moor	1909	1
Signature illegible	Typed note to Lehrer Thomsen re: a previous urn find (typed on tissue paper)		1

Signature illegible - Jokisch?	Typed summary of the finds	20.10.1953	1
Signature illegible - Schmidt?	Typed note to "The Times" re: examples for article	26.1.1954	1/2
Signature illegible - Schmidt?	Typed note to "The Life" re: examples for article	26.1.1955	1/2
Signature illegible - Schmidt?	Typed note to Fr. Falcke of United Press re: examples for article.	26.1.1956	1/2
Signature illegible (address matches P. Koehler)	Typed letter to Karl Schlabow with questions about te 1958 publication	2.7.1979	2
Signature illegible (Studienrat) - Jokisch?	Typed summary of the finds	14.3.1953	2/3
Struve	Typed letter to Frau Studenratin Steen re: summarising the find and explaining the possibility of obtaining stomach contents from some bodies (typed on tissue paper - difficult to read)	16.10.1968	3 1/2
United Press Association, Hamburg	Typed letter to Dr. Schwabedissen with questions about the bodies following a telephone call	26.11.1953	1
van der Sanden, Wijnand	Brief handrwritten note to Michael Gebuehr regarding the radiocarbon dates for the body (in English)	Oct-02	1/2
von Hagen, Heinrich-Otto	Typed letter to Michael Gebuehr with references pertaining to the microscopic examination of mummifed tissue	19.1.1979	1
Wilczek, J.	Typed summary of find	15.5.1953	1
Wilczek, J.	Typed comment on peat surrounding bodies	5.6.1952	1/2
	Radiocarbon dating report - KIA 15912 - cape hair	2002	1

	Radiocarbon dating report - KIA 15123 - left femur - mid-diaphysis	2002	1
	1:250 sketch of find location of body	20.2.80	1
	Typed summary of Schleswig-Holstein bog bodies (not complete) - early draft of a publication?		1
	Typed list of people involved in excavation and examination of bodies		1
	Newspaper report - Lubecker Freie Presse - "Menschentragadie vor 1900 Jahren"	4.11.1953	1
	Radiocarbon dating report - KIA 15913 - wood/root around throat	2002	1
	Typed summary of events during discovery and excavation		1
	Typed report identifying the basics of the peat company and the find		1/2
	Reference page - notes that the X-rays of the Windeby II body can be found in the "hanging page closet" - separate from the file		1/3
	handrwitten archive ledger of the finds		2
	handwritten list of questions for forensic medicine investigations		1
	Dot-matrix computer printout of skull measurements		1
	Handwritten archive records listing finds from the area (some very difficult to read)		8
	Typed letter to Herr Schmidt (incomplete)	13.3.1956	1/2
	Handwritten summary of blood typing from hair		1/2

	Typed list of photos taken at time of excavation and discovery (1-31, Windeby I and 32-44 Windeby II)		1
	Typed letter to United Press Association answering questions about the bodies	26.11.1953	1
	typed note to J Wilczek re: clay vessels found with Windeby I	9.9.1959	1/3
	Newspaper report - Das Stern - "War sie eine Ehebrecherin?"	15.11.1953	2
	Typed list of photos/captions used by the Illustrated London News	19.12.1953	1
	Copy of illustrated London News article	19.12.1952	1
	Typed letter to Illustrated London News re: recent article	14.1.1954	1
Signature illegible	Typed document - appears to be answers to a series of questions about the Windeby I and II and pottery	22.12.1976	1
Initials only (CW?)	Handwritten file note - faded and difficult to read	2.8.1979	1
Initials only (PK?)	Handwritten file note - faded and difficult to read	2.8.1979	1/3
	Handwritten file note - questions re: Windeby I		1
Vierck, H.	Typed letter to Michael Gebuehr re: Offa publication	2.2.1982	1
	Typed summary of bog bodies in Schleswig-Holstein - translation of London Evening News article?		1 1/2
Gebuehr, M.	Typed letter to Herr Bernhard/Herr Kaufmann re: short story on the Windeby Girl	15.10.1996	1
Bernhard, Ruprecht	Typed letter and short story about the Windeby Girl	3.10.1996	5
Signature illegible	Typed report of a find of a wooden artefact (KS19833) from the site with sketch map, plus separate illustration of object	23.12.1950	2

