ANCIENT EUROPE

8000 B.C.–A.D. 1000

ENCYCLOPEDIA OF THE BARBARIAN WORLD

Peter Bogucki & Pam J. Crabtree

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VOLUME I

THE MESOLITHIC TO COPPER AGE

(C. 8000–2000 B.C.)

Peter Bogucki & Pam J. Crabtree

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Ancient Europe 8000 B.C.–A.D. 1000: Encyclopedia of the Barbarian World

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PREFACE

When we were originally approached by Scribners to consider editing this encyclopedia, our motivations for accepting this challenge were identical. We were both keenly aware of the lack of authoritative yet comprehensive information on European archaeology written for the general readership. In particular, we knew that many high school, college, and public libraries have very limited holdings in this area, and we wanted to fill this gap.

Although European prehistory stretches back hundreds of thousands of years to the original colonization of the Continent by *Homo erectus* populations from Africa, we chose to focus this encyclopedia on the period after the retreat of the Ice Age glaciers. These are the critical millennia during which the foundations of later European society known from later historical accounts were established. The Gauls encountered by Caesar, the Celts, the Germans, the Visigoths, and all the other European peoples whom we see hazily through the lens of Classical authors had ancestors whom we know only from archaeology. Moreover, outside the view of the Classical authors, peoples in northern and eastern Europe continued to live prehistoric lives well after written records are available for much of western and southern Europe.

The boundary dates for this encyclopedia were chosen deliberately. Although the Ice Age had ended a millennium or more earlier, the postglacial hunting and gathering societies that had become well-established by 8000 B.C. in many parts of Europe define the beginnings of continuous sequences of cultural development. Tracing such long-term patterns of social and economic change is one of the major intellectual contributions of archaeology. Extending our coverage to A.D. 1000 allows us to encompass the societies that followed the Roman domination of western Europe and the peoples of eastern and northern Europe lying outside the Roman frontiers during the first millennium A.D. Around A.D. 1000, institutionalized governments organized on territorial principles were established in eastern Europe and Scandinavia, and the resultant emergence of written records effectively ends prehistory in these areas.

In choosing contributors, we invited colleagues who are active researchers and who are among the authorities on their specific regions, topics, and periods. Archaeologists and prehistorians normally write for an audience composed of fellow scholars, so writing for a non-specialist readership can pose a challenge. We would like to commend our contributors for writing such splendid essays that explain what happened between about 8000 B.C. and A.D. 1000 across Europe so clearly and lucidly. Archaeologists are also unusually busy people, and we are grateful that they were able to compose their entries on a very short (in the academic world) schedule. Many of these essays were written by colleagues preparing to depart on excavation projects or having just returned from the field.

This encyclopedia is divided into seven sections. The first contains introductory essays on important concepts in archaeology, with specific reference to European prehistory, while the six that follow divide the sequence of cultural developments into major periods: Mesolithic hunters and gatherers, the first Neolithic farmers, developed Late Neolithic farming societies, stratified societies of the Bronze Age, Iron Age towns and trade, and the peoples of the Migration period and Early Middle Ages. Throughout we have included separate articles on key archaeological sites, chosen from among thousands of sites throughout Europe because they are typical for the period being discussed or have particularly informative remains. A glossary provides definitions of key terms, while a detailed index serves as a guide to important topics. Chronological charts and maps in each volume give the reader a way of quickly becoming oriented in time and space.

The task of inviting, persuading, cajoling, and hounding all these contributors fell to Alja Collar of Scribners, without whom this encyclopedia would not have been possible. Alja was firmly and resolutely at the helm as she steered this book in only a year from invitation to completion. We are completely indebted to her. We are also grateful to Cindy Clendenon and Shawn Corridor, who helped coordinate the illustrations and maps that are essential elements of this encyclopedia. Sharon Malinowski played an important role in the initial stages of planning and invitation.

It is important for us to recognize the role of Kathy Moreau in the initiation of this project. Kathy encouraged us to develop the plan for the encyclopedia and brought us to New York to meet John Fitzpatrick, senior editor at Charles Scribner's Sons. The enthusiasm of Kathy and John for this project led us to move quickly to develop the list of topics and contributors.

Since we both have demanding professional responsibilities at our respective institutions, much of the time that we devoted to this encyclopedia was extracted from our family lives. Our spouses, Doug Campana and Virginia Bogucki, were generously understanding, as were our children Mike, Tom, and Robert Campana and Caroline and Marianna Bogucki.

Finally, it is our understanding that Bernard Wailes, professor emeritus of anthropology at the University of Pennsylvania, played a key role in pointing Kathy Moreau in our direction. Bernard played a key role in both of our careers in archaeology, not only by transferring to us some small part of his encyclopedic knowledge but also by instilling in us a passion for studying ancient Europe. We would like this encyclopedia to honor our teacher, mentor, colleague, and friend, Bernard Wailes.

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OCTOBER 2003

MAPS OF ANCIENT EUROPE, 8000–2000 B.C.

Human geography is an essential dimension of archaeology. The locations that ancient people chose for their settlements, cemeteries, and ritual activities are very important for understanding how European societies developed and declined.

Archaeological sites are found throughout Europe. The maps on the following pages show the locations of selected sites mentioned in the text and give an overview of their distribution on a large scale. Smaller and more detailed maps accompany many specific articles.

For clarity, we have divided Europe into five major regions: Northwestern Europe, which covers the British Isles and nearby portions of the Continent; Northern Europe, which includes the North European Plain and Scandinavia; Southwestern Europe, the Iberian Peninsula and the lands around the western Mediterranean; Southeastern Europe, which includes the Danube Basin and Greece; and Eastern Europe, the area east of the Bug River and the Carpathians. Areas beyond these maps, such as the Caucasus and Cyprus, are covered in smaller maps in the relevant articles.

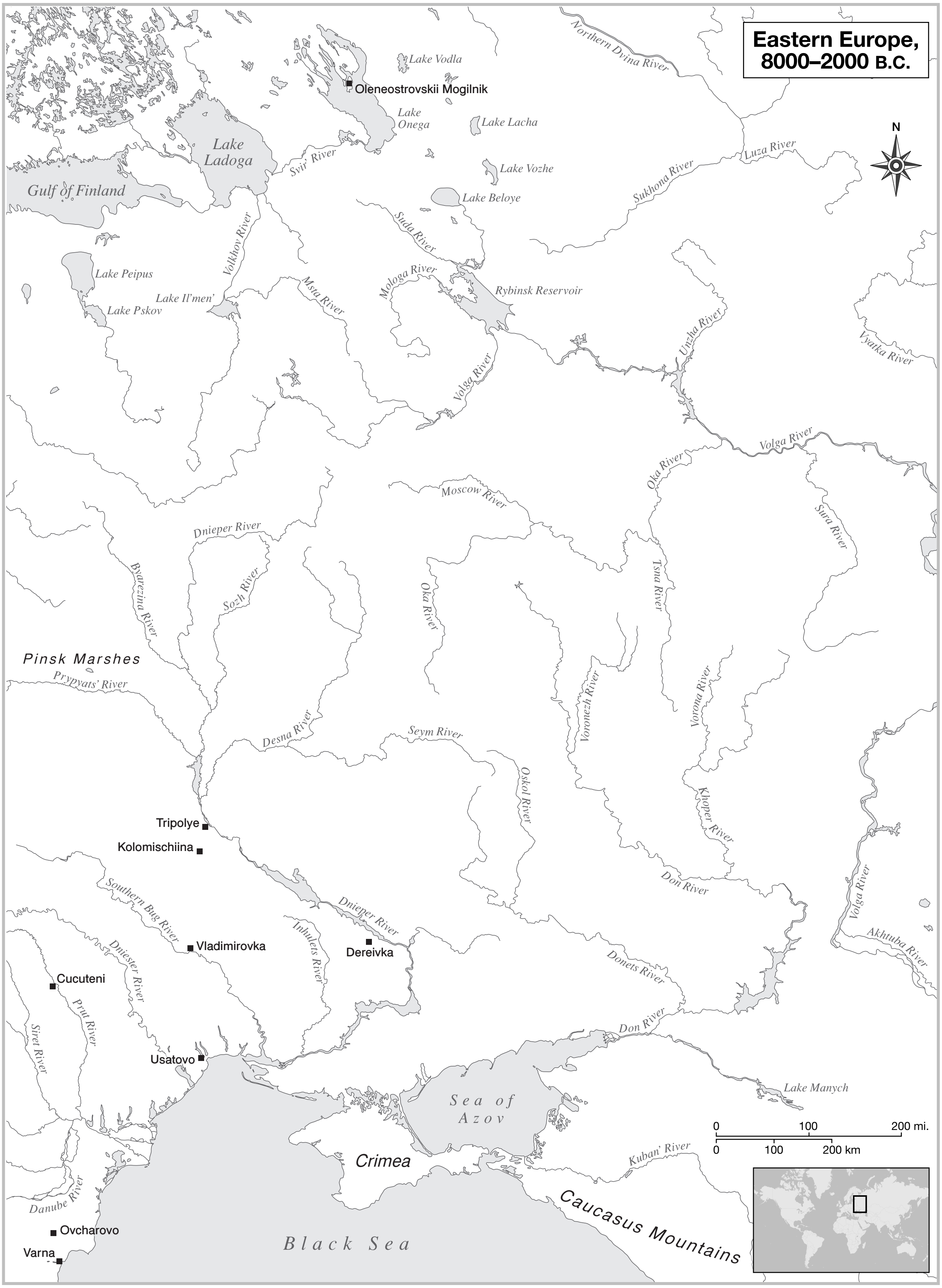
Maps in this volume cover some of the sites mentioned in parts 1 through 4, primarily from the hunter-gatherers of the Mesolithic to the farmers of the Late Neolithic and Copper Age.


Northwestern Europe and the British Isles, 8000–2000 B.C.
0 100 200 mi.
0 100 200 km
Norwegian Sea
Faroe Islands
Shetland Islands
Barnhouse
Skara Brae
Orkney Islands
ATLANTIC OCEAN
Outer Hebrides
Balbridie
Oronsay
Firth of Forth
North Sea
Mt. Sandel
River Bann
Carrowmore
Carrowkeel
Newgrange
Isle of Man
Irish Sea
Star Carr
East Frisian Islands
West Frisian Islands
Ferriter's Cove
River Shannon
Trent River
IJsselmeer
Hüde
Swifterbant
Ems River
Grimes Graves
Severn River
Windmill Hill
Bergschenhoek
Hazendonk
Hardinxveld
Avebury
Thames River
Celtic Sea
Sweet Track
Stonehenge
Hambledon Hill
Sittard
Rijckholt
Rhine River
Schelde River
Köln-Lindenthal
Darion
Bruchenbrücken
English Channel
La Chaussée-Tirancourt
Cuiry-les-Chaudardes
Main River
Seine River
Oise River
Meuse (Maas) River
Moselle River
Aisne River
La Hogue Bie
Barnenez
Marne River
Cerny
Noyen
Seine River
Neckar River
Passy
Hoëdic
Carnac
Téviec
Gavrinis
Yonne River
L. Constance
Loire River
Arbon-Bleiche 3
Grand Pressigny
Jura Mountains
Egolzwil
N
Saône River
Loire River
Cortaillod
Vienne River
Creuse River
Allier River
Sion-Petit Chasseur
Lake Geneva
ALPS
Bay of Biscay
Rhône River
Dordogne River
Garonne River
Lot River
Po River
Arene Candide


Northern Europe, 8000–2000 B.C.
0 100 200 mi.
0 100 200 km
N
Slettnes
Inari
Lofoten
Muonio River
Lainioälven River
Ounas River
Norwegian Sea
Kalixälven
Torneälven
Luleälven
Kemi River
Piteälven
Altrásket
Vindelälven
Skellefteälven
Angermanälven
Umeälven
Oulu River
Oulujärvi
Pyhä River
Lesti River
Indalsälven
Ljungan River
Ljusnan River
Gulf of Bothnia
Glåma River
Klarälven
Begna River
Lågen River
Otra River
Dalälven
Lake Mälaren
Aland Is.
Gulf of Finland
Hiiumaa
Lake Vänern
Lake Vättern
Skagerrak
Saaremaa
Zvejnieki
Gotland
Gulf of Riga
Stora Förvar
Ajvide
Abora
Ertebølle
Visborg
Kattegat
Jutland
Dvina River
Öland
North Sea
Ringkloster
Vedbæk-Bøgebakken
Šventoji
Saltbaek Vig
Smakkerup Huse
Zealand
Tågerup
Baltic Sea
Tybrind Vig
Fyn
Sarup
Skateholm
Neman River
Hjortspring
Limensgård
Bornholm
Courland Lagoon
Gulf of Gdańsk
Rügen
Rzucewo
Siggeneben-Süd
Dąbki
Frisian Islands
IJsselmeer
Elbe River
Narew River
Hüde
Weser River
Friesack
Oder R.
Krusza Zamkowa
Brześć Kujawski
Osłonki
Sarnowo
Ems River
Vistula River
Bug R.
Oder River
Warta River
Vistula R.
Rhine River
Dölauer Heide
Saale River
Darion
Krzemionki Opatowskie


Southwestern Europe and Western Mediterranean, 8000–2000 B.C.
0 100 200 mi.
0 100 200 km
ATLANTIC OCEAN
Bay of Biscay
Gulf of Cadiz
Strait of Gibraltar
Alboran Sea
Mediterranean Sea
Balearic Sea
Gulf of Valencia
Gulf of Lions
Ligurian Sea
Tyrrhenian Sea
ATLAS MOUNTAINS
Chelif River
Medjerda River
Cantabrian Mountains
Iberian Mountains
PYRENEES
Sierra Morena
Baetic Mountains
Jura Mountains
Maritime Alps
Apennines
ALPS
Balearic Islands
Minorca
Majorca
Iviza
Formentera
Corsica
Sardinia
Elba
Lake Constance
Lake Geneva
Lake Maggiore
Lake Como
Lake Garda
Seine River
Yonne River
Saône River
Rhône River
Durance R.
Allier R.
Loire River
Creuse River
Vienne River
Dordogne River
Lot River
Tarn River
Garonne River
Adour River
Ebro River
Segre River
Túria River
Júcar River
Carrión River
Esla River
Sil River
Miño River
Douro River
Tagus River
Guadiana River
Guadalquivir River
Genil River
Po River
Adige River
Arno River
Aichbühl
Similaun Glacier
Val Camonica
Arbon-Bleiche 3
Egolzwil
Cortaillod
Sion-Petit Chasseur
Arene Candide
Barumini
Monte Arci
Châteauneuf-les-Martigues
Gazel
Jean-Cros
Leucate-Corrège
Balma Margineda
La Draga
Son Matge
St-Michel-du-Touch
Villeneuve-Tolosane
Botiqueria dels Moros
Cova de l'Or
Marizulo
Aizpea
Pico Ramos
Los Canes
Cerro de la Virgen
Carigüela
Los Millares
La Pijotilla
Perdigões
Palmela
Muge
Caldeirão Cave
Vila Nova de São Pedro
Zambujal
N

Italy, Southeastern Europe, and the Aegean, 8000–2000 B.C.

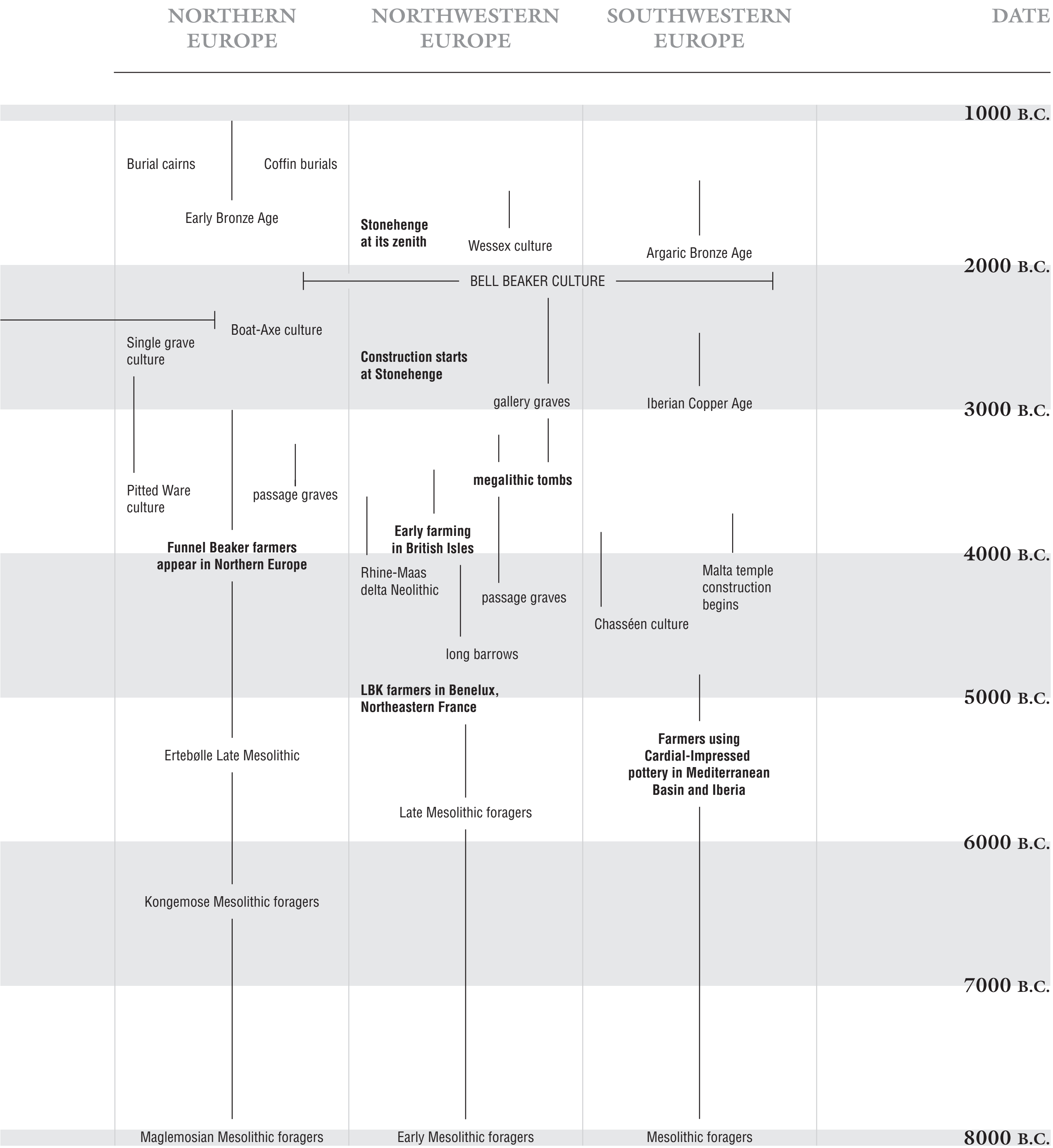

Eastern Europe,
8000–2000 B.C.
N
Northern Dvina River
Lake Vodla
Oleneostrovskii Mogilnik
Lake Onega
Lake Lacha
Lake Ladoga
Svir' River
Luza River
Lake Vozhe
Gulf of Finland
Lake Beloye
Sukhona River
Volkhov River
Suda River
Lake Peipus
Mologa River
Msta River
Rybinsk Reservoir
Lake Il'men'
Lake Pskov
Unzha River
Vyatka River
Volga River
Volga River
Oka River
Moscow River
Sura River
Dnieper River
Byarezina River
Sozh River
Oka River
Tsna River
Pinsk Marshes
Prypyats' River
Voronezh River
Vorona River
Desna River
Seym River
Oskol River
Khoper River
Tripolye
Kolomischiina
Southern Bug River
Don River
Volga River
Dnieper River
Vladimirovka
Inhulets River
Dereivka
Akhtuba River
Dniester River
Donets River
Cucuteni
Prut River
Siret River
Don River
Usatovo
Lake Manych
Sea of Azov
0
100
200 mi.
0
100
200 km
Crimea
Kuban' River
Danube River
Caucasus Mountains
Ovcharovo
Varna
Black Sea

CHRONOLOGY OF ANCIENT EUROPE, 8000–1000 B.C.

Archaeologists need to make sense of how the archaeological record fits together in time and space. A simple tool for organizing this information is a chronological chart, which can be thought of as a timeline running vertically, with the oldest developments at the bottom and the most recent at the top. The vertical lines indicate the duration of cultures and people, whose date of first appearance is indicated by the label at the bottom of the line. The horizontal lines indicate cultures and events that spanned more than one geographic region. Historical events or milestones appear in boldface type.

The following chronological chart traces the development of ancient society in Europe from the hunter-gatherers of the Mesolithic period to the end of the Neolithic or the Copper Age, between about 8000 and 2000 B.C., over six principal regions of Europe: Eastern, Southeastern, Central, Southwestern, Northwestern, and Northern. The chart also includes some events up to 1000 B.C., foreshadowing developments covered in volume II. Key developments (such as the earliest appearance of agriculture in each area), important archaeological cultures (such as *Linearbandkeramik* and Corded Ware), and special types of sites (such as megalithic tombs) are shown. The chronological chart should be used in conjunction with the individual articles on these topics to give the reader a sense of the larger picture across Europe and through time.

DATE	SOUTHEASTERN EUROPE	EASTERN EUROPE	CENTRAL EUROPE
1000 B.C.	**Iron use appears**; Mycenae; Knossos; Otomani culture	Timber Grave culture; **Development of steppe pastoralism**; **chariot use**	Urnfields; Tumulus Middle Bronze Age
2000 B.C.	Nagyrev culture; Minoan civilization; **Early evidence for bronze metallurgy**	Fatyanovo culture; catacomb graves	Únětice culture Early Bronze Age; Bell Beaker culture; Globular Amphora culture
		CORDED WARE CULTURE	CORDED WARE CULTURE
3000 B.C.	Baden culture	**horse riding**; Yamnaya (Pit Grave culture)	The Iceman
	SECONDARY PRODUCTS REVOLUTION	SECONDARY PRODUCTS REVOLUTION	SECONDARY PRODUCTS REVOLUTION
4000 B.C.	Tiszapolgár culture; **Earliest traces of copper metallurgy**	**horse domestication**; Sredny Stog culture	Swiss lake dwellings; Michelsberg culture; Lengyel culture; Rössen culture
5000 B.C.	Vinča culture; **Starčevo – Körös – Criş farmers in northern Balkans**	Cucuteni-Tripolye culture; Dnieper-Donets culture	**Neolithic *Linearbandkeramik* (LBK) farmers spread**
6000 B.C.	**First farmers appear in Greece and Crete**	Bug-Dniester	
7000 B.C.	Iron Gates Mesolithic sites		
8000 B.C.	Mesolithic hunter-gatherers	Mesolithic foragers	Mesolithic hunter-gatherers


NORTHERN EUROPE
NORTHWESTERN EUROPE
SOUTHWESTERN EUROPE
DATE
1000 B.C.
Burial cairns
Coffin burials
Early Bronze Age
Stonehenge at its zenith
Wessex culture
Argaric Bronze Age
2000 B.C.
BELL BEAKER CULTURE
Boat-Axe culture
Single grave culture
Construction starts at Stonehenge
gallery graves
Iberian Copper Age
3000 B.C.
megalithic tombs
Pitted Ware culture
passage graves
Early farming in British Isles
Funnel Beaker farmers appear in Northern Europe
4000 B.C.
Rhine-Maas delta Neolithic
passage graves
Malta temple construction begins
Chasséen culture
long barrows
LBK farmers in Benelux, Northeastern France
5000 B.C.
Farmers using Cardial-Impressed pottery in Mediterranean Basin and Iberia
Ertebølle Late Mesolithic
Late Mesolithic foragers
6000 B.C.
Kongemose Mesolithic foragers
7000 B.C.
Maglemosian Mesolithic foragers
Early Mesolithic foragers
Mesolithic foragers
8000 B.C.

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DISCOVERING BARBARIAN EUROPE

INTRODUCTION

Almost everyone has seen a picture of Stonehenge, the famous circle of large upright stones in southern England. Yet very few people know that it was built in several stages over a period of more than a thousand years, starting nearly five thousand years ago. Most are unaware that it is surrounded by dozens of burial mounds and other earthworks that created a vast Bronze Age ritual landscape. Moreover, despite its fame, Stonehenge is only one of many arrangements of upright stones in the British Isles. Archaeologists puzzle over the Bronze Age societies that built these monuments; however, they know that they were not Druids, to whom popular literature often attributes Stonehenge. The burial mounds have yielded traces of gold, copper, bronze, and amber artifacts—the relics of an elite social class that was able to acquire exotic materials from a distance. Very little is known of where they lived, although it appears that their settlements were simple farmsteads similar to others in the surrounding countryside. The important thing is that Stonehenge did not appear suddenly but rather was built by a thriving society that had inhabited the region for centuries and whose distant descendants eventually met the Romans when they arrived in Britain almost two thousand years later.

When Julius Caesar described the customs of the native inhabitants of Gaul and Britain in his account of his campaigns, he was writing of a land where agriculture had been practiced for nearly five thousand years, yet states and empires had not emerged. During these millennia, however, the European continent had witnessed a remarkable series of transformations of human society. Its people had gone from being hunters and gatherers in the new forests that appeared after the Ice Age to establishing chiefdoms with large settlements that were almost cities. Along the way, they became farmers, learned to use metals, and developed complex social structures. After the Romans came and went, the native peoples of Europe established their own states and cities, many of which still exist today.

The Greeks called these native peoples of Europe outside their borders "barbarians." Ever since, barbarians have had a bad reputation. Today, most people use the term to mean someone or something coarse, uncultured, even crudely violent. They use the term loosely, as a pejorative for all that does not conform to some idea of what it means to be civilized. Archaeologists and historians who study early Europe know, however, that the prehistoric European societies were not all that barbaric, certainly no more so than any other prehistoric societies around the world. The accomplishments of these societies extend far beyond Stonehenge to encompass a variety of technological, social, economic, and artistic achievements.

It is in this spirit of celebrating these societies that we have assembled Scribner's *Ancient Europe 8000 B.C.–A.D. 1000: Encyclopedia of the Barbarian World*. We have brought together a team of some of the most knowledgeable archaeologists and historians who study these ancient European societies to write chapters on their own areas of specialization. The maps show the distribution of archaeological finds across Europe, and the illustrations present some of the most important discoveries. Timelines highlight what was happening at various times in different parts of Europe. A glossary enables the reader to find definitions of key archaeological terms.

Our definition of "barbarian Europe" encompasses the nine millennia between about 8000 B.C. and A.D. 1000. These starting and ending points are deliberately, not arbitrarily, chosen. The beginning is marked by the freeing of Europe from glacial ice and the establishment of modern climatic conditions, and the end is determined by the spread of Christianity across northern and eastern Europe and the establishment of many European states that persist into the present. During these nine thousand years, European society was dramatically transformed.

We have aimed for broad geographical coverage from the Atlantic to the Urals and from the North Cape to the islands of the Mediterranean Sea. To the extent that some events in Europe, such as the spread of agriculture, have their roots in the Near East, we have included coverage of Anatolia, known today as Turkey, in some sections of this volume. Around A.D. 1000, the Vikings extended their reach beyond Europe to Greenland and North America, and several centuries earlier, the Vandals migrated along the northern shore of Africa. European prehistory touches several continents.

It is important to realize that the archaeological record of Europe extends back much further than ten thousand years ago. Early hominids appeared on the doorstep of Europe about 1.7 million years ago at Dmanisi in Georgia. The earliest traces of Stone Age settlement in Europe date at least to 700,000 years ago and perhaps even earlier at sites in southern Europe. Over the next several hundred thousand years, humans reached as far north as southern England and central Germany, where they left hand axes, chopping tools, and their skeletal remains at sites such as Boxgrove in England and Bilzingsleben in Germany. Neanderthals flourished in southern and western Europe between 100,000 and 35,000 years ago, and their eventual disappearance remains a mystery to archaeologists. Anatomically modern humans reached Europe as the ice sheets were beginning one final push southward. On the steppes of southern Russia and Ukraine, they built large houses from the bones and jaws of mammoths at sites like Kostenki and Mezhirich. In southwestern France and northern Spain, they drew remarkable polychrome depictions of large animals on the walls of caves. After the ice began to retreat, they pursued the herds of reindeer north, ambushing them as they migrated across the tundra in northern Germany and Denmark.

The European archaeological record does not end at A.D. 1000. High-medieval and post-medieval sites have many layers of archaeological deposits, and their contents can reveal quite a bit about everyday life. We already know something of these societies from historical documents, and the relationship between the archaeological record and the historical record is complicated. It is clear, however, that these were societies that had the degree of organizational complexity that could be called a "state" or a "civilization," and thus they exit the barbarian world and approach modernity.

Why are the barbarian societies of Europe important? We believe that there are several reasons. The first is that the barbarian societies of Europe provided the technological, economic, social, and cultural foundations for the late medieval and modern European societies that we know from historical accounts. The continuity observed in the archaeological record means that the precursors of all sorts of modern customs and practices have their roots deep in antiquity. DNA evidence makes it possible now even to identify modern individuals as the distant descendants of people whose skeletons are found in prehistoric graves.

Moreover, the inhabitants of Europe between 8000 B.C. and A.D. 1000 left one of the most detailed and complete archaeological records of any major geographical region in the world. Many sites, especially in the wetlands of northern Europe, are remarkably well preserved. Beginning with the antiquaries of the seventeenth and eighteenth centuries and continuing with the pioneering work of nineteenth- and twentieth-century archaeologists such as Augustus Henry Pitt-Rivers and Grahame Clark, scholars have collected an immense amount of information on prehistoric settlements and burials. This information, in turn, has formed the foundation for interpretations of ancient life that hold a high degree of certainty rather than mystery.

Finally, the archaeological record of prehistoric Europe provides an important counterbalance to the view of many historians that unless it was written about, it did not happen. Although Greeks and Romans observed them at a distance from about 500 B.C. onward, native Europeans wrote almost nothing down until Irish monks began to keep written records in the fifth century A.D. and the Vikings began to inscribe their runic letters on stones. As a result, the prehistoric peoples of Europe are almost entirely absent from most histories that deal with the ancient world.

Who studies European barbarian societies? Principally, this topic has been of greatest interest to archaeologists, both from Europe and from elsewhere, although some historians also are interested in the people who came into contact with the literate civilizations of Greece and Rome. Archaeologists are people who study past societies through their material remains. Contrary to the impression given by the Indiana Jones movies, archaeologists do not usually lead lives of great danger in the pursuit of unique mythical items such as the Holy Grail. Instead, they painstakingly piece together the past through the meticulous discovery and excavation of archaeological sites and the analysis and interpretation of the artifacts, skeletons, seeds, and bones that they find. Archaeologists sometimes are called *pre*-historians, for unlike historians, who study the texts and monuments left by ancient civilizations, most archaeologists study preliterate peoples who did not leave their own written history.

The information that archaeologists have is very fragmentary: flakes of flint, pieces of pottery, burned seeds, and the ends of bones. Only rarely do they find the whole objects that one sees in museums. Much of what prehistoric people threw away was not preserved to the present. Wood and skin survive in only very wet or very dry conditions. Sometimes the archaeologist's work is like trying to determine the contents of a room only by looking through the keyhole. Archaeologists do not know the names of the individuals who left the tools and bones. Unless they find a preserved body, such as those found in the Danish bogs, they do not know exactly what these people looked like. Until very late in prehistory, archaeologists do not even know the names by which people identified the tribes to which they belonged.

Archaeologists can discern a surprising amount, however, from those pieces of pottery and bone. They know where prehistoric people lived and how they buried their dead. They know the kinds of tools and other objects these people used, the shape of their houses, and what they ate. Further analysis can reveal where prehistoric people obtained the raw materials they used to make things, how long they lived in one place, and how large their settlements were.

With this limited amount of basic information in hand, the archaeologist then looks for larger patterns. This is where the real detective work begins. By combining various types of evidence, it is possible to study the impact of prehistoric people on their environment and the ways in which they managed their crops and livestock. Patterns of trade and communication emerge. Differences in the status and wealth of individuals and communities can be observed. Art and symbolism become apparent. Ritual practices can be identified, as can conflict and warfare.

It is somewhat more difficult to discover what prehistoric people thought about gender roles, their identity as individuals, and their religious beliefs, although archaeologists make valiant efforts to try to discern these more elusive facets of their lives. Perhaps the most difficult challenge for archaeologists is to trace the development and spread of languages among prehistoric peoples. Advances are always being made in the analytical techniques available to archaeologists, so perhaps in the future it will become easier to understand these aspects of prehistoric life.

Who are the archaeologists who study European barbarians? They are usually scholars, generally very bright and hardworking people, who work in universities and museums as well as in government and private agencies that preserve the remains of ancient societies. Professional archaeologists seek knowledge, not wealth. Other archaeologists are amateurs for whom the discovery of archaeological sites is a hobby rather than a job. In Europe amateur archaeologists often work side by side with professionals, alerting them to their finds and helping in excavations. An important role is played by amateur archaeologists who have a particular skill, such as scuba diving. For example, many prehistoric sites that were once on dry land are now under water in places like Denmark, where sea levels have risen over the past five thousand years. Divers with an interest in archaeology have discovered many remarkable sites just off the coast.

In studying archaeology, it is important to separate the factual evidence and sensible interpretations from the fantasies of those who see archaeology as a mirror for their spiritual and political beliefs. Stonehenge is of interest not only to serious archaeologists for what it can tell them about Bronze Age society but also to impressionable and gullible people who believe that it has mystical power. The corpse of a prehistoric traveler found in the Alps in 1991 has provided an immense amount of information about life five thousand years ago, but it also has been the source of all sorts of foolish speculation. Today, some might say that all interpretations of the archaeological record are equally valid. Serious archaeologists, however, place a greater value on evidence and documentation over flights of fancy and conjecture. New evidence is always coming to light that can overturn current ideas about the past, but such evidence must be presented clearly and evaluated rigorously before it can be accepted. Only then can valid interpretations be made. Archaeologists often disagree with one another about how the archaeological record should be interpreted, but they all base their views on evidence.

The work of these archaeologists has transformed our knowledge of the European past dramatically over the past two centuries and will continue to change it even more in the decades to come. New discoveries are steadily filling gaps in what we know and altering our views of prehistoric life. We hope that as the reader explores the chapters in this encyclopedia he or she will learn not only about the abundant traces of ancient peoples that have been unearthed in Europe but also about the enthusiasm and excitement that archaeologists bring to their work of discovery and interpretation.

Peter Bogucki, Pam J. Crabtree

HUMANS AND ENVIRONMENTS

Even if humans had never evolved, Europe would look different compared with the same area ten thousand years ago. In about 9500 B.C. this peninsula of the Eurasian continent still was recovering from the last great manifestations of the glaciations that had been occurring for about 2 million years (the Pleistocene period, followed after 9500 B.C. by the Holocene period, the current period) and that had been at their height about 18,000 years ago. In 9500 B.C., however, the only major sheet of ice was over Scandinavia, with smaller outliers on the mountains of Scotland and northern England. Nonetheless there was sufficient ice on the globe to lock up a great volume of water, and so sea level was well below where it is in the early twenty-first century. For example, Sardinia and Corsica were joined, the Black Sea was isolated from the Mediterranean, and England was still connected to the major landmass, though Ireland had been separated for many centuries.

LIFE AFTER THE ICE AGE

Even if the great polar ice masses were pretty well bereft of nonhuman life above ground, at their margins there were populations of phytoplankton and zooplankton, fish, migrant seabirds, penguins, seals, and whales. In the north whales, seals, arctic foxes, and polar bears were found at the margins of sea ice and land. Thus the world in 9500 B.C. was nowhere entirely deprived of life, even though proto-Europe itself was a far colder place than it later became.

It is no surprise therefore that an array of increasingly complex and biologically diverse ecological systems covered the landmass south of the Scandinavian ice and that, as the climate ameliorated, these systems moved northward. By 9500 B.C. the formation (usually called a "biome," meaning an integrated system of soils, plants, and animals) nearest the ice, the tundra, was restricted in area and was largely maritime in distribution. The bulk of the Continent was covered in boreal forest, dominated by coniferous trees and containing a great deal of wetland and with a mammal fauna that included moose, beaver, and reindeer. Open land at higher elevations was home to reindeer and wild horse, as was the tundra. To the south was a broad band of temperate forest dominated by a mixture of temperate species, such as oaks, elms, linden, and hazel. A small admixture of conifers was found on poorer soils and at high altitudes. The fauna included red deer and roe deer as well as wild ox, or aurochs. The Mediterranean fringe was covered in steppe and grassland.

One feature of the deglaciated land of Europe was a scattering of lakes, some long and thin in valleys formerly occupied by glaciers and others more round in hollows in glacial debris or in front of ice sheets, as with the Scandinavian basin that was to become the Baltic Sea. The whole was flanked to the west and south by saltwater seas, the open Atlantic and its inlets to the west and the more enclosed and warmer Mediterranean in the south. Where major rivers entered the sea, long branched estuaries with salt marshes and freshwater fens kept pace with rises in sea level.

Such a banding of biomes was home to hunter-gatherer populations of the types usually labeled Upper Palaeolithic. Some groups depended upon coastal fishing and others on mammal populations, such as reindeer or wild horses. Still others inhabited the depths of the deciduous woodlands, and the farther south the groups were, the greater the vegetable content of their diets. All had to show adaptability in the face of the biological and climatic changes that were to come.

EARLY HOLOCENE WARMING

One of the lessons from the present plethora of research into climatic history is that change is not necessarily gradual. In the case of Europe the transition from the tail end of the ice ages to a much more temperate climate was quite rapid. About 9500 B.C. amelioration started to produce warm surface waters (above 14°C [57.2°F]) around the coasts of western Europe, and warming rates may have reached about 1°C (1.8°F) per century in these waters. On land, rates of 3 to 4°C (5.4 to 7.2°F) per 500 years have been postulated for France and even 1.7 to 2.8°C (3.06 to 5.04°F) per century in not yet insular Britain. Overall the climates of Europe may have reached levels similar to those of the twentieth century or even a little warmer by 7000 B.C.

The consequences for the natural world and hence for human habitats were profound. The vegetation belts and their associated fauna shifted northward, so most of Europe was a cool temperate forest zone with dominance by broad-leaved trees. There were montane variants in the Alps, and over much of Scandinavia and eastern Russia the overwhelming dominance of conifers meant that a taiga, or open forest, was the land cover. A taiga biome also penetrated some of the loess lands of the northern European plain, and the Black Sea had a broad penumbra of moist steppe, which was in essence treeless grassland. Within all these biomes, the better conditions encouraged rapid plant growth, so many lakes left in glaciated regions began to fill with organic debris and the area of open water shrank when colonized by marginal vegetation.

A major result of the warming was more free water in the oceans as the polar, mountain, and Laurentide ice sheets melted, producing what are termed "eustatic" rises in sea level. Such increments, however, often were in opposition to isostatic rises in land levels as land surfaces rose when freed from the weight of the ice that had depressed them. The northern part of the Gulf of Bothnia has risen about 850 meters during the Holocene and is still rising at 9 millimeters per year. Northern Britain is still rising, too, though at less than 3 millimeters per year, and the south is sinking at up to 2 millimeters per year. Thus many European coasts during the era of barbarism were the outcomes of competition between eustasy and isostasy, with the latter winning easily to the north. The shorelines and harbors from which the Vikings launched their ships were almost 8 meters above the modern sea level.

The largest-scale physical consequence of sea-level change is found in the Baltic. The region underwent a four-stage evolution in which there was an interaction of ice retreat, eustatic rises of sea level, and isostatic rebound. During the Terminal Pleistocene the Baltic essentially was an ice-dammed freshwater lake, but the retreat of ice in central Sweden led this lake to fall by about 28 meters and become connected to the Atlantic, thus turning brackish. By 7000 B.C. this outlet was closed, and the new but narrow outlet that developed in the region of the Great Belt allowed the Baltic to become a freshwater lake again. After 6500 B.C. more saltwater penetrated, since increased eustasy was accompanied by decreasing isostasy, bringing about the twenty-first-century salinity gradients of the Baltic–Lake Ladoga region.

THE HOLOCENE OPTIMUM

Between c. 7000 and 4000 B.C. the climate in Europe reached its optimal level (the Hypsithermal) in the present interglacial. It was not, however, uniform in its onset. In the British Isles the maximal warmth was about 6000–4500 B.C., whereas in northern Europe 4000–2500 B.C. saw the highest average temperatures. There are of course no instrumental records, but data from fossil pollen and other organic remains, the stratigraphy of lakes and bogs, and from tree rings suggest that temperatures were at least 1 to 2°C (1.8 to 3.6°F) above those of the late twentieth century. This implies of course that the spread of agriculture into much of Europe and the development of all the more complex societies of Celtic Europe and their early medieval successors took place in periods of climatic deterioration (albeit with warmer remissions). The hunter-gatherers had had the best of the weather.

The consequences for the natural environment are obvious to some extent. The forest belts extended northward, so mixed deciduous forest was dominant over much of Europe, save from mid-Scandinavia northward, where conifers and birch predominated, and in mountainous areas. Here there were always more conifers, though not to the extent familiar in the Alps, for example, where there was more beech (*Fagus* spp.). The steppes of the east retreated in favor of woodland cover. Within the forests, too, species that were adapted to greater warmth flourished. The lime (*Tilia* spp.) is a good example, along with ivy (*Hedera* sp.), holly (*Ilex*), and mistletoe (*Viscum*). The European pond tortoise (*Emys orbicularis*), confined to the Mediterranean in the twenty-first century, was found in Denmark and southern Sweden. The presence of insect and molluscan faunas also reflected the warmth, but of greater importance for human communities were the large mammals, such as the red and roe deer, wild ox, wild pig, and beaver. As the optimal period peaked, agriculture became important, and it is clearly critical that such cereals as wheat and barley were able to ripen even in the British Isles and southern Scandinavia.