	Newspaper report - Norddesutsche Rundschau - "Unter gekreutzen Birkenstaeben" - re: Windeby bodies		2
Hellmann, Hans-Dieter	Newspaper report - The German Tribune - "2,000-year-old moors give up their bodies but not their secrets"	05.Dec.1982	2
Signature illegible	Handwritten letter reporting the find of a cow horn in peat (KS 21544)	26.10.1954	1/2
WINDEBY ILLUSTRATIONS			212 1/3
	photographs - Windeby I		22
	photograph of Windeby I X-ray of hand		1
	photograph of Windeby I X-ray of tibia showing (Harris Lines)		2
	photographs of Windeby I excavation (glassine envelope)		6
	Large colour photo of Windeby hand after conservation		1
	mounted B&W photos (Windeby body)		10
	mounted B&W photos of excavation of Windeby I and II		44
	mounted photos of Windeby I excavation (5 photos on 1 page)		1
	Black and white copy of sketches of Windeby I		2
	Outline sketch of Windeby body and clay vessels - location diagramn		1

	sketch of Windeby I skeleton to show body position and position of clay vessels		1
	site sketches		3
	sketches of Windeby I body		2
	Large surveyors map of area		1
	map of site showing location of bodies	1952	1
	sketch of Windeby II body		1
	small sketches of Windeby I body and hand		2
SHELL MIDDENS			
WINDEBYER NOOR	**MUSCHELHAUFEN**	**1904/1905**	
Rothmann	original handwritten excavation notes and sketcher (in envelope) - quite delicate (27 pages of notes in old style calligraphy, 5 maps, 1 sketch) - notes virtually illegible	1904/1905	33
	colour sketch map of site		1/2
Jessen, Willers	Handwritten letter to the "Professor" - virtually illegible	25.3.1904	1
Jessen, Willers	Handwritten letter to the "Professor" - virtually illegible	10.4.1904	1
Rothmann	Handwritten letter to W Jessen - virtually illegible	27.4.1904	1/2
Jessen, Willers	Handwritten letter to museum - virtually illegible	2.6.1904	2
Reimers, J.	Handwritten letter to Herr Rothmann	27 Mai 1904	1
Reck?	Handwritten abschrift - report of the find	3 Juni 1904	1 1/3
Reck?	Handwritten abschrift - report of the find (same basic info as above)	3 Juni 1904	1 1/3
Document 113a	Handwritten note documenting previous correspondence		1/2
Document 113b	General notes about previous correspondence		1/2

Illegible signature - Koenigeiche Museen, Berlin	Brief handwritten note - illegible	3. Juni 1904	1/2
Kock	Plain postcard in tiny handwritten script - addressed to Herr Rothmann - regarding a find of wood in the same area	12.6.04	1/3
Signature illegible - Der Regierungs-Praesident	Typed letter regarding the need for further investigation and mention of a coin	16 Juni 1904	1
Signature illegible - Luebeck	Handwritten letter to Professor Rothmann - very difficult to read	2.Juli.1904	2
Signature illegible	Handwritten letter to Professor Rothmann - illegible	1904	2
Signature illegible but the same as previous document - Chemisches Laboratorium - Berlin	Handwritten letter to Professor Rothmann - illegible	9 Marz 1905	1/2
Rothmann?	Handwritten note on the back of previous document - discusses the problems with transport	15 Marz 1905	1/2
Signature illegible (Berlin)	Handwritten letter - mainly illegible - a few words could be identified	27 Marz 1905	3
Signature illegible - possibly by Johanna Mestorf	Handwritten note on back of previous document - tiny script - completely illegible	31 Marz 1905	1
Voss?	Handwritten letter from Koeniglichen Museem fur Volkerkunde acknowledging correspondence	29 Marz 1905	1
-	Newspaper clipping - newspaper not identified	-	1/3
Jessen, Willers	Newspaper clipping - "Ueber die Muschelhaufen am Windebyer Noor" - Eckernforde Zeitung ((Jessen 1904a)	25. Juni 1904	1