Another feature of the optimal period was its water relations. In the early part the climate over most of Europe was drier than in the twenty-first century, but as time passed there was a move to wetter conditions, especially in the west. In part this change reflected the increasing influence of the sea as its levels rose. A leading consequence of this continued eustasy was the formation of the Dover Strait and then the submergence of the low-lying terrain between England and the Low Countries to form the North Sea. By c. 7400 B.C. the British Isles were insulated from the rest of Europe, and it took the completion of the Channel Tunnel in the 1990s to make it possible again to walk from Dover, England, to Calais, France. In cultural terms this separation took place in the Mesolithic. The adoption of agriculture in the British Isles necessarily was preceded by a sea passage of some kind of mix of ideas, people, seeds, and young cattle.

Wetter conditions are reflected to some extent in higher lake levels and thus the renewal of lake-fringe successions, but they are most apparent in upland areas and the western fringe of Europe. Two processes are notable. The first is the leaching of minerals down the profiles of many types of soils, particularly from those on such acid substrates as sandstone and gritstone. The redeposition of minerals, such as iron and manganese, in solid horizons ("pans") made the soils prone to becoming waterlogged, and hence their floras moved away from large tree species toward wet- and acid-tolerant species, such as birch, and to dwarf shrubs of the Ericaceae family. On some uplands in Scandinavia and the British Isles great blankets of peat formed on low slopes where the rainfall exceeded about 700 millimeters per year. It is possible that there was some human involvement in the inception of these miry spreads, whose surface often was one of the bog mosses of the genus *Sphagnum*.

POPULATION AND ENVIRONMENT AT 5000 B.C.

A synoptic look at this time reminds one that the fundamental change in the human condition, namely the adoption of agriculture, had penetrated to most regions in which cereals would ripen. The breeding of hardier varieties and the extensive use of oats (*Avena* spp.) in the coolest and wettest places later extended this zone. Along with cereals and pulses, cattle and sheep were essential ingredients of the agro-ecosystems that developed. All this implies that human communities were responsible for new genotypes as economies based on domestication got farther away from the southwestern Asian heartland and moreover that new ecosystems were an inevitable consequence of the new cognition of nature that grew out of the imperatives of farming as a way of life. The rises in sea level were helpful in allowing drift in the North Atlantic onto coasts north of 50 degrees latitude in places where otherwise ice might be expected. A few places nonetheless retained hunters or developed herders; only the latter groups (e.g., the Saami) were to persist beyond "prehistoric" times.

BARBARIAN LANDS THROUGH TO MEDIEVAL TIMES

The next major environmental changes of wide significance to human societies in Europe were a significant deterioration in climate after 700 B.C., with a better phase during A.D. 1–600 and then a period of warmth between c. A.D. 900 and 1250 known as the Little Optimum or the Medieval Warm Epoch (MWE). The very existence of this latter fluctuation is to some extent uncertain, but it seems best attested to in northern and western Europe. This forms a convenient terminal point because certainly by the end of this period the whole of Europe possessed some form of Christian culture. The implication, however, is that the development of the relatively complex societies that were labeled barbarian by the Greeks, the Romans, and then Christendom were all constructed in a period of relatively poor climate (with temperatures perhaps 1 to 2°C [1.8 to 3.6°F] below those of the more recent past). This was a time in which a series of fluctuations produced, among other effects, southward and downward movements of tree lines, more conifers in mountains and central Scandinavia, more rapid peat growth, more sea ice in the North Atlantic basin, and a lowering of sea temperatures.

The evidence from ice and peat cores, too, shows that there were short-term fluctuations caused by volcanic eruptions, especially in Iceland. A major expulsion of debris into the atmosphere can produce demonstrable decreases in temperature (a kind of "nuclear winter") and no doubt declines in crop yield. Within the period of most interest, fallout of volcanic ash ("tephra") from Icelandic sources (especially the mountain Hekla) can be detected much farther south, with tephra horizons at 1525–1850 B.C., 635–1100 B.C., A.D. 365–415, and A.D. 850–1050. Estonia felt two impact craters c. 4000 and 2000 B.C. The whole of Europe (and perhaps a wider area) suffered from extreme cold in the years around A.D. 540. The MWE, by contrast, usually is thought to have caused the retreat of sea ice, which allowed Norse colonization of Iceland and Greenland. Temperatures 1°C (1.8°F) higher than those of the late twentieth century have been suggested for northwestern Europe.

None of these deleterious influences prevented the occupation of Europe by a series of societies based on agriculture, whose accomplishments were by no means negligible, even if they lacked the literate attainments of classical peoples. All the different types of environments contained successful and indeed apparently sustainable economies, which were subject only to the usual environmental hazards of preindustrial economies. Crop failure, animal diseases, warfare, and civil breakdown are all recorded, and no doubt the pressures of population growth upon the resource base were critical, at least locally. Most coasts, except those facing north, attracted economies in which fish were important, provided that a cereal could be grown or traded. The tundra–boreal forest (taiga) zone developed reindeer herding. The deciduous forest proved amenable both to shifting cultivation and to permanent clearance for mixed farming. The mountains sustained valley agriculture, in which transhumance of animals eventually formed an integral part of food production. The introduction of irrigation into the Mediterranean, however, was the result of Islamic influence upon the classical cultures; it was not one that any barbarians adopted, except in areas they reclaimed after attacking parts of the Roman Empire. In all of these areas the influence of environment cannot be gainsaid, yet in none of them is there certainty that human culture and choice were negligible. There were always roads not taken.

HUMAN IMPACTS ON THE ENVIRONMENT OVER ELEVEN MILLENNIA

Accepting that agriculture spread into northern and western Europe during the period 6000–4000 B.C., then some westernmost parts housed 4,000 years of Holocene hunter-gatherers. More central and southerly regions had hunter-gatherer populations from the Late Pleistocene right through to the time when farming became an irreversible way of life. The notion that food-collecting economies do not manage their environments in the manner of agriculturalists has long been abandoned, especially with the realization that fire is a potent management tool at the landscape scale. There is evidence of considerable burning in the Late Pleistocene and Early Holocene in the northern European plain, the Low Countries, and the lowlands of northeastern England, for example—though it is always possible that the tundra and birch-scrub vegetation could have been set alight by lightning in what was then a more Continental climate.

In the wetter uplands of the British Isles and Norway, however, fire apparently was used to combat the upward spread of forests and to maintain openings in woodlands that dominated the Middle Holocene. The presence of shrubs such as hazel (*Corylus avellana*) probably was deemed to be advantageous as direct food sources as well as browse for forest mammals, and so closed-canopy high forest was not an optimal source of food. Where trees were removed or prevented from growing, their water-pump effect was lost. The subsequent waterlogging and acidification of soils (accelerated where charcoal clogged the soil pores) were instrumental in the growth of blanket peat over wide areas, a process whose inception could happen at later times if forests disappeared and whose enlargement thereafter was sensitive to climate. On drier sites with acid soils, heath developed. Its continued existence depended on being grazed and burned; otherwise it would be colonized by scrub and then oak woodland.

If many hunter-gatherers existed in a mosaic of woodland and open areas, little adaptation would have been needed for early agriculturalists. Although the idea that the pioneers were all shifting slash-and-burn farmers has been superseded, the growth of cereals in small clearings that also housed domestic stock whose dung maintained soil fertility would scarcely have been ecologically radical even if it was culturally revolutionary. The practice of feeding leafy branches to domestic stock would have thinned out canopies, and the success of sedentary farming, letting populations expand, would have diminished the area of forests and increased the cover of secondary woodland and open grassland. Hence the gatherer-hunters and the prehistoric farmers together changed many of the European ecosystems—especially those of the mixed deciduous forest zone—into a cultural landscape with more natural patches. The reindeer herders, on the other hand, seem to have exerted environmental influence only near settlements, and there is no evidence that prehistoric populations had lasting effects upon populations of sea creatures.

Between the onset of Neolithic farming cultures and the end of "barbarianism," all human communities dependent on agriculture had in common the need to maintain the fertility of the fields and to cope with any expansions in human populations. The period also may have seen substantial migrations of human groups across Europe, though DNA-based evidence calls some of this movement into question while reinforcing various older interpretations. By one means or another new ideas found their way across the Continent. For example, the transmission of rye as an addition to the cereal repertoire allowed more intensive use of the southern fringe of coniferous lands in Russia and Scandinavia, with the results still visible in their bakeries. The moldboard plow allowed cultivation of heavier soils, and no doubt contact with Roman methods encouraged more intensive use of land even outside the *limes.*

In some forested zones the prehistoric farmers practiced shifting cultivation (which persisted in Finland into the nineteenth century). This was a good adaptation to woodland and a low population density, but it was less effective than permanent clearances that are well manured. Hence much agriculture between the Neolithic and the High Middle Ages was a variant on keeping up the fertility of the grain-, pulse-, and hay-producing fields. Their drainage, irrigation, fertilization, and general management all have environmental linkages, which involve manipulation of the preexisting ecosystems (many of which would certainly not be "natural").

Alongside these processes, those of the modification of the genetics of plants and animals proceeded. The differentiation of the plow horse and the warhorse is a simple example. Some periods stand out as particularly important. The age of the development of iron technology is certainly one of them. In many palaeoecological investigations across Europe, the beginning of the Iron Age saw intensified forest clearance, as this became altogether easier with the use of a hard-edged axe. At the same time the production of iron exerted an environmental impact. Apart from the digging for ore, the smelting process required significant amounts of charcoal. Then iron-tipped plows allowed the turnover and aeration of heavier soils in a kind of snowball effect of environmental change, which also contributed more silt to the river floodplains from higher soil-erosion rates; river estuaries and deltas changed shape and biological components.

Beyond the fields, Iron Age economies changed woodlands, as cattle and pigs were allowed to graze and browse in them and the woods were managed to provide leaf fodder. Wetlands were reclaimed as coastal communities learned to construct banks that kept out the tides. *Egil's Saga,* written in Iceland in about A.D. 1230, records a visit to the Frisians that details their occupation of the salt marsh–fen–wood zone of the coasts of the Low Countries. The tidal marshes were the scene of salt production in the Iron Age, and thereafter the heaps of waste from this activity in turn provided raised settlement sites for villages and fields. Inland peat bogs, too, were reclaimed, at least at the edges. There is some suggestion, too, that pagan Saxon aristocracies were keen enough on hunting to have areas set aside for the pleasure of the chase, though not on the scale of their Christian Norman successors. Many "barbarian" societies had notions of sacred space, which very likely meant the setting aside of land and water. The Early Mesolithic site at Star Carr in northern England is neatly on the kind of peninsula that taiga communities in Russia later used as sacred locations; part of southern England was, in one interpretation, an "isle of the dead" in the Neolithic. The ambiguity of the woodlands and wild terrain generally as sources of useful materials, as land banks, and as places of some dread are encapsulated in later European folklore and fairy tales. The element of fear is well expressed in the famous narrative poem *Beowulf* of Anglo-Saxon times.

In most of Europe the division of the landscape into "owned" units is evident in the landscape. Even if some of them were communally rather than privately owned, there were nevertheless few resources—and hence few parts of nature—that did not in some way belong to human communities or individuals. In a sense a stratification of human societies occurred (described for the Celts in some of the most detailed written accounts of European societies outside the classical world), which was accompanied by a fragmentation of nature. There were fields, the "waste," mountains, and moors that were of less value and even frightening, and there were eventually proto-urban settlements with different social groupings and with expanding trade networks (e.g., the Viking routes that encircled Europe by c. A.D. 850 and impinged upon the Caspian by A.D. 880). Many parts of the natural world became commodities to be exploited and sold. No doubt the example of the Romans flowed over into later societies in that respect.

As with most preindustrial societies, there is no doubt that the inhabitants of barbarian Europe were closer to the natural world than their fossil-fueled successors. The story is one of a generally one-way movement toward more intensively productive agro-ecosystems capable, in the end, of supporting craftspeople, aristocrats, merchants, and townsfolk. Granted there were reversals when the pollen diagrams record the recolonization of scrub and woodland, when disease was regionally devastating, or when an authoritative power withdrew, as when the Romans left some parts of northern Europe or when a lord decided to punish his neighbors. In essence, however, the peoples under scrutiny created distinct cultural landscapes, just as happened in the classical world. Many signs of those environments are present in the twenty-first century for the discerning eye and the careful spade to discover.

See also **Star Carr** (*vol. 1, part 2*); **Saami** (*vol. 2, part 7*).

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I. G. SIMMONS

THE ORIGINS AND GROWTH OF EUROPEAN PREHISTORY

Europeans have always been curious about the past, but before archaeology or even antiquarianism came into being, their only notions of remote antiquity came from written records, oral histories, religious beliefs, and above all, legends and superstitions, which often ascribed ancient relics and monuments to the devil, giants, elves, mythological heroes, and the like. Buried antiquities often came to light accidentally, through plowing or construction: large stone tools were explained as thunderbolts, and in eastern Europe, pottery vessels that mysteriously emerged from the ground through the activities of burrowing animals were seen as "magic crocks." In medieval Europe, Christian beliefs ruled supreme, the Bible was seen as literal truth, and it was thought that God created the world in seven days. In 1650 James Ussher, archbishop of Armagh, claimed that the world was created on 23 October 4004 B.C., a calculation that seems ridiculous now but was quite conventional at that time, in an age before techniques were developed that could establish a chronology based on natural science.

From the end of the fifteenth century onward, and especially during the European overseas expansion from the sixteenth to the eighteenth centuries, there were encounters with foreign cultures, many of them "primitive." They were equated in culture and appearance with the ancient peoples of the Old World, who were known from classical sources. This period also saw the rise of antiquarianism, a growing awareness of the remains of the past. In the sixteenth century in particular, some European scholars came to realize that information about the remote past could be derived from the study of field monuments. Thus in 1586 William Camden, for example, published *Britannia,* the first general account of early British remains, including Stonehenge, and the seventeenth-century antiquaries John Aubrey and William Stukeley did pioneering work on British monuments, combining ever improving standards of fieldwork with somewhat uncritical interpretations. Scandinavia, too, produced distinguished antiquaries in this period who studied antiquities and systematically documented ancient remains—especially megalithic monuments and burial mounds.

It was at this time, too, that the first serious attempts to obtain information from excavation took place when the Swedish antiquarian Olof Rudbeck showed that, rather than simply retrieving objects from the ground, one could treat the process like an anatomical dissection and note the objects' relationships to different soil layers. He published stratigraphic sections of the monuments he studied in this way. Similarly, at Cocherel in France in 1685, the nobleman Robert le Prévôt excavated a prehistoric chambered tomb with painstaking care and recorded his discoveries of skeletons and objects with minute detail (fig. 1). In eastern Europe, Jan Johnston, a seventeenth-century physician, explained the mysterious "magic crocks" more rationally as prehistoric urn burials.

One of the most important advances in this period was the discovery of the true nature of early stone tools. A few scholars had observed analogies between the flaked and polished stone artifacts

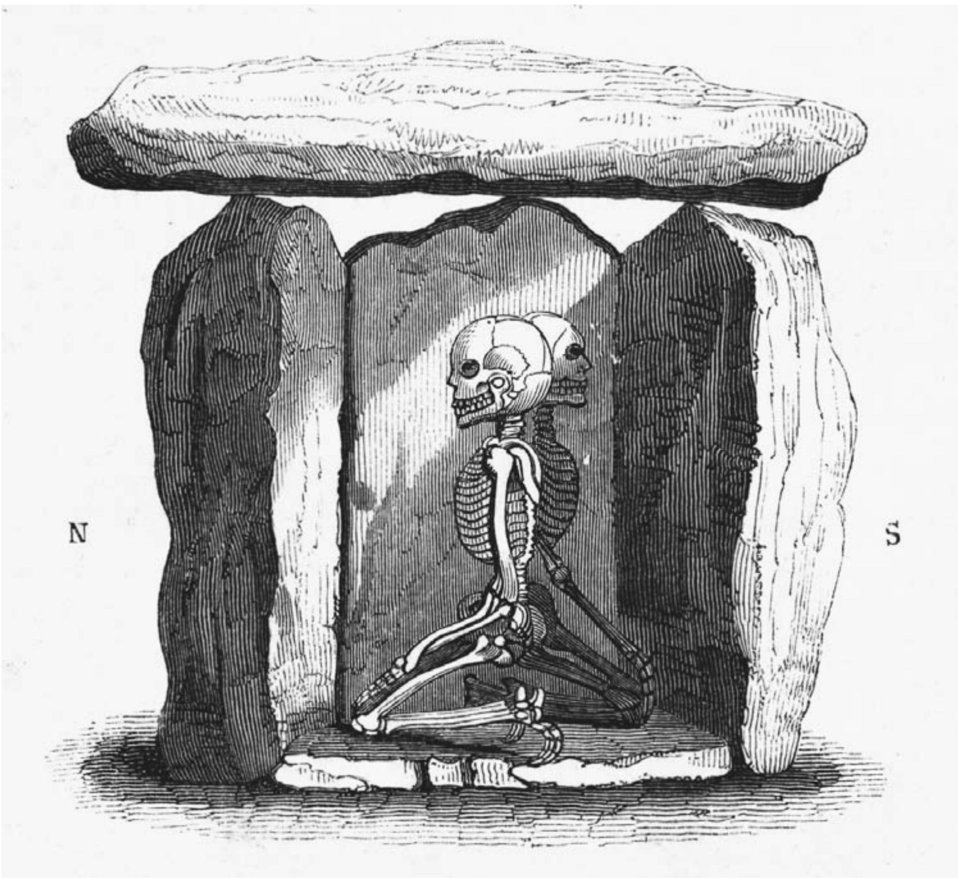

Fig. 1. Fanciful nineteenth-century reconstruction of skeletons in a Danish megalithic tomb. FROM WORSAAE'S *PRIMEVAL ANTIQUITIES OF DENMARK*. BY PERMISSION OF THE SYNDICS OF CAMBRIDGE UNIVERSITY LIBRARY.

brought back by explorers from foreign lands and comparable objects found in Europe. The abovementioned excavations also provided important confirmation of this notion, while in the early eighteenth century experiments began to replicate flint objects and reconstruct the manufacturing techniques of the ancients.