-	Newspaper clipping (small) - on same page as previous clipping - from Kieler Zeitung	27 Juni 1904	1/2
-	Handwritten documents - illegible - although the name of Danish publishers and some dates (book/article references on same subject?) can be identified		4 1/3
			60 2/3
	Assorted photographs		33
	Diagram of shell midden	Apr-04	1
-	Large sketch maps of site and midden		4

Daetgen

AUTHOR	DOCUMENT	DATE	# OF PAGES
-	Typed report of discovery	-	1
-	Typed summary of methods of conservation	12.7.1961	1
-	List of finds from the region	-	1
-	Typed summary of discovery of head	-	1
-	Typed summary of clothing	-	1
-	Newspaper report - Flensburger Nachrichten ("Ein aussergewohnlicher Fund")	1959	1
-	Newspaper report - Kiel Nachrichten ("Suebenknoten als Haartract")	-	1
-	Newspaper report - Neustaedter Tageblatt ("Vor 2000 Jahren hingerichtet")	11.12.1960	1
-	Newspaper report - Chronik ("Vor annahernd 2000 Jahren hingerichtet")	1960	1
-	Typed letter to Albert Ketelsen regarding the construction of a display case	16.2.1965	2
Aletsee, L.	Typed letter to Dr. Struve re: pollen sampling	7.3.1961	1/2
Aletsee, L.	Typed postcard to Dr. Struve re: pollen sample	7.4.1961	1/4
Aletsee, L.	Typed letter to Dr. Struve about possible pollen analysis for the Daetgen find	20.19.60	1
Aletsee, L.	Typed letter to Dr. Struve about a recent publication on the body	15.10.1968	1
Aletsee, L.	Typed letter to Dr. Struve regarding C14 dating of skin and bone samples in Kiel	19.2.1968	1

Aletsee, L.	Typed letter to Dr. Struve regarding the status of pollen analysis and C14 dating	20.9.1964	1
Doose, J.W.	Handwritten letter to Herr Rothman - very difficult to read		1/2
	Typed transcription of original letter (No. 149/06)		1/3
Hopf, Maria	Letter to Dr. Struve about possible stomach content analysis of the body	21.4.61	1
Ketelsen, Albert?	Handwritten note - possibly about conservation of body (very difficult to read)	25.9.1961	1
Kuehl, I.	Handwritten report on body	15.12.1966	4
Kuehl, I.	Handwritten summary of estimation of stature		1
Martin, O.	Typed first draft of article (later to appear in "Offa")	-	5
Martin, O.	Typed letter to Dr. Struve re: samples for stomach content examination	28.4.1961	1
Mestorf, J.	Handwritten note and sketches of original report on textiles (1906)		2
	Typed transcription of original summary report on textiles	-	2
Struve, K.	Handwritten report of discovery	-	1
Struve, K.	Letter summary to the Kriminaltechnische Institut in Wiesbaden - description of discovery	14.4.61	2
Struve, K.	Typed letter to Alfred Dieck re: the find of the Daetgen body	4.Januar.1960	1
Struve, K., parts by Aletsee, L. and Martin, O.	Typed draft manuscript for 1967 Offa article		49