THE ESTABLISHMENT OF PREHISTORY

In the seventeenth century, when increasing numbers of early flint tools were coming to light, the conception of human antiquity still did not extend beyond written memory, and so hand axes, like megalithic monuments, were attributed to Celts or pre-Roman peoples such as the Gauls. A book by the French polymath Isaac Lapeyrère, in which he argued that "thunderbolts" were artifacts of an ancient "pre-Adamite" race, was publicly burned in Paris by the Inquisition, and the author was forced to recant before the pope. By the Age of Enlightenment, in the second half of the eighteenth century, a new spirit of inquiry in all domains had arisen. It included a strong sense of human progress—that is, a conviction that the human condition was improving from cruder beginnings, that the ways of life of contemporary hunter-gatherers thus might resemble those of early Europeans, and that stone artifacts were indeed tools from before the use of iron. Lucretius, a Roman poet of the first century B.C., already had written of the likely sequence of human technologies from stone to bronze to iron. It was only with the reorganization of the Danish National Museum for History in Copenhagen by Christian Jürgensen Thomsen in the early nineteenth century that this "Three Age System" finally became established as the cornerstone of prehistoric chronology. Order was brought to chaos, and objects could be

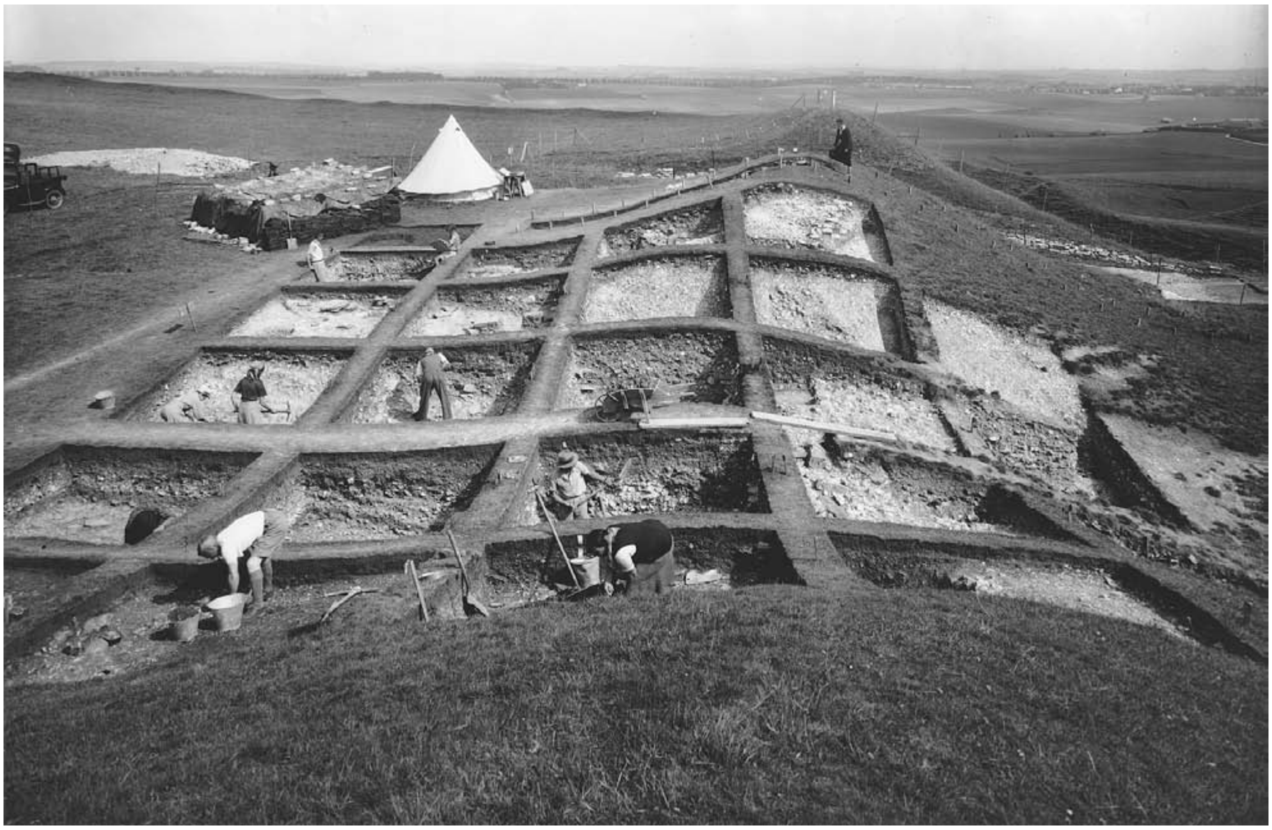

Fig. 2. Excavations at the site of Maiden Castle in England in the 1930s. COPYRIGHT THE SOCIETY OF ANTIQUARIES OF LONDON. REPRODUCED BY PERMISSION.

placed in a sequence, grouped according to the period to which they belonged, and characterized by tools of stone, bronze, or iron.

Toward the end of the eighteenth century, a craze for barrow digging—the excavation of ancient burial mounds—took hold in western Europe (fig. 2). This was a phenomenon that caused terrible damage to numerous ancient monuments, especially as few records were kept and finds were subsequently lost. Some digs nonetheless were noteworthy in Denmark and particularly in Britain, where William Cunnington and Richard Colt-Hoare were pioneers of careful and scientific excavation. They were unable, however, to assess how old the objects they unearthed might be.

In 1797 an English gentleman farmer called John Frere found worked stone tools, including hand axes, in a brick quarry at Hoxne, Suffolk, at a depth of 4 meters (13 feet) in an undisturbed deposit that also contained the bones of large extinct animals. He not only recognized the stones as artifacts but also attributed them to "a very remote period indeed." His publication of the finds went largely unnoticed.

A major turning point came by the mid-nineteenth century, when it finally became established that humans had coexisted with extinct animals. At the beginning of that century, such scholars as François de Jouannet had begun collecting flint tools and visiting caves in the Périgord region of southwestern France, and it became apparent that the cruder flaked tools probably preceded the more advanced polished forms. All such artifacts were attributed to "Gauls." In Britain, William Buckland unearthed a burial, stained with red ochre, in a cave at Paviland in Wales and believed this "red lady" (actually a male) to be Romano-British despite the presence of elephant, rhinoceros, and bear bones. Buckland did not believe in the contemporaneity of humans and extinct animals, but John MacEnery, exploring Kent's Cavern at Torquay in southwestern England, found flint tools mixed with the bones of extinct fauna and became convinced that they were associated.

Similar discoveries were made in other parts of Europe. Paul Tournal, a French pharmacist from Narbonne, through his work at the cave of Bize, came to propose the existence of fossil humans—he also had found cut marks on associated bones of extinct animals. Tournal's great importance is that he stressed the geological evidence and broke the tradition of linking ancient cave deposits with the biblical Flood. By 1833 he already was dividing the last geological period into the historic (going back seven thousand years) and the "antehistoric," of unknown duration. This was the first use of such a term and launched the whole idea of prehistory. It was also Tournal who came to see the disappearance of extinct animals as being due not to catastrophes like the Flood but rather to the same gradual processes of change that are seen in modern times. This approach, of explaining the past through modern laws, was to become even better known through the work of the Scottish geologist Charles Lyell.

In his *Principles of Geology* (1830–1833), Lyell proposed that all past geological processes were the same as those of the present and spanned a tremendously long period, so that there was no need for supernatural catastrophes like Noah's Flood to explain the stratigraphic record, or fossil record. Thanks to his influential work, "catastrophism" gave way to "uniformitarianism," the notion that, if geological processes past and present are uniform, then Earth's surface must have been shaped by sedimentation and erosion over aeons, thus rendering Ussher's date of 4004 B.C. for the creation of the world nonsensical.

One factor that had helped convince Lyell was his visit to the excavations by Jacques Boucher de Crèvecoeur de Perthes at Abbeville, France. Boucher de Perthes, a customs officer and amateur archaeologist, produced a three-volume work, *Celtic and Antediluvian Antiquities* (1847–1864), that drew a clear distinction between the ancient flaked industries (antediluvian) and the more recent polished tools (Celtic). His excavations in the gravels of the Somme region encountered stone tools in deep deposits alongside the bones of mammoths and woolly rhinoceroses.

In tandem with these developments in archaeology, the first solid remains of fossil humans also had been unearthed. In 1833 the Belgian Philippe-Charles Schmerling published the results of his work in caves around Liège, where he had discovered at Engis, for example, what are now believed to be Neanderthal burials. Another Neanderthal was found at Gibraltar in 1848, but it was in 1856, at the Feldhofer Grotto in the Neander Valley, Germany, that the existence of "Neanderthals" finally was proved, despite considerable doubts and skepticism from the scientific establishment. Everything came together in 1859 with the publication of Charles Darwin's *On the Origin of Species by Means of Natural Selection,* a work heavily influenced by Lyell that saw different organisms, including humans, not as the result of divine creation but as the products of natural evolution. Four years later Lyell's own *Antiquity of Man* integrated all these disparate lines of evidence and laid the foundations for both prehistoric archaeology and palaeoanthropology.

GETTING UNDER WAY

Until the mid-nineteenth century, the investigation of the remote past had been a pastime for amateurs and country gentlemen; henceforth it began to turn into a science, with specialist practitioners and established procedures and terminology. In late-nineteenth-century Europe, archaeology developed into a serious scholarly activity in which accurate collection of data was of growing importance. The 1850s, for instance, saw the discovery of the Swiss Neolithic lake settlements, with their extraordinary preservation of organic materials that normally perish and thus elude the archaeologist. In the same period the excavations of Johann Ramsauer began in the huge Iron Age cemetery of Hallstatt in the Austrian Alps, where he investigated a thousand graves over the course of nineteen years and meticulously recorded his findings. In both cases, archaeology began to reveal to the world the sophistication of some prehistoric communities and the extensive trade networks in exotic materials that existed in some areas during prehistory.

Another kind of sophistication—that of the remarkable art of the Ice Age—also came to light during the late nineteenth century. First were the portable carvings and engravings that were unearthed in excavations by such pioneers as Edouard Lartet and Henry Christy in rock shelters of the Dordogne during the 1860s. Their discovery of a mammoth engraving on a piece of mammoth ivory at the shelter of La Madeleine was one of the final decisive proofs of human antiquity. Then came the gradual discovery of paintings and engravings on cave walls in France and Spain, beginning with Altamira in 1879, found by the little daughter of the Spanish polymath Marcelino Sanz de Sautuola. For a variety of reasons, the world was not ready to accept that such splendid artistic creations could have come from the "primitive savages" of the Stone Age, and so cave art had to wait another two decades to be authenticated and accepted by the ever reluctant scientific establishment. In 1902 the Montauban Congress of the French Association for the Advancement of Sciences officially accepted cave art based on the accumulated evidence from caves in Southwest France.

Pioneering excavators, such as the Abbé Pouech in France and William Pengelly in England, independently developed a method of laying out a grid over their sites, to record the position in three dimensions of each bone or artifact. Sir John Lubbock, in his *Prehistoric Times* of 1865, introduced the terms "Palaeolithic" (Old Stone Age, or period of flaked stone) and "Neolithic" (New Stone Age, or period of polished stone). The first journal devoted to prehistoric research, the *Matériaux pour l'histoire positive et philosophique de l'homme,* was founded in France in 1864, followed a year later by Germany's *Archiv für Anthropologie.* Lartet had proposed the first classification of prehistoric times based on animal palaeontology (e.g., the cave-bear age and the reindeer age). This was replaced in 1869–1872 by Gabriel de Mortillet with a classification based on stone tools rather than fauna and with each phase named after a "type site," for example, the Aurignacian, named after the French rock shelter of Aurignac.

Another French scholar, Edouard Piette, was responsible for filling the apparently empty hiatus between the end of the Palaeolithic and the start of the Neolithic. In his excavations at the huge cave of Le Mas d'Azil, he established the existence of transitional phases, such as the Azilian, characterized by painted pebbles and small harpoons. Other later industries eventually were given their own names, collectively forming the "Mesolithic," or Middle Stone Age. It was also Piette who initiated a young French priest, Henri Breuil, into the study of prehistory—Breuil was to become a dominant figure throughout the first half of the twentieth century not just in his specialized field of Ice Age art but in the whole of prehistory.

GREAT EXCAVATIONS

As archaeology became more professional and painstaking toward the end of the nineteenth century and in the early twentieth century, the most crucial new emphasis was on establishing the context of finds, as a source of information. In this respect, the preeminent practitioner was General Augustus Henry Pitt-Rivers in England. He investigated prehistoric and Roman sites on his vast estates and used his military discipline to devise fastidious new techniques of excavation and recording, attaching particular importance to "common objects" and "trivial details" to be able to date and interpret archaeological sites. Other important excavations in this period occurred in Scandinavia. The Bronze Age burial mound of Borum Eshøj (Denmark) was found to contain two tree-trunk coffins holding a young man and an elderly woman, whose clothing was exceptionally well preserved by waterlogging. In Serbia the Neolithic tell mound of Vinča, near Belgrade, was excavated by Miloje Vasić and became a chronological yardstick for the whole of the Balkans. And in the northern Caucasus, Nikolai Veselovskii dug a Bronze Age burial mound at Maikop in 1897 and found a wooden mortuary house holding several skeletons with extraordinarily rich grave goods of gold, silver, textiles, and other exotic materials.

Perhaps the most famous excavations at this time in European prehistory were those of the German Heinrich Schliemann at Mycenae and the Englishman Arthur Evans at Knossos in Crete. Schliemann began work in Anatolia at Troy in 1870, but in 1876 he turned his attention to Mycenae on the Greek mainland, where he discovered Bronze Age royal shaft graves with their famous gold face masks. Evans revealed the pre-Mycenaean Minoan civilization of Crete in the palace of Knossos with its colored frescoes.

The increasing care with which excavations were being carried out together with the chronological schemes being devised and the unearthing of key stratigraphies, such as Vinča, led to a major focus on typology and chronology at this time. Classes of objects were arranged into linear series, usually with the simplest at one end and the most complex at the other. The leading typologist of this kind was the Swedish scholar Oscar Montelius, who eventually was able to propose a division of the northern Bronze Age into a series of six consecutive phases, based on gradual changes in artifact types. Such schemes led to the possibility of cross-dating similar objects from different places, and by linking some northern European artifacts to finds from the Aegean and Egypt, where some actual dates were available, one could deduce certain dates for various phases in other parts of Europe. In the absence of a method of obtaining absolute dates in any other way, the chronological priority of the Aegean and Egypt dominated prehistory until after World War II and encouraged the view *"Ex oriente lux"*—that all aspects of civilization had come to northern Europe from the eastern Mediterranean. One disadvantage of this approach to prehistory was that in compiling the anonymous typologies of artifacts, with different kinds moving around and spreading, scholars tended to lose sight of the people who made them.

THE TWENTIETH CENTURY

The mid-twentieth century saw a number of revolutions in prehistory. Naturally, important discoveries were made at regular intervals, such as the Ice Age decorated cave of Lascaux in 1940, but advances in other fields and in science were far more crucial—aerial photography, pollen analysis, and especially radiocarbon dating. Aerial photography (the first archaeological air photos were taken of Stonehenge in 1906) rapidly grew to become an invaluable tool, offering views of entire landscapes, detecting earthworks and more subtle soil or crop changes, and making it possible to discover and study numerous hitherto unknown sites.

On the ground, excavation techniques continued to become more rigorous, and the number of professional archaeologists grew apace. The most eminent figure of the period undoubtedly was Sir Mortimer Wheeler in Britain. He followed Pitt-Rivers's military tradition, demanding discipline on his sites (such as Iron Age hillforts), with careful record keeping and prompt publication and particular stress on a site's stratigraphic sequence as a key to its dating and interpretation.

In the 1930s and 1940s, environmental specialists became increasingly involved in excavation and fieldwork. Once again Scandinavians were the pioneers, producing the first landscape studies by the end of the nineteenth century. The Scandinavian scientist Lennart von Post developed a technique for reconstructing ancient vegetation by counting the pollen grains surviving in each layer of a core sample. Together with the ever-increasing refinement of the study of animal bones, plant remains, insects, and other organic material, pollen analysis offered tremendous insights into ancient climate, environment, and agriculture. The most famous approach, which firmly integrated environmental studies with the highest standards of excavation, was that of the British prehistorian Grahame Clark, as exemplified in 1949–1951 at the Mesolithic site of Star Carr—a lakeside site where waterlogging had preserved wooden tools and other organic objects. Other botanical work in this period, such as analysis of the stomach contents of Tollund Man, one of the preserved Iron Age bog bodies in Denmark, helped bring the past to life for the public.

Excavation of open-air sites, rather than caves and shelters, began to open up large areas instead of small squares or test pits—from Germany to the Soviet Union, great expanses were uncovered to trace the plans and distribution of structures. Overall, excavations became extremely slow, painstaking dissections by multidisciplinary teams concerned with placing the occupants of a site into their cultural and environmental context and recovering every possible scrap of information. The aim of archaeology was no longer the simple unearthing of precious or interesting objects but rather the solving of problems and retaining representative samples of bones, pollen, and sediments for laboratory analysis. At the same time, it became possible to produce broad syntheses, assimilating material from many different areas into an integrated picture of the past. By far the greatest specialist in this exercise was the Australian Vere Gordon Childe, who not only published extremely influential syntheses of European prehistory and coined the terms "Neolithic Revolution" and "Urban Revolution" but also developed and popularized the concept of an archaeological culture. Such a culture was defined as a set of artifacts, limited to a particular time and place, that seem to represent a distinct people or ethnic group.

World War II, like World War I, had a devastating effect on archaeology in Europe through the general cessation of excavations, the drafting or demise of notable archaeologists, and the destruction of sites and collections. The mid-twentieth century also saw the manipulation of archaeology by Nazism in Germany and Stalinism in the Soviet Union. The Nazis, in particular, poured money into archaeological research, aiming to establish both the antiquity of German settlement across much of Europe and German superiority over other European peoples. One benefit that the war brought to archaeology was the invention of radiocarbon dating, which arose from the atom bomb research of the American chemist Willard Libby. His method has been the single most significant advance in the history of archaeology, with a truly revolutionary impact on the field. For the first time it proved possible to obtain an absolute age for organic materials, such as wood, charcoal, or bone, and thus released archaeologists from the endless need to spend time on artifact typologies and indirect dating. It meant that different avenues could be explored and different questions asked.

As such direct dating hitherto had been unhoped for in the field of prehistory, the first results provided by scientists were eagerly and uncritically accepted by most archaeologists. It rapidly became apparent from conflicts with already well-established calendar dates from the eastern Mediterranean, however, that all was not well with some radiocarbon ages. By the 1960s it was known that the results for some periods were unreliable, differing significantly from definite ages fixed by documents or tree rings and that certain other results needed to be corrected or "calibrated" to convert them from radiocarbon years to calendar years. One effect of this phenomenon was that the ages of the megalithic monuments of western Europe were pushed back, thus severing any possible links with the civilizations of the eastern Mediterranean, which had hitherto been seen as the sources of all such ideas and monuments.

LATER DEVELOPMENTS

The last two decades of the twentieth century saw further advances in the scientific techniques available to archaeologists: a wide range of dating methods for a variety of materials, more accurate instruments for "seeing" beneath the soil, the use of satellites and the global positioning system (GPS), and the ubiquitous influence of computers. The application of sampling techniques and statistical analyses has become more sophisticated. Archaeology as an academic subject has increased steadily in popularity, while a far higher percentage of resources has been diverted from research to salvage projects involving surveys and excavations ahead of the bulldozers and developers. At the same time there have been numerous different theoretical approaches to the study of the past, particularly in some parts of northwest Europe.

"Processual archaeology" arose in the 1960s, primarily in the United States, in an attempt to develop archaeology as an explicit science detached from the historical sciences that supposedly had hampered its development. Processual archaeology insisted that hypotheses had to be deduced from general principles and then tested against independent data, but very few people, least of all the main proponents of processual archaeology, ever bothered to test their hypotheses in this way. Many archaeologists remained extremely skeptical of the entire approach and simply carried on as before. Some of the proponents engaged in largely fruitless attempts to define universal laws of human behavior as deduced from archaeological analysis. More lasting and worthwhile was a notable advance in investigation of how the archaeological record reflects past human behavior, how it is produced, and the transformational processes that a site undergoes before excavation.

This "revolution" inevitably brought a reaction and rejection, which came in the late 1970s in the form of "post-processual archaeology." Moving away from the determinism of the earlier approach, it emphasized the role of social mores, politics, and ideology in how archaeologists produce their interpretation of the past. No knowledge is politically innocent, no archaeological statement can be truly objective, and claims about the past cannot be ranked. Since then approaches to archaeology have splintered. At the beginning of the twenty-first century, no particular trends were discernible; indeed there has been a widespread return to basic fieldwork and excavation, while the theoretical squabbles and clamoring of the late twentieth century have died away.

Major discoveries certainly will continue, as will the ability to extract increasing amounts of information from the data, helped by new scientific techniques as yet undreamed of. What can be learned today from a prehistoric site would amaze the great pioneers of the nineteenth century let alone the seventeenth century, but in view of the constantly accelerating developments in technology and science, one cannot possibly imagine what will be learned from the sites of the future.

See also **Tollund Man** (*vol. 1, part 1*); **Maiden Castle** (*vol. 1, part 1*); **Star Carr** (*vol. 1, part 2*); **Neolithic Lake Dwellings in the Alpine Region** (*vol. 1, part 4*); **Stonehenge** (*vol. 2, part 5*); **Hallstatt** (*vol. 2, part 6*); **Hillforts** (*vol. 2, part 6*).

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PAUL G. BAHN

THE NATURE OF ARCHAEOLOGICAL DATA

FOLLOWED BY FEATURE ESSAY ON:

While historians use written records, such as diaries, journals, and account books, to reconstruct the past, prehistoric archaeologists rely primarily on material remains. Examples of such remains include pottery fragments, house foundations, and bones from butchered animals. The methodological challenge facing all archaeologists is to determine how these material remains can be used to reconstruct past ways of life and the ways in which prehistoric societies changed through time. Material remains include three types of data—artifacts, features, and "ecofacts."

ARTIFACTS

Artifacts are portable objects that are either made or modified by humans. In prehistoric European sites, some of the most common types of artifacts are stone tools, pottery, and metal objects.

Stone tools are most often found on Mesolithic and Neolithic sites, although they continued to be made throughout much of the Bronze Age in some parts of northern Europe. Chipped-stone tools are made of amorphous materials—those that lack obvious planes of cleavage. In Europe, chipped-stone tools are most often made of obsidian, a volcanic glass that was widely traded throughout the Mediterranean, and flint.

The simplest way to produce a stone tool is to strike a block, or core, of stone with a hammer stone, a technique known as direct percussion. The resulting flake has a sharp edge and can be used for a variety of cutting and slicing tasks. Longer, narrower flakes, known as blades, can be produced by placing a punch made of bone, antler, or wood between the hammerstone and the core. Microliths, which are commonly found on many European Mesolithic sites, can be produced by snapping a flint blade into many small, geometric pieces. These microliths are commonly used as barbs on arrowheads. A different method of stone tool manufacture, grinding or polishing, became prevalent during the Neolithic period. While modern archaeologists view the Neolithic as the period when farming spread across Europe for the first time, the original meaning of the term "Neolithic" is "new stone age," the period when ground and polished stone tools first appeared. Polished stone axes and adzes (a tool with the blade set perpendicular to the handle) can be used for woodworking and for forest clearance.