Struve, K:, parts by Aletsee, L. and Martin, O.	Typed revised draft manuscript for 1967 Offa article		51
Struve	Typed list of references for 1967 Offa article		16
Struve, K.?	Typed letter to L. Aletsee regarding a future publication on the Daetgen body	15.9.1964	1
Weber, H.H.	Typed letter to Dr. Struve thanking Dr. Struve for the copy of the publication	23.9.1968	1
Rothmann?	Handwritten report of the discovery of clothing and hair on 31.5.1906	10.7.1906	
	Newspaper report - ("Moorleiche gefunden") - source unknown	9.9.1959	1/4
Schiebler, T.H. and Schaefer, U.	Copy of "Neue Moorleichenfunde in Schleswig-Holstein" from UMSCHAU	Aug-61	2
	Newspaper report - ("Moorleiche ein aussergewoehnlicher Fund) - source unknown		1/3
Scheibler, T.H.	Letter to Professor Kersten re: UMSCHAU article	14.8.1961	1/2
Initial only (K?)	Letter to Professor Schiebler re: receipt of UMSCHAU article	21.8.1961	1
	Newspaper report ("Bei Schuelp: Moorleiche gefunden") - source unknown	1960	1/4
	Newspaper report ("Ein Hingerichteter?") - source unknown		1/4
Hermann, B.	Copy of "Das Raster-Elektronenmikroskop als Hilfsmittel anthropologischer Untersuchungen" - article	1974	10
	Note that the bulk of the file for the 1959 bog body can be found in Paternoster 4, Karton 16		1/4

	field notes and large map in envelope - Iron Age settlement by Daetgen (field notes illegible)		10
Schaefer	handwritten report for 1969 excavation of Iron Age site near Daetgen	Apr-69	2
	Typed report of 1969 excavation of Iron Age site near Daetgen	Feb-70	11
	Typed report of the Iron Age cremation urns found near Daetgen (LA 18)	Sep-76	2
	Typed list of contents of file from LA18		1/2
Schaefer, G.	Handwritten note re: find of cremation urns	14.9.1976	1/2
Schaefer, G.	Handwritten note re: find of cremation urns	14.9.1976	1/2
	Typed list of urns and contents		1/2
Schaefer, G.	Typed report of discovery of cremation urns	Sep-76	2
	Typed list of the bog bodies from Schleswig-Holstein, info taken from Dieck (1965)		5
	Typed page with summary of find "Zusammenfassung"		1
	Handwritten notes - appears to be early draft of an article - quite difficult to read		5
Struve, K.	Typed letter to Dr. Martin re: stomach content analysis	5.5.1961	1
Martin, O.	Typed letter to Dr. Struve re: stomach content analysis	15.8.1961	1
Struve, K.	Typed letter to Dr. Martin re: stomach content analysis	30.8.1961	1
Martin, O.	Typed letter to Dr. Struve re: stomach content analysis	28.3.1962	1
Struve, K.	Typed note to Professor Schiebler re: questions about the body	16.3.1962	1/2
Initial only (illegible)	Typed letter to Dr. Schaefer re: manuscript	16.3.1962	1/2
Schiebler, T.H.	Typed letter to Dr. Struve re: previous letter	30.3.1962	1/2

Struve, K.	Typed letter to Dr. Martin re: stomach content analysis	9.4.1962	1 1/2
Martin, O.	Typed letter to Dr. Struve re: stomach content analysis	5.5.1962	1
Signature illegible (Struve?)	Typed letter to Dr. Aletsee re: pollen analysis	15.9.1964	1
Aletsee, L.	Typed letter to Dr. Struve re: dating of the body	29.9.1964	1
Signature illegible (Struve?)	Typed letter to Albert Ketelsen re: conservation	16.2.1965	1 1/2
Initial only	Typed note to Dr. Struve with small B&W photo of Maranao woman from the Philippines with hair knot similar to Suebian knot	21.9.1965	1
Signature illegible	Typed file note reporting that two pieces of skin were sent to Professor Hermann in Goettingen for research in bog body conservation methods	15.5.1981	1/2
Hermann, B.	Typed letter to Michael Gebuehr requesting a piece of bog body skin	6.5.1981	1/2
Henssge	Typed letter to Dr. Kuehl re: X-rays	3.10.1966	1
Gill-Robinson, H.	Copy of e-mail to Dr. Bernd Herrmann, re: data from two skin samples sent to Goettingen in 1981	30-Oct-03	1/2
Hermann, B.	Copy of e-mail response to H. Gill-Robinson re: skin samples	30-Oct-03	1/2
			226
ILLUSTRATIONS			
Orthop. Universitatsklinik Kiel	Long photographs of vertebrae RE12 (P3 E7)	-	2 photos