A second major class of artifacts is pottery. While some pottery was produced at Mesolithic sites in northern and eastern Europe, it became widespread during the Neolithic period. Pottery is made of clay, a plastic material (meaning it can be molded or modeled) that can be manipulated into a wide range of forms, including cooking pots, pitchers, cups, storage jars, and even sculpture and other art objects.

Pottery vessels can be formed in a variety of different ways. They can be molded by hand, an example of which is the coiling technique, where coils of clay are used to create the general outline of the vessel and then are smoothed to form its final shape. During the Roman era and the Early Middle Ages, some pottery was also made using a potter's wheel. For example, Ipswich ware was produced in Ipswich, England, between the seventh and ninth centuries A.D. using a slow wheel.

During pottery production, the clay is combined with a nonplastic material known as temper to minimize cracking and shrinkage during firing. A variety of different materials were used as temper in prehistoric Europe, including shell and chaff. Pottery vessels can then be fired in either a bonfire or a kiln. During firing, the clay undergoes an irreversible chemical change, producing a material that is both durable and watertight. Pottery vessels can be decorated in a variety of ways, including painting and burnishing (polishing)—usually with a smooth stone. Since pottery fragments are durable and the techniques of manufacture and decoration vary according to both time and space, pottery is especially useful for defining and recognizing different archaeological cultures (see below). For example, the *Linearbandkeramik* (LBK) or Linear Pottery culture, which is associated with the first farmers of central Europe, is usually recognized by its distinctive pottery with incised curvilinear decorations.

Metal objects are the third principal class of artifacts found in European archaeological sites. Objects made of copper, silver, and gold are often found on later Neolithic sites in Europe. For example, Ötzi, the famous "Iceman" discovered on the border between Austria and Italy in the early 1990s, was carrying a copper axe when he died. Metal objects became far more common during the subsequent Bronze and Iron Ages. During the late third millennium B.C., the use of bronze (typically an alloy of 10 percent tin and 90 percent copper) became increasingly widespread. During the first millennium B.C., iron gradually replaced bronze for tools and weapons. By the end of the first millennium B.C., iron was produced on a very large scale in many parts of central Europe, and everyday items, such as agricultural tools, were commonly made of iron. Coins, made of a variety of metals and alloys, also become common in the later Iron Age and the Early Middle Ages.

Many other artifacts from prehistoric Europe were made of organic materials, such as bone, antler, wood, linen, and wool. Bone and antler working is well documented from the Early Mesolithic onward at sites such as Star Carr in England. Bone continued to be widely used in Europe until the early twentieth century, when it was finally replaced by plastics. Bone and antler survive quite well in nonacidic soils, and worked bone and antler tools, such as points and combs, are known from many prehistoric and early medieval sites in Europe.

Other organic materials, such as wood, decay rapidly and survive only under special circumstances, such as waterlogging. Waterlogging produces an anaerobic environment that inhibits the action of bacteria and other microorganisms that typically destroy organic materials. Wooden canoe paddles have been recovered from the submerged Mesolithic site of Tybrind Vig in Denmark, and small wooden boats have been recovered from a variety of waterlogged sites that date from the Mesolithic period through the Early Middle Ages. In addition, small fragments of textiles sometimes survive when they are in direct contact with metal objects. For example, the textile remains that have been recovered from the Viking period trading colony of Birka in Sweden have shed light on the nature of clothing and textile manufacture in northern Europe during the Early Middle Ages.

FEATURES

Features can be thought of as nonportable artifacts. They are structures that cannot be moved about but that were constructed or modified by prehistoric people. Typical examples of archaeological features include pits, ditches, middens (trash heaps), house foundations, fortifications, hearths, and field boundaries. Some archaeological features are more visible than others. For example, the small huts at the Early Mesolithic site of Mount Sandel in Northern Ireland are marked by a circular series of small stake holes set at an angle. No traces of these small stake holes were visible on the surface of the site prior to excavation. On the other hand, large earthworks, such as the series of earthen banks and ditches that surround the Iron Age hillfort of Maiden Castle in southwestern England, are a visible part of the landscape. Buried archaeological features can sometimes be identified using aerial photography, a technique that was first used by archaeologists after World War I. Small irregular earthen features, such as traces of ancient plowing, cast small shadows that are visible from the air early in the morning and late in the evening. Cereal crops and grass growing over excavated features, such as pits and ditches dug into the subsoil, appear greener than the surrounding vegetation during periods of drought. While these crop marks are best seen from the air, they are also visible on the ground and were first recognized by the British antiquary William Camden in the sixteenth century.

Graves are a particularly important class of features. Many human graves include grave goods—items that were placed into the grave to accompany the dead. Grave goods can include clothing, dress fasteners, jewelry, and ceramic and metal vessels that may hold food or drink, tools, weapons, and occasionally animal or human sacrifices. In some burials, bodies were placed directly into the ground, while others employed coffins or more elaborate funeral chambers. Graves are of particular interest to archaeologists since all the items within a single grave were buried at the same time. Some of the best-known examples of graves from late prehistoric and early medieval Europe include the Late Hallstatt (c. 600–480 B.C.) "princes' graves" from west-central Europe and the Early Anglo-Saxon (seventh century A.D.) boat burials from Sutton Hoo in eastern England.

Cremation entails burning the body as part of the funerary rite. The remains of the cremation, including ash, bone fragments, and the remains of burnt grave goods, are sometimes placed in ceramic urns and then buried. The Urnfield burials of Late Bronze Age central Europe are among the most renowned examples of cremation burials in European archaeology.

ECOFACTS

Some archaeologists use the term "ecofacts" to describe a third class of material remains that are commonly recovered from archaeological excavations. Ecofacts are not necessarily made or modified by humans, but they do provide information on prehistoric environments and the ways they were used by early peoples. Common types of ecofacts include animal bones (sometimes termed "faunal remains"), seeds and other plant remains, and plant pollen.

Animal bones are recovered in large numbers from many prehistoric and early medieval sites in Europe. For example, over 2 tons of animal bones were recovered from the Early Anglo-Saxon (c. 420–650 A.D.) village of West Stow in eastern England. Experienced zooarchaeologists (archaeologists who study faunal remains) can use the bones to identify the species and the part of the skeleton from which these animal bones come. In some cases, the sex and the age of the animal can also be determined. Faunal remains can be used to reconstruct hunting patterns, animal husbandry practices, and diet.

Plant remains are also important in the study of past farming practices and diet. Most studies of archaeologically recovered plant remains have focused on seeds, most of which survived to modern times because they were charred or waterlogged. In addition, impressions of seeds are sometimes preserved in pottery vessels and other fired-clay objects. Studies of Neolithic seed remains indicate that emmer wheat was the most common crop grown at early farming sites in central Europe. Studies of other plant remains, such as tubers, are still in their infancy. However, pioneering studies of the fleshy parts of plants have shown that tubers, such as wild beets, were collected by the Mesolithic inhabitants of the Netherlands.

Prehistoric pollen grains are commonly recovered from lake beds and archaeological sites. Pollen, along with other forms of biological and geological evidence, can be used to reconstruct the vegetational history of different regions of Europe. One of the earliest and best-known applications of pollen analysis to archaeology is the reconstruction of the Early Postglacial vegetational history of southern Scandinavia. The pollen profiles document how pioneer species of trees, such as birch, pine, and willow, were gradually replaced by trees, such as oak and linden, during the reforestation of Europe at the end of the Ice Age.

SITES

A site is defined as any concentration of artifacts, ecofacts, or features that marks a location of past human activity. Settlement sites are locations where prehistoric and early medieval people lived on either a temporary or a permanent basis. They can range from temporary camp sites, such as the Early Mesolithic site of Star Carr in Yorkshire, where hunter-gatherers resided for a few weeks, to farming villages of the Early Middle Ages that were permanently occupied for several centuries. Prehistoric Europeans also made use of quarry sites and mines to obtain raw materials, such as flint, salt, and metal ores. Cemetery sites first appear in the Late Mesolithic period in northern and eastern Europe. They are important sources of information on social organization, gender, and prehistoric ideology. Ritual or ceremonial sites, such as megalithic tombs and stone circles, can also shed light on prehistoric religion and cosmology. For example, excavations at the Iron Age site of Dún Ailinne in Ireland have revealed a series of large circular wooden structures that appear to be associated with the late prehistoric kings of Leinster. The site also appears to have served as a center for ritual feasting.

In the late twentieth century, archaeologists moved beyond the study of individual sites to examine the broader questions of prehistoric landscapes. Modern European archaeologists are concerned with the spatial relationships between archaeological sites of the same period and between individual sites and surrounding geographic features, such as lakes, rivers, forests, mountains, and valleys. Archaeologists have attempted to reconstruct the views and lines of sight from major prehistoric monuments. Stonehenge, for example, undoubtedly one of the most important sites in all of European prehistory, is situated in an agriculturally rich region in southern England known as the Downs and is surrounded by a series of wealthy burials, each of which was covered with a large earthen barrow.

INTERPRETATION: USING MATERIAL REMAINS TO RECONSTRUCT THE PAST

Archaeologists derive meaning from artifacts, features, and ecofacts by examining which kinds of remains are associated with one another, how they are distributed spatially, and how they relate to the larger landscape and environment in which they are found. A key to the interpretation of material remains is the notion of archaeological context—the location of a find within a site and its relationship to other material remains. For example, a pottery vessel found near a hearth in a kitchen may have a very different meaning than one found within a burial pit. In order to preserve as much information as possible about archaeological context, archaeologists typically record the exact three-dimensional location of artifacts and features within a site. They also record the type of matrix (soil) in which an artifact is found and the artifacts that are associated (found together) with it. Looting (the illegal removal of artifacts from archaeological sites) destroys all information about the archaeological context of the finds. Because their context has been destroyed, looted artifacts can tell very little about the past.

Archaeological deposits are frequently stratified, or formed in a series of layers. The law of superposition indicates that the deepest stratum or layer was deposited first, and the uppermost was deposited last. Interpretation of the sequence of strata allows archaeologists to see changes through time. For example, in the early nineteenth century, Christian Jurgensen Thomsen, the first curator of the Danish National Museum, argued that stone artifacts were generally older than metal ones. The detailed excavations of his student, Jens Jacob Asmussen Worsaae, revealed that archaeological layers that contained only stone artifacts were always stratified below those that contained both stone and metal objects.

Archaeologists are also interested in studying variations in material culture across space. Archaeologists use the concept of archaeological culture to describe groups of artifacts and features that are found together repeatedly. As noted above, the *Linearbandkeramik* farmers of central Europe made distinctive pottery that was decorated with curvilinear designs. These early farmers lived in rectangular timber longhouses, grew emmer wheat, and kept cattle, pigs, and sheep. The *Linearbandkeramik* is a classic example of an archaeological culture. Archaeological cultures are limited in both time and space. LBK farming sites are spread across central Europe from France to Hungary, and most LBK sites date to the later sixth millennium B.C. It is not known whether or not all the LBK people spoke the same language or whether or not they would have recognized each other as members of a single ethnic group. However, archaeological cultures are useful in studying spatial and temporal variations in human behavior.

Under ideal circumstances, artifacts are found exactly where they were lost or discarded by prehistoric people. In the real world, a wide range of cultural and natural processes may have affected material remains between their abandonment by prehistoric Europeans and their discovery by modern archaeologists. As discussed above, many organic artifacts begin to decay in a matter of weeks or months. Plowing, construction, and burrowing animals can disturb features and remove artifacts from their original position. Looting also damages sites. Archaeologists must carefully assess ways in which their sites were modified by postdepositional processes, such as plowing, before they can use material remains to study the past. Understanding how the archaeological record is formed allows archaeologists to use material remains to reconstruct past lifeways and understand patterns of cultural change.

Some scholars argue that archaeological research is like putting together a jigsaw puzzle that is missing many of its pieces and that has no picture on the box. Others argue that archaeologists are more like detectives, piecing together past behavior from small clues. The archaeological record, like this historical record, is fragmentary and will never provide a complete picture of prehistoric life. However, archaeologists are constantly seeking new analytical techniques that will allow them to extract additional information from material remains.

See also **Maiden Castle** (*vol. 1, part 1*); **Tybrind Vig** (*vol. 1, part 2*); **Mount Sandel** (*vol. 1, part 2*); **Star Carr** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Stonehenge** (*vol. 2, part 5*); **Late Bronze Age Urnfields of Central Europe** (*vol. 2, part 5*); **Ipswich** (*vol. 2, part 7*); **Sutton Hoo** (*vol. 2, part 7*).

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TOLLUND MAN

One of the best-known of a series of bog bodies from the Early Iron Age (500 B.C.–A.D. 1) in northern Europe is the Tollund Man. The well-preserved body was discovered during peat cutting on 8 May 1950 in Tollund Mose, near Bjælskov Dal in central Jutland, the western part of present-day Denmark. The peat cutters suspected a crime and notified the police at the nearby town of Silkeborg. The extraordinary character of the find was nevertheless soon realized, and the preeminent Danish archaeologist P. V. Glob was called in as a specialist.

The body had appeared approximately 2.5 meters below the modern surface covered by a thick layer of peat. The entire body was lifted out of the bog in a crate, and excavation was carried out at Silkeborg Museum, where the Tollund Man (at this writing) is kept. The head was treated in a pioneering way by a conservator-restorer in 1950: it was dehydrated with organic solvents followed by impregnation with wax. The body proper was reconstructed in 1987 based on the dehydrated remains and on original photos.

The deathbed of the deceased was a thin layer of peat near the sandy bottom of the peat bog; in fact this was the very surface of the bog when the body was deposited 220±55 B.C. (based on radiocarbon dating of soft body tissue). In conventional terms this dates the body to the middle part of the pre-Roman Iron Age. Tollund Mose is a so-called raised bog, which never ceases to grow and which, due to specific physical and chemical conditions, tends to preserve organic materials. Bog bodies recovered in such conditions often look as if they were buried only recently. Bacterial growth is typically stopped and nails, hair, and skin of bog bodies become tanned.

The Iron Age man recovered at Tollund was lying in a natural position of sleep on his right side, facing south, about 50 meters from the bog shore. He was naked except for an oxhide belt around his hips and a pointed cap on his head. The cap was made of pieces of sheepskin sewn together with the woolen side turned inward and fastened securely under his chin by a hide thong. His hair was cut very short. His face was clean-shaven but with stubbles of beard clearly visible on his chin and upper lip. Around his neck was a tightly tied leather strap, which had cut a deep groove in the soft skin of his neck and throat and which was found coiled over his shoulder and down his back. The man had evidently died by hanging. The carefully closed eyes, the resting position of the body, and relatively peaceful expression of the face together suggest that he was carefully deposited in the bog almost as if properly buried. Nonetheless, the circumstances are much in contrast to the normal local burial custom of the age, which involved cremation with the ashes placed under a stone circle in a cemetery.

A series of post-excavation examinations indicate that the Tollund Man was forty to fifty years old and in good health except for the occurrence of whipworms. He had eaten a purely vegetarian meal twelve to fourteen hours before his death. The porridge contained barley, wheat, and flax in addition to a large number of wild seeds, and it was prepared using bog water. Some of the seeds derive from rather rare plants, perhaps indicating that the last meal was a ritualized one.

Another strangulated body, the so-called Elling Girl, had been found in 1938 merely 61 meters from the Tollund Man. Still another body is known to have been recovered in 1927 in the same peat bog. The Elling Girl was, on discovery, wrapped in a sheepskin cape with a leather cloak round her legs, indicating that she too had been cared for. Her long hair had been gathered on top of her head and then braided and tied to the nape of the neck, probably prior to the hanging. She was about thirty years old and had died at approximately the same time as the Tollund Man.

Several bog bodies are known from northern and western Europe. Most of them date to the earlier Iron Age. The Grauballe Man was found in Nebel Mose, also in the Silkeborg region, in 1952. He had died 265±40 B.C. and had eaten roughly the same kind of meal as the Tollund Man. Before he was deposited in the peat bog he had had his throat slit so savagely that it almost severed his gullet. In addition, he had received a hard blow across one temple and one of his legs had been broken. Other bog bodies discovered on the Jutland Peninsula include those from Borremose in Himmerland, which were retrieved near a fortified pre-Roman Iron Age village; the Gundestrup cauldron, a contemporaneous piece of Celtic gilded silverwork, was found in this same area. Bog bodies from elsewhere include the Lindow Man, the Huldremose Woman, the Haraldskjaer Woman, the Roum Girl, the Windeby Girl, and the Rendswühren Man. Common to them is that they show signs of untimely and very violent deaths and that they received an extraordinary burial in a watery place. Such places were throughout prehistory in Europe believed to be inhabited by the gods, who on special occasions demanded material gifts and sometimes even human sacrifice. The Tollund Man and fellow victims offer unique possibilities of gaining insight into the sinister side of Early Iron Age communities.

In her 2001 study titled *Dying for the Gods,* Miranda Green suggests on the basis of archaeological and written sources that ritual killing was a rare but nevertheless constant feature of Iron Age Europe. Such extraordinary ritual activities were a cognitive response to a world that was thought to be inhabited by supernatural forces. These might be malignant or benign depending on how they were treated. Times of war and crisis especially would have motivated people to seek the favors of the gods. Victims probably were mostly prisoners and hostages of war, whose social status and standard of living varied widely, to judge from their personal appearance and nutritional state.

See also **Pre-Roman Iron Age Scandinavia** (*vol. 2, part 6*).

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HELLE VANDKILDE

SURVEY AND EXCAVATION

FOLLOWED BY FEATURE ESSAY ON:

It is common for a barbarian society to have left no written record of its way of life and its achievements. For still other such societies, the written record is extremely thin and fragmentary. In short, the historical documents that are available for study in both cases fall far short of providing a comprehensive picture of a particular society. Thus, before the advent of archaeology, there were clear limitations to knowledge of the life of these societies. Archaeology is now the primary avenue for increasing understanding of what happened in the remote past. For the archaeologist, the process of discovery normally begins with fieldwork. There are two main lines of investigation in the field. One is the survey; the other is excavation. Here, these investigative methods are described, and the ways in which they play complementary roles in archaeological research are explained.

THE SURVEY

Of the two methods, the survey is the least well known to the general public, owing to the comparatively late development of this line of investigation. In terms of the history of archaeology, there were very few places in the world where a field survey was carried out in the years before 1960. Thus, compared with excavation, survey is a newcomer. Only in the last forty years of the twentieth century did this kind of fieldwork begin to make a real contribution. At the most basic level, the survey covers a broad landscape and maps the scatters of archaeological remains that are found on the surface.

The survey crew examines the ground in a systematic way and identifies the surface scatters that are present within the area of the survey. Once a scatter (conventionally called a "site") is recognized, its position is plotted on the map, and other information about its location is recorded: the site's elevation, the distance from the site to the nearest source of freshwater, and the position of the site with respect to natural lines of communication in the region. In addition, the field crew collects at least some of the archaeological materials (pieces of pottery, stone tools, and so forth) from the surface of the site.

At a higher level, the goal of the survey is to discover and record all of the sites that are present in those places covered by the survey. Because the sites that are recovered date to different periods of time, the archaeologist is interested in studying the changes in the spatial distribution of sites from one time period to the next. In other words, the central question for the survey archaeologist is how the settlement pattern in a given region unfolds over the course of time. Thus, once the coverage of the landscape has been completed in the field, the work turns to the preparation of site-distribution maps for the respective periods. By means of the comparative study of this series of maps, it is possible to trace the long-term evolution of patterns of settlement in the region under investigation.

THE EXCAVATION

In contrast to the survey's broad outlook, the excavation focuses on the individual site. This line of fieldwork allows the archaeologist to plumb the depths of a given site in greater detail. As one digs down through the layers at a site, there is the opportunity to document the stratigraphy of the site. In turn, the stratigraphic sequence plays a key role in working out the site's chronology. The relative age of a given layer is determined by its relationship to the layers above and below it. Technically, this is known as the law of superposition. (As in the case of geology, the layer, or stratum, on top is younger than the one below.) The stratigraphic sequence at an archaeological site is documented by drawing the sections that are exposed by the dig. The excavation also permits the archaeologist to uncover the internal layout of the site. In the case of the Iron Age hillfort of the Heuneburg overlooking the Danube River, this layout takes the form of several rows of rectangular, timber-framed houses located inside the site's defensive wall. To record the structural remains (hearths, houses, fences, drainages ditches, and so forth) brought to light by the excavation, plans are drawn and photographs taken during the course of the work.