-	colour photo slides (Paternnoster 6, E11, Karton "Dias Moor/Moorliechen")	-	6 slides
	sketch map showing location of 1906 find (part of handwritten report listed above)		1
	B&W photographs of the body		1
	outline map of find sites for 1906 and 1959 finds		1
	Negatives for 5 photos of Iron Age cremation urn site		5
	site diagrams/feature diagrams	1969	40
	large map of Autobahn extension showing location of Iron Age settlement site (does not relate towns)	29.7.1968	1
	B&W photographs (with negatives) of Iron Age settlement site	Apr-69	29
	maps of area showing location of site		2
Schaefer, G.	map of cremation urn site	15.9.1976	1
	negatives only (for B&W photos) - possibly from body excavation		13
	small B&W photo - possibly of body excavation		1
	1:10 partial sketch of body in the peat		1
	sketch of general site showing section where body found		1
	B&W photographs of the body and excavation		27

Kühsen			
AUTHOR	**DOCUMENT**	**DATE**	**# OF PAGES**
Struve, K.W.	Typed report on the Kuehsen skeleton	12.5.60	2
Ulbricht, I.	Typed letter to Professor Kunter, Giessen regarding the skull of the Kuehsen skeleton	25.3.93	1
Struve, K.W.	Typed letter to Professor Schaefer regarding possible anthropological analysis of the skeleton	16.3.1966	2
Kuhl, I.	Handwritten letter to Professor Schaefer - questions about the Kuehsen skeleton	5.7.1965	2
	Handwritten lists of artefacts excavated from site near Kuehsen - difficult to read (includes small photos of some artefacts)	1958	3
			10
Struve, K.W.	5 small black and white photos of excavation of the skeleton	1960	1
Kersten, Karl	sketches of stone artefacts		3

APPENDIX C: List of publications mentioning or discussing the bog bodies in this research

Rendswühren
Buell 1997
Coles and Coles 1989
Cordes 1965
Dieck 1965
Fischer 1998
Gebühr 2002
Glob 1969
Handelmann and Pansch 1873
Hänsel 2000
Lund 2002
Menon 1997
Schlabow 1976c
van der Plicht et al. 2004
van der Sanden 1995b, 1996
Virchow 1871
von Haugwitz 1993 (unpublished dissertation)

Damendorf (1900)
Bahn 2003
Bauermeister 1938
Brothwell 1986
Brothwell and Gill-Robinson 2002
Buell 1997
Coles and Coles 1989
Cordes 1960, 1965
Dieck 1965
Fischer 1998
Gebühr 2002
Hirsch and Schlabow (1958)
Jankuhn 1938, 1958
Schlabow 1938, 1951, 1976c
Stettiner 1911
Tidelski 1938
Turner and Briggs 1986
van der Plicht et al. 2004
van der Sanden 1995b, 1996
von Haugwitz 1993 (unpublished dissertation)

Osterby
Bahn 1997
Beuker 2002
Buell 1997

Coles and Coles 1989
Deem 1998
Dieck 1965
Fischer 1998
Gebühr 2002
Jankuhn 1958a
Kersten 1948, 1949
Lund 1976, 2002
Schlabow 1948, 1949, 1976c
Schütrumpf 1958
Turner and Briggs 1986
van der Plicht et al. 2004
van der Sanden 1995 b, 1996
von Haugwitz 1993 (unpublished dissertation)

Windeby I and/or II
Aldhouse Green 1999
Aldhouse Green 2001b
Bahn 1997
Berg et al. 1981
Beuker 2002
Buell 1997
Caselitz 1979
Chamberlain and Parker Pearson 2001
Coles and Coles 1989
Deem 1998
Dieck 1965
Fischer 1998
Gebühr 1979, 2002
Grüner 1979
Hage 1958
Hänsel 2000
Helmer 1979a
Jankuhn 1958b
Lund 1976, 2002
Menon 1997
Parker Pearson 1999
Reid 1999
Schäfer 2003
Schaefer 1954, 1958, 1961
Schlabow 1958a, 1958b, 1958c, 1976c
Schlabow and Hage 1958
Schütrumpf 1958
Spatz et al. 1958
Turner and Briggs 1986
van der Plicht et al. 2004

van der Sanden 1995b, 1996
von Haugwitz 1993 (unpublished dissertation)
Williams 2003

Dätgen
Aletsee 1967
Beuker 2002
Chamberlain and Parker Pearson 2001
Coles and Coles 1989
Cordes 1960
Deem 1998
Dieck 1965
Fischer 1998
Hänsel 2000
Herrmann 1974
Ketelsen 1966
Lund 2002
Martin 1967
Schaefer 1961
Schlabow 1976
Stettiner 1911
Struve 1961b, 1964, 1967
van der Plicht et al. 2004
van der Sanden 1995b, 1996
von Haugwitz 1993 (unpublished dissertation)
Williams 2003

Kühsen
Dieck 1965
Schaefer 1961
Struve 1964
von Haugwitz 1993 (unpublished dissertation)

APPENDIX D: Windeby I Osteometrics

Maxmimum cranial length (g-op)	18 (spreading)
Maximum cranial breadth (eu-eu)	12.9 (spreading)
Bizygomatic diameter (zy-zy)	10.9 (spreading)
Basion-bregma height (ba-b)	13.3 (spreading)
Cranial base length (ba-n)	9.7 (spreading)
Ba-pr	8.4 (spreading)
Ecm-ecm	5.4 (spreading)
Pr-alv	42 mm
Au-au	102 mm
n-pr	11 mm (error??)
ft-ft	84 mm
fmt-fmt	102 mm
n-ns	48 mm
al-al	17 mm
d-ec (L)	35 mm
d-ec (R) – due to asymmetry	37 mm
orbital height (L)	33 mm
orbital height (R)	33 mm
ec-ec	85 mm
d-d	20 mm
n-b	111 mm
b-l	109 mm
l-o	93 mm
ba-o	40 mm
foramen magnum breadth	30 mm
mastoid length	22 mm
id-gn	25 mm
height of the mandibular body	20 mm
breadth	6 mm
go-go	62 mm
cdl-cdl	101 mm
maximum ramus breadth	33 mm
minimum ramus breadth	24 mm
mandibular ramus height	49 mm
mandibular length	N/A – no mandibulometer
mandibular angle	N/A – no mandibulometer

Windeby I post-cranial metrics	
Scapula (right)	
Height (anatomical breadth)	137 mm
Breadth (anatomical height)	76 mm

Humerus (right)	
Maximum length	29 cm
Epicondylar breadth	50 mm
Vertical diameter of head	42 mm
Maximum diameter at midshaft	14 mm
Minimum diamenter at midshaft	11 mm
Radius (right)	
Maximum length	20.7 cm
Anterior-posterior (sagittal) diameter at midshaft	8 mm
Medio-lateral (transverse) diameter at midshaft	10 mm
Ulna (right)	
Maximum length	23.4 cm
Anterior-posterior (dorso-volar) diameter	8 mm
Medial-lateral (transverse) diameter	11 mm
Physiological length	20.6 (spreading)
Minimum circumference	9 mm
Os Coxae (right)	
Height	18.5 (spreading)
Illiac breadth	13 (spreading)
Pubis length	75 mm
Ischium length	70 mm
Femur (right)	
Maximum length	43 cm
Bicondylar length	41.3 cm
Epicondylar breadth	70 mm
Maximum head diameter	40 mm
Anterior-posterior (sagittal) subtrochanteric diameter	40 mm
Medial-Lateral (transverse) subtrochanteric diameter	26 mm
Anterior-posterior (sagittal) midshaft diameter	19 mm
Medial-lateral (transverse) midshaft diameter	18 mm
Midshaft circumference	61 mm
Tibia (right)	
Length	N/A (no epiphsyes)
Maximum proximal epiphyseal breadth	N/A (no epiphyses)
Maximum distal epiphyseal breadth	N/A (no epiphyses)
Maximum diameter at nutrient foramen	23 mm
Medial-laterial (transverse) diameter at nurtrient foramen	26 mm
Circumference at the nutrient foramen	72 mm