Because of movies, television documentaries, and the popular press, many people have an idea about what takes place in the context of archaeological excavation. The treatment of excavation in the media—with its inevitable focus on the moment of great discovery by the lone archaeologist—often fails to give a true picture of this kind of work, however. Instead of picking up misguided ideas from the media, one needs to think about excavation in more realistic terms. To begin with, one must set aside the notion that the "dig" commonly involves moments when remarkable finds are suddenly brought to light. On most excavations, this rarely happens. Most of the work that is done is much less eventful. The excavation calls for sustained and patient work day after day, first in cleaning each new stratigraphic unit and then in documenting it. The excavation is like a marathon race: the archaeologist sets out on a long, slow run that is likely to be parsimonious in its moments of excitement.

It is worth recalling that the archaeologist is responsible for the proper recovery and documentation of all that comes to light during the course of excavation and not just those things that he or she may find of special interest. At the same time, one of the keys to the success of the excavation is teamwork. The dig is no place for the individualist. The members of the crew must have the training and experience needed to perform their respective tasks skillfully, and under the leadership of the director at the site, they have to work together as a team.

Since archaeological sites vary widely from one to the next, there is no one best approach to excavation. The methods that the archaeologist employs need to be tailored to the specific nature of the site. For example, at the small hunting camp of Pincevent in France, which was occupied some fifteen thousand years ago, each piece of worked stone was carefully exposed in place, and its position or provenance then was plotted in three dimensions. This was done for individual pieces of bone and other classes of material culture as well. An attempt was made at total recovery in the context of an entire site.

In contrast, the excavation of the early medieval town of York in northern England had to deal with a much larger and more complex site, which produced vast quantities of cultural remains. There, the earliest archaeological layers are buried deeply in the ground, and the town as a whole can be uncovered only by means of a series of excavations over many years. In addition, York is a rescue excavation, where the archaeologist has to complete the dig by a fixed date and where the fieldwork may well be the last chance to investigate the site before it is transformed by modern urban development. In other words, much depends not just on the kind of site but on the purpose of the excavation. If research is the primary motivation for the dig, the excavator is likely to place greater emphasis on fine-grained recording and to ask a wide range of specialists to collaborate in the project. If the work is done because the site is threatened and a rescue excavation has to be undertaken with limited resources, then a more practical approach will have to be adopted.

Moreover, local environmental conditions can influence the kinds of objects that are preserved at a site and, in turn, the appropriate methods of recovery. For example, in an area with wetland conditions of preservation, such as the Somerset Levels in Southeast England, two-thirds of the finds recovered can take the form of organic materials (wood, seeds, leaves, and so forth). Accordingly, special methods must be used in the excavation and the conservation of what is found at such a site.

The main implication is that excavation is far from a routine matter. For the excavator, it is not simply a question of finding a good site and assembling the equipment (trowels, shovels, buckets, brushes, wheelbarrows, screens for sieving, notebooks, drawing boards, cameras, and equipment for surveying the site and taking elevations) and the crew. The director must make many crucial decisions at the start of an excavation, and they determine, in large measure, how successful the fieldwork turns out to be.

Some of the most important decisions are those in the sphere of sampling. Briefly, this is the name given to the choice of the size of the excavation units, the places where they are to be dug, and the proportion of the site's total area to be excavated. In the simplest terms, sampling is the decision-making process concerned with choosing where and how to dig at the site. In making such plans, the archaeologist naturally is interested in achieving a good trade-off between the volume of earth to be moved and the return of information about the site from such work. Thus, the sampling strategy—whether the excavator opts for a formal design or for a more informal approach based upon previous experience—attempts to harness the goals of the excavation and the resources (manpower and funds) that are available for the project.

While there are wide differences between one excavation and another, it is possible to identify several common features or integral parts of all excavations. One of them, as previously mentioned, is a sampling strategy. At the start of the fieldwork, there has to be a clear idea of how the excavation will proceed. Since new information about the site will emerge as the excavation unfolds, it often makes good sense to think in terms of a sequential approach to sampling (that is, one where new information, as it becomes available in a stepwise sequence, is incorporated in the decision-making process). A second shared feature of all excavations is the recovery and recording of stratigraphy, or the vertical dimension of the excavation. As mentioned earlier, the identification of individual stratigraphic units and the definition of their interrelationships are at the heart of the chronology of the site. The third integral part of the excavation is the documentation of all features and structural remains exposed at the site, or the horizontal dimension of the dig. This line of evidence provides the key to the functional interpretation of the site (i.e., the kinds of activities that once took place there and their layout and spatial organization).

Still another component of every excavation is the recovery of artifacts and their processing and classification. Collectively, the set of artifacts recovered from a site is referred to as its "finds." The recovery of an artifact can come about in three ways. First, the object can be recognized during the course of digging and its position recorded before it is removed from the ground. In the second case, all of the cultural materials that come to light from a given layer and a given grid square are collected as a group. The degree of spatial resolution in the provenance of the finds obviously is lower than in the first case. In the third case, the artifact is recovered when the soil from a given unit of the excavation is passed through screens (the sieving of the excavated soil), to make sure that even objects of small size are recovered.

The processing of finds normally begins with the washing of the material. This is followed by marking of the pieces (so that each artifact is linked with its provenance in the field) and separation of the finds into different classes of material (coins, pottery, roof tiles, and so on). The next step is the preliminary classification of each kind of material. The lists of such preliminary classifications give the director an overview of the finds at different parts of the site. Later on, specialists will make more refined classifications. To keep track of every item, a well-organized system of storage (that allows easy access to the artifacts) is essential, as is a computer-based information system. As part of the process of documentation, many of the artifacts have to be drawn or photographed. A selection of these illustrations will appear in the final excavation report. Again, the details of the work on the finds—from their recovery in the field through their processing and classification to their eventual publication—vary with the nature of the site.

COMPARING THE SURVEY AND THE EXCAVATION

It is useful at this point to step back and consider some of the ways in which the survey and the excavation differ from each other. Such a comparison, along broad lines, also helps reveal how these two forms of fieldwork complement each other. The survey is, of course, far more expansive in its orientation than is the excavation. The survey is concerned with the large picture. It sets out to record in basic terms all of the forms of habitation that are found in a given region. In this approach the archaeologist is discouraged from having a strong preference for any one period or for any one type of site. Those doing surveys have to be eclectic in their interests; they must direct their attention to the relationships—both in space and in time—that exist between sites. In contrast, the excavation entails a narrower focal point; it takes the individual site as its object of study. The strong suit of the excavation is that it offers much greater control over chronology. In addition, there is the opportunity to examine the internal structure of the site—something that usually is not possible for the survey. In short, the excavation is the mode of fieldwork that allows one to focus in detail on the archaeological record but at the price of the vision of a single site.

In practical terms, the survey can be done with a lower budget than the excavation. It also calls for a smaller crew than most digs. Accordingly, the survey is attractive for the young archaeologist who may have limited access to funding. To carry out a survey successfully, however, the archaeologist should have some training in the fields of environmental studies in archaeology, geomorphology, geography, and economic history. To put it another way, the archaeologist doing a survey has to be ready to address the issues of landscape archaeology. On the other hand, the person planning to direct a new excavation needs to have a somewhat different background, including a good knowledge of the period or periods to be excavated as well as several years of experience on previous excavations.

Finally, it is worth noting that the survey is far less destructive than the excavation. It is a truism that the act of excavation destroys those parts of the site where the digging is done. Damage to the archaeological record is something that all archaeologists want to avoid. In the case of a site that is not threatened, an excavation can be justified only if the fieldwork meets high standards and the results are properly published. In contrast, the survey is far less damaging. There is a clear advantage over the excavation, since the survey leaves the sites in the region essentially intact. It is worth adding that the surface of a site is already being damaged in those parts of the world where modern forms of agriculture are practiced (that is, where the surface of the land is plowed on a regular basis). Because of plowing, the artifacts on the land surface and in the plow zone are no longer in primary context at the site. The plow zone is by no means a kind place for the long-term survival and preservation of most classes of material culture. Moreover, within the plow zone, the artifacts themselves are in active circulation from one bout of plowing to the next. Controlled experiments show that less than one-tenth of the artifacts circulating in the plow zone actually make their appearance on the land surface at any one time. Thus, the collection of pieces from the land surface has only a modest impact on the full set of artifacts occurring in the plow zone.

INTERACTION

One can begin to gain a sense of the interplay between the two lines of fieldwork by looking at some of the ways in which the survey and the excavation are mutually dependent. The aim here is to highlight the interaction between the two lines of fieldwork. The chronology established for a particular region is based for the most part on the results of excavations. In turn, this chronology is used whenever the survey archaeologist assigns dates to what is collected in the field. Once the survey is completed, a report is written on the results of the fieldwork, and the archaeologist often attempts to put forward a new synthesis of the long-term history of occupation in the region. In turn, the excavation, which makes it possible to explore the local situation in greater detail, offers one of the main ways to test whether this new interpretation is on the right track. At the same time, the survey usually leads to the discovery of promising new sites to excavate. In effect, the survey gives the excavator a wider choice in terms of good places to dig. When an excavation is carried out at one of the new sites found by the survey, the archaeologist, in preparing the report at the end of the excavation, tries to place the site in wider context by reviewing what is known about coeval sites in the region, as revealed by surveys. Thus, in terms of their interaction, there is an ongoing, two-way dialogue between the survey and the excavation.

CURRENT TRENDS IN DEVELOPMENT

It is important to emphasize that both the survey and the excavation are still in the course of development. The methods and strategies employed are not final ones that exist in a standardized form. Like modern medicine in the cure of many diseases, the search is still under way to find the most effective treatment. This aspect of the survey and the excavation can be illustrated by looking at their histories over the last few decades of the twentieth century. One observes in both cases a tendency toward intensification in the approach taken to recovery in the field. When time and money are not an issue, there is an interest in achieving a more refined grain of spatial resolution in the documentation of the archaeological record. Another major development of these years, shared by both survey and excavation, is the growing consciousness of the role played by many different factors in the formation of a site. These include the cultural factors that contributed to the form of the site at the time of its occupation—for example, the structures built at the site, their use and modification over time, and what happened to the objects and building materials at the site when it was abandoned. There are also the natural factors that subsequently acted to transform the objects and features that happen to have survived there. When a survey or excavation is conducted, the archaeologist tries to think through the full range of processes that are involved in the generation of the archaeological record, including postdepositional factors.

In Europe, the approach taken to excavation changed considerably in the last half of the twentieth century. Before 1960 (following the lead of Sir Mortimer Wheeler, a distinguished British archaeologist), it was common for the excavation to be carried out by making a series of trenches at the site. Since then, under the influence of Philip Barker and his work at medieval sites in England, there has been a shift in strategy to uncovering a large, contiguous area at the site. This approach tends to be more effective when it comes to documenting the buildings and other structures at a site.

Another shift that began in the 1970s was a new emphasis on the recovery of botanical remains. To recover seeds and pieces of charcoal from the soil in a more systematic fashion, new equipment based on the principle of flotation was introduced. When soil is run through water containing a frothing agent, the seeds literally rise to the surface and can be skimmed off. Thus, the "ecofact" has taken its place alongside the artifact in field archaeology. A third significant development occurred in 1979, when Edward Harris published *Principles of Archaeological Stratigraphy,* which offered a new way to record and display the stratigraphic units found by an excavation. Others have begun to pay greater attention to the soils at a site—the matrix that holds the artifacts and the ecofacts and that also contains information on the processes contributing to the formation of the site.

Because of the high costs of excavation in many parts of the world (the United States, Japan, and Europe), it is essential for the archaeologist to know as much as possible about a site before digging begins. Previous knowledge invariably makes for a more efficient research design. It also gives the excavator a better chance to run a well-directed dig. The methods that are used to guide the planning for an excavation can be divided into two main groups: remote sensing and work on the ground. The former method involves acquiring images of the site's layout or structure from the air. One technique is aerial photography, which has a long history of use in archaeology. In most cases, the photographs that are examined are ones that have been taken for other purposes, such as mapmaking. It is often more rewarding for a project to have its own series of air photographs, taken at a larger scale (that is, from a lower height and showing the more details of the site). Satellite images sometimes are used for this purpose. As the resolution of satellite imagery increases, it will become an essential tool for work of this kind. In addition, under arid conditions, radar imagery from space, which can penetrate desert sands, has proved to be productive in the detection of buried sites and buried features of the landscape.

There are various techniques of geophysical prospection that one can employ on the surface of a site. One of these techniques involves passing an electric current through the ground and then making inferences about buried structures at the site. The earth-resistance survey, as it is technically called, is based on the different patterns of electric resistivity observed on a map of the site. Another type of on-site prospection is the magnetometer survey. Different kinds of structures at a particular site, such as a burned house or a hearth, can be recognized in the form of magnetic anomalies that stand out from the normal soil at the site, which has other magnetic properties. A third method is called ground-penetrating radar, which is related to radar imagery from space. When an electromagnetic wave is propagated toward the ground, some of it penetrates the soil and then bounces back to the surface. By moving the radar instrument over ground along closely spaced lines, patterns of difference in the bounce-back values over the site can be discovered. Again, the appropriate method of prospection depends on the local conditions at the site under investigation.

There is commonly another step in fieldwork before the start of excavation. This consists of coring at the site as a means of checking on the results of one of the three surveys just described. Using either a hand auger or power-driven equipment, cores are made on a grid at the site to obtain a more tangible indication of what is buried in the ground. The overall aim of remote sensing, geophysical prospection, and coring is, of course, to learn as much as possible about the character of the site so that informed decisions can be made when the digging actually begins.

The survey also has witnessed change in the last fifty years of the twentieth century. To begin with, there are now information technologies, such as Geographic Information Systems (GIS), that facilitate the collection and display of spatial data. Formerly, work of this kind had to be done by hand. The earliest surveys in Britain consisted of field walking, where the main aim was to map the major monuments in the countryside. In the 1960s there were an increasing number of surveys in different parts of the world, and the methods used in the coverage of the ground soon became more systematic. There was an attempt to record the full range of sites, small and large, on the landscape. The growth of survey archaeology then accelerated in the 1970s—a time when many surveys were started throughout the world.

At first glance, the survey looks deceptively easy. In planning a new survey, the main challenges would appear to be selecting the region for study; choosing the approach to the coverage of the ground (e.g., the spacing between crew members in the field and the choice of sampling units, such as grid squares or transects); developing a system for mapping and recording the sites identified by the survey; and finding crew members with experience in this kind of work. By the 1980s, however, the realization had begun to emerge that the survey is a more complicated endeavor than the archaeologist had previously thought. The loss of innocence took place when some archaeologists began to repeat the coverage of the same area in different years (as a control on the quality of their fieldwork). To their surprise, they found that there was significant variability in what was observed on the land surface from one year to the next. In retrospect, we can see that most of the surveys done before 1990 were too optimistic in terms of their working assumptions about the dynamics of the plow zone and about the visibility of sites on the land surface.

As part of the trend toward the intensification of fieldwork, the survey archaeologist understandably would like to record the scatters found on the landscape at as fine a grain of spatial resolution as possible. To be more complete in the documentation of what is observed on the land surface, one wants to make sure that all light scatters and even individual pieces are mapped in the field. This line of thought has led some archaeologists to begin doing what is called the nonsite survey. The aim is to record the totality of the cultural materials on the land surface in those places covered by the survey. For very light scatters, there is a fundamental problem that arises in the case of a region where much of the land is plowed, which is the situation in most countries of Europe.

The problem has to do with the circulation of artifacts in the plow zone and the fact that only a small proportion of the pieces in a plow zone make their appearance on the surface at any one time. Indeed, this ratio typically is less than 1 in 10. This means that the pieces on the surface are the result

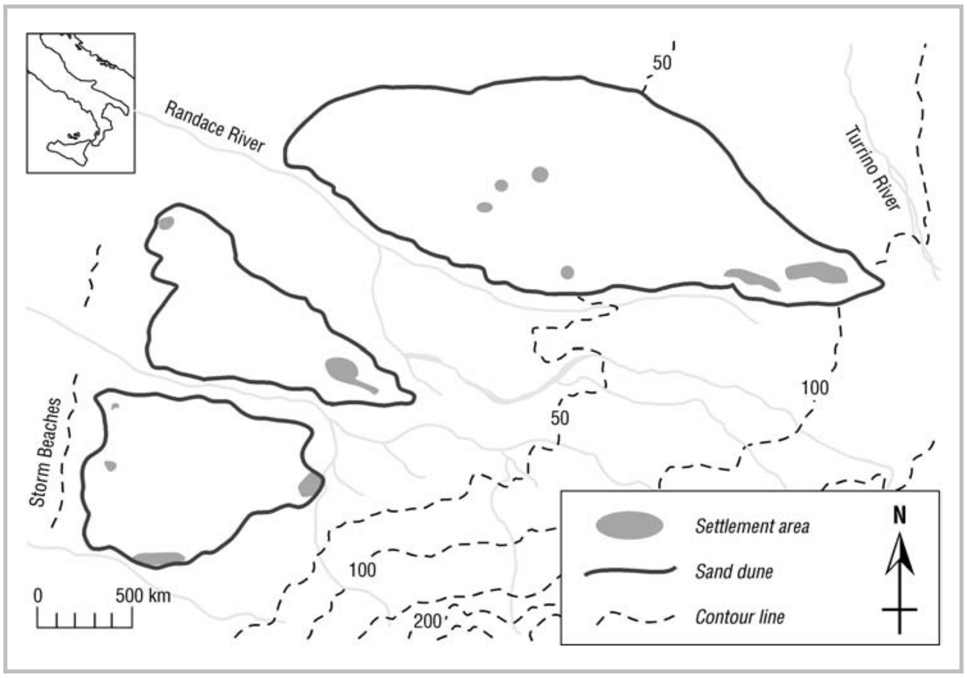

Fig. 1. The distribution of Stentinello settlements at Acconia in southern Italy. The survey, by repeating the coverage of the Acconia area several times, obtained the dense pattern of impressed-ware Neolithic settlement observed here.

of a stochastic process. In a given place, the random sample of material that is found on the land surface varies from one bout of plowing to the next. The stochastic character of the surface material does not represent a major problem in those places where there are large numbers of pieces in the plow zone. There, the surface sample tends to be much the same from one field season to the next. It becomes a serious methodological problem when the numbers are small. A given light scatter has a low degree of consistency from one year to the next in the number of its pieces, in the different classes of material culture that are represented, and even in its chronology. Thus, the question of how best to deal with light scatters remains basically an unresolved problem for the survey archaeologist who would like to aim for total recovery.

The issue of visibility is no less challenging. Few surveys before 1990 took the question of visibility seriously into consideration. The working assumption was that the pattern of sites (or scatters) observed on the surface at the time of the survey was the same as the pattern of sites that were once occupied in the region. There are two main factors that obscure the recognition of a site on the surface. One is connected with the burial of a site and has to do with geomorphological processes that have modified the landscape since the time the site was abandoned. This often happens on fluvial plains and in the case of a site located at the foot of a steep slope. The second factor involves the state of the vegetation or ground cover in a given field. If the field has been plowed and rained upon, there is no ground cover, and conditions are favorable for seeing artifacts on the surface. If a wheat crop is growing in the field or it is covered with grass, for example, then just the opposite will be the case. Controlled studies, which take both factors into account, reveal that places with good visibility yield many more sites than locations with poor visibility. Thus, all places on the landscape do not have the same potential for the recovery of archaeological sites.

There are three important implications for the design of the survey that follow from this realization. First, there is the need, at the start of the survey, for a good map of the geomorphological features of the region. Normally, the coverage of places where the inflation of the land has buried sites is not all that productive for the survey. Second, it is necessary to record detailed information about ground cover on a field-by-field basis during the course of the survey. Third, because they act as a filter through which to see in the field, the effects of visibility must be taken into account in the analysis of the spatial distributions of sites as well as in the interpretation of the true patterns of settlement in a region and how they have changed over time. In short, the survey is much more complex than it seemed to be in the past. It is no less demanding than the excavation.

CONCLUSION

In archaeology, the recovery of new evidence in the field rests on the partnership between the survey and the excavation. While each line of fieldwork has its own methods and aims, the results produced are complementary. Neither method can stand on its own without the contribution of the other. At the same time, both lines of investigation are still far from reaching their full maturity in terms of their historical development. Thus, the dialogue between them is an open one and will continue to move in new directions in the years to come.

See also **Viking York** (*vol. 2, part 7*).

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SALTBÆK VIG

The Saltbæk Vig Project was a regional archaeological investigation of the beginnings of agriculture in prehistoric southern Scandinavia around 3950 B.C. The chronological focus of the project was the Late Mesolithic and the Early Neolithic, approximately 5000–3300 B.C. The multistage project included intensive field walking of all accessible fields within defined survey zones. Guided by the field walking data, a total of fifty-three test excavations were carried out to investigate whether clusters of material on the surface had any related stratigraphy and to confirm the date and characteristics of the surface collections. Excavations were conducted at sixteen sites dating from around the transition to agriculture that had organic remains. Recording of museum collections, interviewing of local landowners, and palaeo-environmental investigating were also components of the project.