Fibula (right)	
Maximum length	298 mm
Maximum diameter at midshaft	11 mm

APPENDIX E: Kühsen Osteometrics

Maxmimum cranial length (g-op)	15.7 (spreading)
Maximum cranial breadth (eu-eu)	10 (spreading)
Bizygomatic diameter (zy-zy)	11.5 (spreading)
Basion-bregma height (ba-b)	12.7 (spreading)
Cranial base length (ba-n)	10.5(spreading)
Ba-pr	15.4 (spreading)
Ecm-ecm	5.5 (spreading)
Pr-alv	48 mm
Au-au	101 mm
n-pr	58 mm
ft-ft	93 mm
fmt-fmt	97 mm
n-ns	43 mm
al-al	19 mm
d-ec (L)	33 mm
orbital height (L)	29 mm
ec-ec	86 mm
d-d	24 mm
n-b	106 mm
b-l	101 mm
l-o	N/A (no opisthion)
ba-o	N/A (no opithsion)
foramen magnum breadth	N/A (no opithsion)
mastoid length	18 mm
id-gn	23 mm
height of the mandibular body	24 mm
breadth	9 mm
go-go	86 mm
cdl-cdl	98 mm
maximum ramus breadth	36 mm
minimum ramus breadth	33 mm
mandibular ramus height	53 mm
mandibular length	N/A – no mandibulometer
mandibular angle	N/A – no mandibulometer
Windeby I post-cranial metrics	
Scapula (left)	
Height (anatomical breadth)	N/A
Breadth (anatomical height)	N/A
Humerus (left)	
Maximum length	29 cm

Epicondylar breadth	48 mm
Vertical diameter of head	N/A
Maximum diameter at midshaft	16 mm
Minimum diamenter at midshaft	13 mm
Radius (left)	
Maximum length	N/A
Anterior-posterior (sagittal) diameter at midshaft	11 mm
Medio-lateral (transverse) diameter at midshaft	9 mm
Ulna (left)	
Maximum length	N/A
Anterior-posterior (dorso-volar) diameter	11 mm
Medial-lateral (transverse) diameter	9 mm
Physiological length	N/A
Minimum circumference	34 mm
Os Coxae (left)	
Height	16.2 (spreading)
Illiac breadth	12.2 (spreading)
Pubis length	79 mm
Ischium length	69 mm
Femur (left)	
Maximum length	39.3 cm
Bicondylar length	N/A
Epicondylar breadth	N/A
Maximum head diameter	39 mm
Anterior-posterior (sagittal) subtrochanteric diameter	21 mm
Medial-Lateral (transverse) subtrochanteric diameter	26 mm
Anterior-posterior (sagittal) midshaft diameter	19 mm
Medial-lateral (transverse) midshaft diameter	22 mm
Midshaft circumference	61 mm
Tibia (left)	
Length	N/A (no epiphsyes)
Maximum proximal epiphyseal breadth	N/A (no epiphyses)
Maximum distal epiphyseal breadth	N/A (no epiphyses)
Maximum diameter at nutrient foramen	25 mm
Medial-laterial (transverse) diameter at the nurtrient foramen	21 mm
Circumference at the nutrient foramen	70 mm
Fibula (left)	
Maximum length	N/A
Maximum diameter at midshaft	31 mm