The Saltbæk Vig is located in northwestern Zealand, eastern Denmark, near the town of Kalundborg. This area was selected because the water level in the inlet is artificially maintained at 1.2 meters below sea level due to a land reclamation project dating back to the 1860s. As a result coastal Mesolithic localities from late Kongemose culture and onward are now above sea level in the inlet. Much of the area is accessible to fieldwork because of cultivation and limited modern development. Museum records had indicated that material from the Late Mesolithic Ertebølle culture as well as material from the Early Neolithic Funnel Beaker culture was present in the area, and there was potential for preserved organic materials.

The research area was defined by the sea and by the watershed around the inlet and the major river that feeds into it, the Bregninge Å. The area is approximately 16 kilometers long from northwest to southeast and 8.8 kilometers wide, or about 140 square kilometers, including the roughly rectangular inlet, which is 36 square kilometers. The field survey covered about 22 square kilometers in three zones. In all 415 localities, including settlements, stray finds and graves were recorded; 55 localities were previously known. More than fifty thousand artifacts were collected and stored at the local museum including forty thousand flakes, more than five thousand blades, four hundred polished axes and fragments, two hundred projectile points, one thousand pieces of pottery, and a variety of other flint and ground stone objects.

GENERAL FINDS

The survey recorded all materials that were encountered, but as expected most finds belonged to the Stone Age. The majority of localities were found along the south shore of the inlet, concentrated toward the mouth to the west. Relatively few sites were found along the north shore or in the valley of the Bregninge Å in the eastern, more inland part of the project area. The four transects and areas surrounding the long dolmens produced only few finds documenting the general low density of inland settlement.

A few settlements, stray projectile points, and cores were found belonging to the Late Palaeolithic (11,500–9000 B.C.), Maglemose (9000–6400 B.C.), and Kongemose (6400–5400 B.C.) periods. Only a few sites from the Bronze Age (1800–500 B.C.) and Iron Age (500 B.C.–A.D. 700) were recorded, mainly in the Tranemose area south of the Saltbæk Vig.

Most Mesolithic sites date from the Ertebølle culture, 5400–3950 B.C.; in all twenty-eight settlements were located immediately on the coast at low elevations, 80 percent of these on marine deposits. Settlements were located where fishing opportunities were optimal. At Saltmade, a middle Ertebølle site, a permanent fish trap was found dating from 5100 B.C. Another similar site at Smakkerup Huse from 4990 B.C. had a partly paved fishing area and boat landing along the shore containing fragments of dugout canoes, many wooden stakes, bone awls used as spear points in fishing, and an outcast layer with waste material from the settlement. The site was occupied year-round; hunting for terrestrial mammals and collection of plant food and shellfish supplemented the shallow-water fishing. Similar Mesolithic sites include Tybrind Vig, Møllegabet, and Vænget Nord. Usually the pattern is one large permanent site in a fjord supplemented by smaller seasonal camps. In Saltbæk Vig three clusters of sites appear to have coexisted at the mouth of the Vig, along streams on the central part of the south shore, and at the Bregninge Å delta. Mesolithic sites in the region are about 2,200 square meters and on average contain 136 artifacts with a maximum of 494 artifacts. Sites from the Mesolithic and the transition period to the Neolithic are about half the size of the sites from the early and middle Funnel Beaker and not as rich in flint.

Distinction of late Ertebølle and early Funnel Beaker assemblages found in the survey poses a problem because of strong similarities in both lithic and ceramic technology. Besides diagnostic ceramics the best indicators are specialized core axes from Ertebølle and early polished flint axes from the Funnel Beaker (fig. 1). Among six sites from around 3950 B.C., when the first domesticated animals appear, most show a continuation of Ertebølle tradition. At Smakkerup Huse, cattle bones dating from 3920 B.C. were found in an otherwise Mesolithic context with wild fauna and Ertebølle flint and pottery, including the pointed bottom of a small cup. Other sites, like one located inland on the sandy hill of Lindebjerg, represent new settlements away from the classic waterside locations of the Mesolithic and probably a different kind of subsistence: an earthen long barrow dating from 3790 B.C. is located in the vicinity of this settlement along with several later settlements and megalithic tombs from the middle Funnel Beaker period. A similar early site was found below the long barrow at Mosegården.

Almost sixty settlements were recorded from early and middle Funnel Beaker (3950–3200 B.C.), defined by the presence of Funnel Beaker–type pottery and polished thin-butted flint axes. Settlements were situated more inland, on higher sandy areas, but also on clay soils showing a more diverse use of the landscape; many finds were located beyond the coastal zone of the survey. Deposits of pots and axes were placed in wet areas; megalithic tombs were found near settlements or at higher elevations.

Settlements vary in size but are rich in flint, yielding up to 4,000 pieces, with an average of 186 artifacts per site. The density and spread of material on sandy elevations around Illerup and at the plateau hills may represent repeated and shifting use. This would suggest long-term attachment to a preferred part of the landscape, but—in contrast to the Ertebølle—not a long-term continuity of the individual site apart from the funerary monuments. Similar accumulations of occupation have been observed in the southern Swedish region of Scania and on the south Danish island of Als. The economic

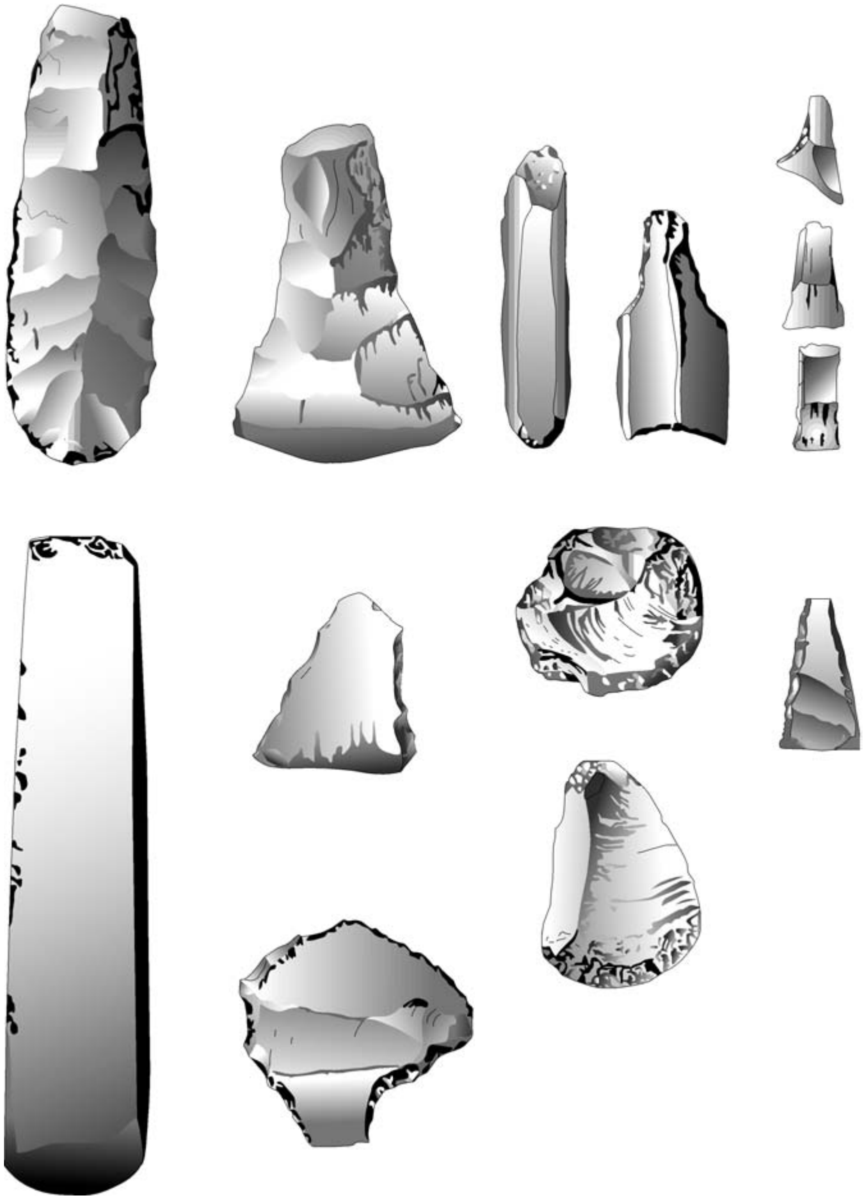

Fig. 1. Flint artifacts from Ertebølle culture (top) and Funnel Beaker culture (bottom). Tools depicted here include axes, scrapers, and transverse arrowheads. ADAPTED FROM *JEG SER PÅ OLDSAGER* (1966).

and social changes in early and middle Funnel Beaker seem to involve a system of redistribution of food and other products among occupationally specialized groups. For example the flint inventory at Grønvang was dominated by burins (chisel-type tools), at Lindebjerg North by scrapers. At other sites, such as Smakkerup Huse (3500 B.C.) and Nekselø (3500–3100 B.C.), dimensions of the permanent fish traps suggest catches beyond local consumption.

Late Funnel Beaker (thirty sites from 3300–2800 B.C.) and Corded Ware (three sites from 2800–2400 B.C.) finds are focused more on the coast; the substantial settlements are about 3,600 square meters. Late Neolithic settlements and stray finds (2400–1800 B.C.) show a reduction and a shift in the habitation. Eight small settlements (less than 1,000 square meters) and several burial mounds are located along the north and east shore of the inlet, particularly on Alleshave.

TRENDS

By investigating the correlation between various aspects of the landscape and the archaeological data, a pattern of land use emerges involving a wide range of activities of greater or lesser intensity. Through time three thresholds in settlement organization can be identified where the cultural landscape was reorganized and new areas inhabited. The first is the appearance of a coastal habitation following the establishment of a marine environment in the bay during the Late Kongemose and Ertebølle. The second threshold is the shift to inland locations and increased settlement size during the Early Neolithic Funnel Beaker. The third is the reduction and relocation of the habitation to the coastal areas along the north side of the inlet during the Late Neolithic.

A curious duality appears at the beginning of the Neolithic with a gradual adoption of Neolithic elements (including domesticates) by the local Ertebølle, on one hand, and a movement of people inland with a farming economy and burial monuments, on the other. With absolute dating of only one site, it is uncertain whether the two trends are coeval or the inland occupation is slightly younger.

An intensive field survey like Saltbæk Vig increases the known number of settlement sites. Previous records were biased toward Neolithic burial monuments and stray finds of polished flint axes. This study especially emphasized the Mesolithic presence in the area: both settlements along the coast and inland hunting activities on higher sandy areas. Finally, the multidisciplinary approach produced a wealth of subsistence and palaeoenvironmental data from the Saltbæk Vig area.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **Tybrind Vig** (*vol. 1, part 2*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*).

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ANNE-BIRGITTE GEBAUER

DATING AND CHRONOLOGY

The nineteenth century saw profound changes in the advance of knowledge in several important areas. Geology and biology had both come to realize that vast spans of time were needed to explain the observed fossil changes and rock formations. Geologists had introduced the idea of strata occurring in the order in which they had been formed, an idea readily translated to archaeology, where lower layers of finds were assumed to be older.

The new ideas of biological evolution advanced by Charles Darwin in his 1859 essay *On the Origin of Species* gave another sense of time. Whereas great scientists like Isaac Newton had, a couple of centuries before, readily accepted that the world started some six thousand years ago, based on a particular interpretation of the biblical story, Darwin left scientists grappling with the idea that humans had developed from "lower" creatures over a very long period of time, which meant that there was a long prehistory to be examined and understood.

By the end of the nineteenth century, archaeologists had recognized a progression in technologies apparent in their artifact collections, and the contexts of the finds had suggested that human populations had moved from stone tools, through the use of copper, to bronze, and then iron. Archaeologists of the day, however, had little or no evidence to put dates to these changes or get any sense of the length of periods involved.

The history of the Near East and Middle East was fairly well understood in the late nineteenth and early twentieth centuries, thanks largely to the fact that in these literate societies records had been kept, giving times for the reigns of kings and major events. This meant that the great works, such as the pyramids of Egypt, could be dated reasonably well, as could the introduction of metallurgical technologies in different parts of this region. The region was considered to be the cradle of civilization, from which the knowledge of building techniques and metalworking spread out gradually through trading links and other associations to displace the crude technologies of prehistoric Europe. This was known as the idea of diffusion.

Some did argue that, in a way that parallels evolution in the biological world, the technologies may have evolved in different areas and spread more locally, but with limited dating evidence, this idea was almost impossible to support or reject from the available information.

In order to construct a meaningful story explaining the developments of human populations in any part of the world it is essential to have a reliable dating framework. With no written records pertaining to the barbarian world, the only way in which any framework could be constructed was by cross-reference to areas where the historical chronology was known. Typological dating—that is, dating by analogy to other artifacts of known date—can become a difficult circular argument. Added to this, the idea that technology had diffused out from the ancient East gradually toward the west, perhaps with a major jump to the Iberian Peninsula (modern Spain and Portugal), which itself then acted as another center for diffusion, colored the interpretations, since a passage of time was generally added for the process of uptake of the new technologies.

It is with this widely accepted idea of the spread of civilization across Europe from the East, with dating in the East being well established through the historical record, that archaeological thought progressed until the scientific advances of the second half of the twentieth century.

EARLY RADIOCARBON DATING

In order to appreciate the impact of the information that has been provided by radiocarbon dating on our understanding of prehistory, it is first necessary to have a brief understanding of the theory and practice of the methodology.

Carbon exists in three forms, or isotopes, ^{12}C, ^{13}C, and ^{14}C, of which two are stable, but ^{14}C, or carbon 14 as it is sometimes known, is radioactive and decays over time. Carbon 14 is produced when cosmic neutrons strike nitrogen in the upper atmosphere. It readily combines with oxygen to form $^{14}CO_2$—radioactive carbon dioxide, which mixes throughout the atmosphere.

All living things take in some of this material while they are alive, either as gas from the atmosphere, or dissolved in water, or, in the case of animals, as part of their diet of plants or other animals. The amounts of this radioactive carbon are very small indeed, something like one part for every million million parts of nonradioactive carbon. As soon as an organism dies, however, it no longer takes up more carbon 14, but that which it does have decays slowly, reducing to half the original amount in about 5,730 years. If one knows how much radioactive carbon there was at the time the organism was alive, and one can measure the tiny amount of it left in the organic matter today, given the rate of decay, it is theoretically possible to tell the length of time that has elapsed since the organism died.

This calculation is achieved by converting the carbon into either a liquid or gaseous substance and measuring the number of radioactive decays from this sample over a time period. This brilliant idea for a new dating technique was first applied by Willard Libby in 1949 and was very quickly recognized by archaeologists as a way of establishing the missing chronological framework within which to set their findings. Yet it was quite some time before the majority of archaeologists were prepared to accept the dates being produced. They had several reasons to be skeptical about the results of radiocarbon dating.

First, contamination of the sample is a serious potential problem, especially since one is dealing with such small quantities of carbon 14. For example, a minute drop of oil (ancient carbon), small amounts of fungus growing on the organic remains, or even flakes of skin from the collector of the sample (modern carbon) could seriously affect the results.

The so-called half-life for carbon 14—that is, the time it takes to decay to half its original amount—was understood by Libby early on to be 5,568 years, whereas it is now known to be closer to 5,730 years. Also, the amounts being measured are very small indeed, so that minuscule errors in reading the amounts of radioactive material present in the sample will have proportionally a very large impact on the result.

Another potential problem is that although it was initially assumed that all organisms took in the same mix of radioactive and nonradioactive carbon, it was later found that a process known as "fractionation" occurs, whereby different organisms take up different isotopes in varying proportions.

Finally, one of the original assumptions behind the carbon-14 dating process was that the amount of radioactive carbon in the atmosphere is likely to have been fairly constant throughout the last fifty thousand to sixty thousand years—the maximum period during which radiocarbon dating generally can be applied, because after this time the amounts become too small to be measured with an acceptable degree of accuracy.

As each of these problems was addressed—by greater understanding of the theory behind the system, by the introduction of better protocols for the collection, submission, and analysis of the materials, and by improvements in the analyzing equipment—the technique gained wide-scale acceptance, and Willard Libby was awarded the Nobel Prize for chemistry in 1960.

Colin Renfrew refers to this period when the first dates were coming out as the "first radiocarbon revolution." But even as the method of carbon-14 dating gained acceptance, some surprising results emerged concerning dates relating to early agriculture and settlement. Dates from Jericho suggested settlement around six thousand years ago, about fifteen hundred years earlier than expected (subsequent analyses have set the foundation of prepottery Jericho to around 7000 B.C.). Dates for the European Neolithic were coming out around a thousand years earlier than the accepted wisdom of the time. The radiocarbon-derived dates for artifacts from the Egyptian and Mesopotamian areas, for which there was a sound historical chronology already in existence, were apparently different by a few hundred years, whereas many dates that started to come from prehistoric sites in Europe were suggesting that they were far older than was thought possible. The many potential errors in deriving radiocarbon dates continued to make it easy to suggest that the whole methodology was flawed.

DENDROCHRONOLOGY

The next real breakthrough in the story of how a dating framework for prehistory in the barbarian world came about was the availability of precisely dated wood samples that would allow for independent testing of the radiocarbon timescale. Dendrochronology, or tree-ring dating, is based on the fact that trees of the same species, growing over a wide geographical area and subject to the same weather conditions throughout their growth, will produce similar ring-width series that can be crossmatched between them (fig. 1). Although every individual tree will reflect its own unique circumstances in its rings, there is generally sufficient climatically induced "signal" that if the ring series is long enough it can be matched to others that grew at the same period in history. If one starts with living, or recently felled trees, each ring can be assigned a calendar year. Some individuals of a species may have missing or even apparent double rings, but these can usually be detected by cross-matching against many other trees from the same species.

By finding older sources of wood, either preserved in deposits or used in archaeological contexts, it is possible to match the outermost rings of this older wood with the innermost rings of the dated material, and extend the chronology back in time. By successive overlapping of older and older material, long chronologies, over thousands of years, can be produced.

Dendrochronology developed rapidly at the start of the twentieth century, particularly in the United States with the work of A. E. Douglass (1919). When Charles Ferguson in the mid-1960s developed a bristlecone pine chronology going back several thousand years (1969), and in the 1980s Bernd Becker (1981) and Michael Baillie and colleagues (1983) produced long oak chronologies, wood samples from a wide geographical area, of precisely known date, could be subjected to radiocarbon analysis. As early as 1967, H. E. Suess produced a graph that enabled corrections to be applied to radiocarbon dates resulting from the fluctuations observed from tree-ring samples, and this method of determining chronology was rapidly developed.

If the amount of carbon 14 in the atmosphere had remained constant, and if the conditions of preservation of the material had not had differential effects on the amounts of radioactive carbon in the samples, one would expect that if the amount of carbon 14 was plotted against time (or against the calendrical date of the wood sample derived by dendrochronology) one would find a simple relationship.

The results actually obtained show that there have been great fluctuations in the amount of carbon 14 in the atmosphere at different periods in history and that these changes can occur rapidly, over a matter of a few years or decades, as well as showing longer-term fluctuations over centuries or millennia. This variation is thought to be the result of fluctuations in the magnetic field of the Earth.

This means that if one simply draws a decay curve and reads a date from it corresponding to the amount of carbon 14 found in a given sample, there is the potential to be a long way from the actual date of the sample. In fact the decay curve has many "wobbles" within it, such that it is possible that the same amount of carbon 14 found in a sample could actually result from material from more than one date. By the late 1980s these fluctuations had been well documented by Minze Stuiver and Gordon Pearson, and it became possible to give a more precise statistical probability of the actual date range of the sample being submitted. Stuiver and Pearson's later curve (1993) has become the standard against which most radiocarbon determinations in the time span back to about 6000 B.C. have been calibrated.

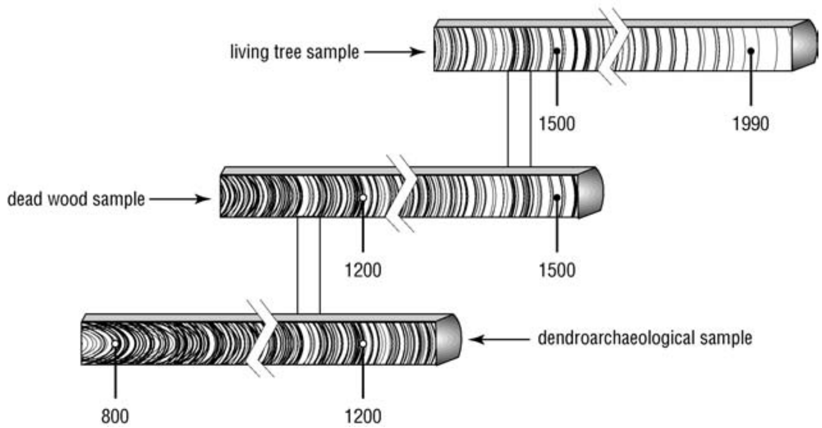

Fig. 1. Cross-dated wood samples overlap in time. Successive overlapping of older tree-ring sequences allow long chronologies to be built. In practice, many wood samples represent each year of the chronology.

This high-precision dating requires far more accurate measurements of the carbon 14 in the sample, an accuracy that results from more careful preparation of the sample and longer counting periods, but such improvement obviously incurs greater costs. To obtain a 10 percent increase in the level of accuracy requires an additional one hundred times the length of counting. It is not always appropriate to expend these resources on samples if, for instance, all that is required is to know the broad relative dates of several samples in a sequence. A situation therefore emerged whereby one could obtain a "routine date" or a "high-precision date" depending on the questions to be answered.

In the late 1970s a further advance in radiocarbon dating was made with the introduction of accelerator mass spectrometry (AMS). In this method, the actual amount of carbon 14 present in the sample is measured directly by mass spectroscopy, rather than counting the number of radioactive decays in a given time period. The introduction of AMS carbon-14 dating has reduced the associated error terms to a period of around plus or minus sixty to eighty years in most cases.

CALIBRATION

Once a radiocarbon age determination has been produced, it is generally converted into a calibrated age, by reference to a calibration curve based on carbon-14 determinations of dendrochronologically dated wood. Such calibration curves show the variations in carbon content against calendar years, with the associated error terms—which vary in different periods. A very basic understanding of statistics is necessary here. An uncalibrated age is given with its associated possible error, expressed as one standard deviation from the mean: for example, 2500±100 B.P. (or "years ago"). In order to ensure that there is a 95 percent probability (the normal limit for most scientific studies) that the calibrated date will lie within the range quoted, we need to take a two-standard-deviation range: that is, 2500±200, or 2700–2300 years B.P. If the upper and lower limits of these uncalibrated dates are then plotted on the calibration curve, they can be converted into calendar years, which may give a broader or narrower date range, depending on the shape of the curve at this point.

Apart from the dating of human artifacts, the development of long dendrochronologies has allowed environmental factors to be dated, giving important background information to the human story. Dendroclimatology, the extraction of climatic information from the tree-ring series, is a well-established and growing area of tree-ring work.

Dendrochronology has itself provided dates of great importance—for example the event of 1628 B.C. first described by Valmore LaMarche and Katherine Hirschboeck (1984) and discussed at length by Baillie in *A Slice through Time* (1995). The eruption of Santorini (also known as Thera) took place in the Bronze Age and would have had effects throughout the Aegean. The precise dating of this event has implications for interpreting several prehistoric events in the region and has often been proposed as the most likely cause for the end of Minoan civilization on Crete. This itself was clarified when an ash layer identified as coming from this eruption was found stratified before the end of Minoan civilization, between two phases known as LM1A and LM1B. LM1A appears to end at Akrotiri with the eruption, and the end of LM1B is traditionally linked to around 1450 B.C.

Some scientists believed that the eruption, presumably marking the end of LM1A, could not be put earlier than 1550 B.C. based on links between the Aegean artifacts and the established Egyptian chronology; although when a tree-ring event first suggested a possible date in the seventeenth century B.C. other workers were able to reconcile their interpretations of the archaeology to fit with this date. The Santorini eruption brings together several strands of scientific dating—tree rings, radiocarbon dating, and ice core work, as well as traditional linkages based on stylistic similarities between objects.

Radiocarbon analysis of short-lived organic matter, such as seeds charred by the eruption, has been carried out on many samples. This has produced a range of dates that even after calibration gives a spread that is not completely capable of distinguishing between a seventeenth and a sixteenth century B.C. date. In fact, the eruption falls on one of those parts of the radiocarbon calibration curve where it is actually not possible to distinguish between 1628 B.C. and 1530 B.C. because the curve has a "wobble" during this period (fig. 2). In this particular time frame, the collection of more and more radiocarbon samples to date a single event does not make the actual date any clearer.

Layers in ice cores also approximate to annual events and have been used as a dating tool, with the added advantage that acidity peaks in the ice have been found to coincide with ash deposits from volcanic eruptions. An acidity layer corresponding to an eruption has been noted at 1645±20 B.C. This range is remarkably close to the 1628 B.C. event noted in two different tree-ring sequences from widely separate geographical areas.

No one can prove that these two markers represent the same event, and no one can yet prove that the event in question is the eruption of Santorini. However, there are no other candidate eruptions that have yet been identified, and something must have caused both observations.

The ice core evidence and the amounts of sulfur outgassed from Santorini, causing the acidity peak, have been the subject of much debate. The radiocarbon dates for this event show a spread that is not helpful in pinning down the actual date. Ancient historical records in the form of Egyptian writings only give negative information, in that were the date of the Santorini eruption really in the mid–sixteenth century B.C. one might reasonably expect it to have been recorded in this century, but no records have been found. Baillie makes a strong argument for the tree-ring date to relate to Santorini and leaves us with the thought that if it is not recording that event, another major event causing the decline in tree-ring widths over North America and Ireland must have taken place, which is as yet unrecognized.

THE COLLAPSE OF TRADITIONAL THINKING ON PREHISTORY

Tree-ring calibration of the radiocarbon timescale removed the doubt lingering in some minds about the veracity of the dates being produced and brought in a whole new raft of dates for both the Near East and Europe. Much greater than the production of dates themselves, however, was the realization that came about as a result of having large numbers of accurate dates. Although the established historical framework for the ancient East remained largely unaltered, most dates for significant events in Europe, such as the introduction of stone buildings or monuments, metalworking, and so forth, were found to be far earlier than most archaeologists had previously expected. Whereas the great pyramids of Egypt had always been considered to be among the oldest man-made stone buildings on Earth, dating back to perhaps 2500–2700 B.C., it now emerged that the megalithic tombs of western Europe were older than either the pyramids or the round tombs of Crete, both of which had always been considered as their precursors. Newgrange in Ireland dates to about 3200 B.C. Similarly, it can now be shown that copper was being worked in the Balkans several centuries before a comparable level of development emerged in the Aegean, a region that was thought to be the source of a skill base that was then taken westward.

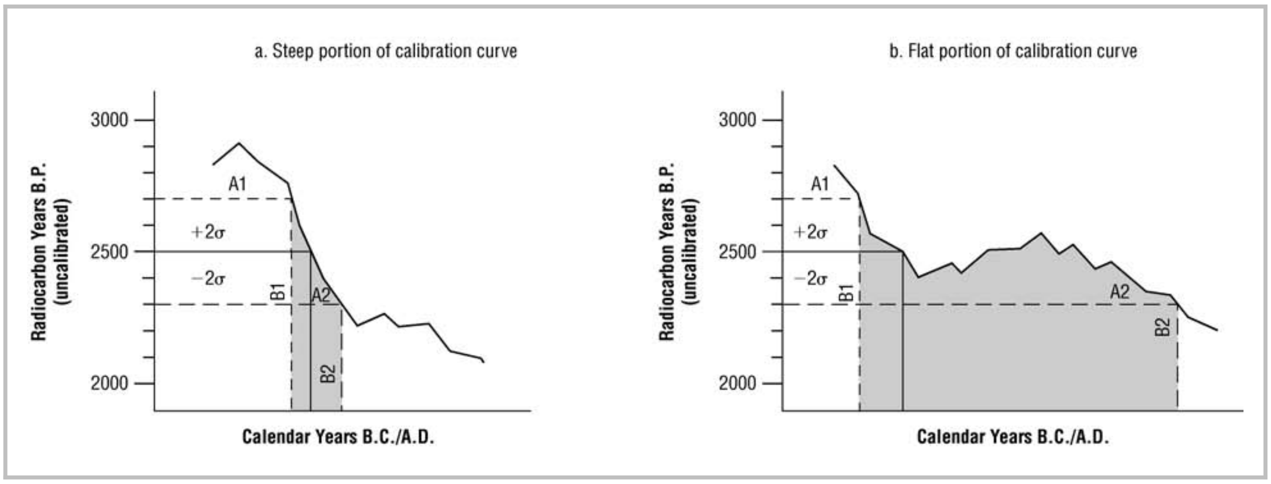

Fig. 2. Hypothetical radiocarbon calibration curves derived from tree rings.

The whole idea of the diffusion of ideas from the East, bringing civilization to western Europe was found to be wrong. Colin Renfrew recognized what he called a "chronological fault line," with the areas of the Aegean and eastern Mediterranean lying on one side and western Europe on the other. Those areas to the south and east of the line do not have their dates much altered as a result of tree-ring-based radiocarbon calibration, whereas those to the north and west are made several centuries earlier.

Continuing the analogy with geology, all the strata and cultures once thought to lie at the same level before radiocarbon dating became shifted in their relationship to each other, with the western European layers being much earlier in comparison, but with their internal relative dating to each other remaining the same. So the "layers" of the Late Neolithic in the Iberian Peninsula, for example, used to be matched with the Early Bronze Age in the Aegean, but now match at a similar time level. Thus all the earlier work of relating changes and sites to each other within each of these areas remains valid; it is just the associations across the "fault line" where changes have to be taken into account.

OTHER DATING METHODS

The closing decades of the twentieth century saw the development of a range of other specialist dating methods. Some of these are more suited to dating rocks and remains beyond the normal useful range of radiocarbon dating. Methods that are of relatively limited use in the timeframe considered here, are not readily applicable to archaeological remains, or are as yet still considered under development include the following.

potassium-argon dating
uranium series dating
fission-track dating
amino acid racemization
archaeomagnetic dating

Of far more value with prehistoric archaeological remains are thermoluminescence (TL), optical stimulation luminescence dating (OSL), and obsidian hydration. The last of these is restricted to obsidian finds, which form a surface hydration layer when exposed to air, the thickness of this layer corresponding with the length of exposure.

Thermoluminescence (TL) and optical (OSL) dating have perhaps been the most widely used, especially with ceramic artifacts. TL was developed in the 1960s and 1970s. TL is based on the fact that some minerals such as quartz, feldspars, and calcites react in a particular way after exposure to radiation, so that when heated, they give off light. The system relies on impurities in the original item. The sites of the atoms of the impurities attract free electrons, which are released when heat energy is applied. The electrons recombine at luminescence centers and release photons. The amount of thermoluminescence is proportional to the number of trapped electrons present, which is in turn proportional to the radiation exposure, or time elapsed. This is not a straight linear relationship, since the longer the exposure time, the fewer the sites available to trap electrons.

Some event in which the temperature of the object reached 450°C needs to have taken place to "zero" the system—for example, the firing of pottery, or heating in a hearth. It may be difficult to guarantee that objects, say, at the edge of a hearth were in fact zeroed. Pottery does not have this drawback, and objects as young as one hundred years can be dated in this way. The subsequent exposure of such items to sunlight might empty some or all of the sites, but the method is very suitable for buried objects.

The first comparisons of dates between thermoluminescence and radiocarbon were published in 1970 by D. W. Zimmerman and J. Huxtable. TL dates from three sites were 5350 B.C., 5330 B.C., and 4610 B.C., and the range of radiocarbon dates for the same site fall into the period 5300–4600 B.C. This was reassuring news for many scientists.

OSL works on principles similar to those of TL, with samples being exposed to green laser light to empty the electron traps. The main difference from TL is that light rather than heat is the agent that zeroes the system and gives the dating reference. Samples of quartz grains exposed to sunlight but then subsequently deposited and buried are the main samples subjected to this analysis. One example is the White Horse at Uffington in southern England. This is a prehistoric figure of a horse, cut directly into the hillside and packed with white chalk. Various experts had judged the artistic style of this object to be either Anglo-Saxon or Celtic (Late Iron Age). However, analysis of silt laid down, presumably around the time of formation, gave OSL dates in the range 1400–600 B.C.—dating the piece to the Late Bronze Age, which relates quite well to other finds in the area.

The existence of an independent, scientifically based dating framework that does not rely on stylistic similarities between objects has profoundly changed our view of the ancient world. Although each of these dating techniques has its limitations, and individual results still need to be assessed with the appropriate caution, the overall pattern that emerges is quite different from that of a relatively few decades ago.

Consequently, the view of prehistory in areas such as western Europe has changed dramatically since the 1960s. Although definitions of civilization are always difficult, and generally involve living in complex social societies and writing, our view of the so-called barbarian people inhabiting western Europe—living primitively while the great civilizations of Egypt and the Aegean thrived, and "waiting" to be civilized by influences from the East—has had to be changed out of all recognition when considering the organization necessary to build the large stone structures of Stonehenge in England, Newgrange in Ireland, Maeshowe in Orkney, the megalithic tombs of Brittany and Spain, and the timber pile-dwellings of central Europe.

See also **Boyne Valley Passage Graves** (*vol. 1, part 4*); **The Minoan World** (*vol. 2, part 5*).

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MARTIN BRIDGE

ARCHAEOLOGY AND ENVIRONMENT

The nature of past environments is a key aspect of archaeology because human action cannot be understood in isolation from its surroundings. For example, the lifestyle of a human group living in a densely forested area in a temperate climate would be very different from that of the same community inhabiting a treeless arctic landscape. Furthermore, in the case of any individual archaeological site, it must be realized that the modern environment may bear little relationship to that of the past. There may have been major changes in climate, sea level, soils, and plant and animal communities over the millennia. Thus a site occupying a coastal setting in the Mesolithic period might now lie several kilometers inland, or it might be completely submerged by the sea.

The reconstruction of past environments is based on many types of evidence, ranging from long-term perspectives on climate change provided by analysis of deep sea sediments and the Greenland and Antarctic ice sheets to reconstruction of local plant and animal communities from biological remains excavated from archaeological sites. Specialists from many fields, including climatologists, geologists, soil scientists, botanists, and zoologists are involved in analyzing such data.

THE HISTORY OF ARCHAEOLOGICAL INTEREST IN THE ENVIRONMENT

Until the 1970s archaeology was concerned mainly with using structures and artifacts to produce a reconstruction of a site, with little attention paid to the surrounding environment. If any "environmental" evidence at all was retrieved, it usually consisted of animal bones and larger plant remains (such as charred grain), which might be discussed in relation to site economy.

Important exceptions did exist, notably where excavation of wetland sites was involved. In wetlands, permanent waterlogging results in an oxygen-poor environment that reduces the level of microbial activity and enables organic materials to be preserved. These materials range from pollen grains to complete wooden buildings, and from microscopic parasite eggs to intact bodies such as the Danish Iron Age "bog bodies" Tollund Man and Grauballe Man. The discovery of sites such as the prehistoric lake villages of Switzerland in the mid-nineteenth century prompted the realization that the study of plant and animal remains could add significantly to an understanding of site function and setting.

In Britain one area of wetland that became a focus for early collaboration between archaeologists and environmental scientists was the East Anglian Fenland. The Fenland Research Committee was established in the 1930s to investigate the sedimentary history and archaeology of the area, which was densely settled in the Roman period. The prehistoric archaeology of the Fens was investigated by Grahame Clark, who later demonstrated the potential of biological remains for answering questions about environment and resource availability in his well-known excavations at the Early Mesolithic site of Star Carr in northeastern England.

Period	Climate	Evidence	Approximate start date in NW Europe
Subatlantic	Cold and wet	Unhumified *Sphagnum* peat	c. 800 B.C.
Subboreal	Warm and dry	Humified peat with pine tree stumps	c. 3800 B.C.
Atlantic	Warm and wet	Unhumified *Sphagnum* peat	c. 6000 B.C.
Boreal	Warm and dry	Humified peat with pine stree stumps	c. 9000 B.C.
Preboreal	Sub-arctic	Remains of sub-arctic plants	c. 9500 B.C.

The Blytt-Sernander scheme of Holocene climate change. ADAPTED FROM LOWE AND WALKER 1984.

Clark's excavations at Star Carr from 1949 to 1951 revealed a dump of timber at the edge of a substantial lake, associated with an exceptionally large number of artifacts made from deer bone and antler. Clark collaborated with specialists on animal bones and plant remains to reconstruct the environmental setting of the site and to shed light on the availability of food resources and raw materials. Furthermore, he used aspects of the animal bone assemblage in an attempt to ascertain the seasons during which the site was occupied.

Today, advances in excavation and sampling methods mean that evidence for the environment can be retrieved from most excavations, whatever the soil conditions. The nature of the soil does, however, affect the types of biological materials that will be preserved: sites on calcareous (chalk or limestone) soils, for example, are good for preserving bones and shells, whereas sites on acidic (low pH) soils are not. Such on-site evidence is complemented by the increasingly detailed information coming from off-site deposits, including peat bogs and lake sediments, which have often accumulated undisturbed for thousands of years. Such sequences can shed light on long-term changes in climate, sea level, and plant and animal communities, and can be linked to the archaeological record by radiocarbon or other dating techniques.

CLIMATE AND SEA-LEVEL CHANGES

The current period of relatively warm and stable climate is known as the Holocene, and follows a series of cold (glacial) and warm (interglacial) climate fluctuations during the period termed the Pleistocene. The Pleistocene-Holocene transition is traditionally placed at 10,000 radiocarbon years B.P. (before present), but "absolute" dates from annually layered lake sediments, tree rings, and annually deposited ice layers in the Greenland ice sheet indicate that it occurred about 11,500 years ago (or c. 9500 B.C.). Climatic warming at this time was remarkably rapid. In Greenland temperatures increased by about 15°C in a decade or less, followed by another period of more gradual warming over the next thousand years or so. It is remarkable to think that Early Mesolithic people living through this period would have experienced significant climate change within their own lifetimes, along with associated changes in availability of plant and animal resources.

Climatic warming led to the melting of enormous ice sheets that had covered much of northwestern Europe during the Ice Age, producing dramatic changes in sea level and coastal topography. In the Ice Age, Ireland and Britain formed part of a single landmass with continental Europe, but a rise in sea level resulted in the formation of the Irish Sea and then the English Channel, which eliminated the land link to the continent by c. 7400 B.C.

In addition to rising sea levels caused by ice melt (glacio-eustatic sea-level rise), coastal change also occurred due to "rebound" following the release of the weight of ice (glacio-isostatic changes). The effects of sea-level change mean that the modern coast of Europe is very different from what it was at the start of the Holocene, and different parts of the coast were affected differently due to a combination of isostatic recovery, absolute sea-level rise, and sedimentation. Parts of the coast where there was a fall of relative sea level may display raised beaches, for example, while a sea-level rise is indicated by submerged forests and settlements, which may be exposed on the coast at low tide. In addition to changes of sea level, river channels have altered considerably due to erosion and silting, and many lakes formed by the action of the glaciers have long since filled with sediment.

After the rapid warming of the Early Holocene, climate remained relatively stable during the prehistoric and early historic periods, although more subtle changes in temperature and rainfall continued to occur. These are apparent from various sources of evidence, of which the most widely available and studied are peat bogs. The degree of decomposition (humification) of peat is related to the climate in which it formed. Under cool or wet conditions the plants making up the peat decompose only slightly and form a pale-colored peat in which individual plant remains are clearly identifiable. Conversely, under warm or dry conditions plant remains decay to a greater degree and produce a dark-colored, highly humified peat. Peat bogs may thus contain layers of pale and dark peat, which can be linked to the climate at the time of deposition. Furthermore, the types of plants making up the peat vary depending on climate. Under very wet conditions the peat may consist mainly of mosses, such as *Sphagnum,* whereas, under drier conditions trees and shrubs may colonize the bog surface, resulting in the formation of a woody peat.

In the early twentieth century the Scandinavian botanists Axel Blytt and Rutger Sernander used such changes in Scandinavian peat bogs to construct a scheme of Holocene climate zones (see table), which was later widely applied across northwestern Europe. The zones were assumed to represent broadly synchronous changes in climate in different regions, but with the advent of radiocarbon dating it was shown that there was considerable regional variation in the timing and character of climate change. In the 1990s and early 2000s approaches to climate reconstruction from peat were refined to make it possible to record both major large-scale and subtle short-term changes, and improvements in the accuracy and precision of dating mean that these events can often be closely linked to the archaeological record.

Climate change is often invoked as a driving force behind key changes in the archaeological record, such as the adoption of agriculture. In Europe the transition from hunting, fishing, and gathering to farming has long been linked to changes in temperature and rainfall, although some of these hypotheses were based on climate reconstructions that have since been revised. Recent analyses of the ice cores from Greenland indicate that maximum Holocene temperatures were reached between c. 6600 and 2300 B.C., spanning the agricultural transition in Europe, and pollen evidence suggests that, toward the middle of this period, summer temperatures across much of Europe were approximately 2°C warmer than today. Warmer temperatures would have affected both natural vegetation and crops, but whether this effect was beneficial would have depended on other aspects of climate, such as the seasonal distribution and quantity of rainfall, the details of which are unknown. Furthermore, climate change during this period varied by region, and it is unlikely that a consistent link to the adoption of agriculture could be demonstrated across an area as environmentally diverse as Europe.

Recent research has also highlighted the significance of short-term climate changes resulting from variations in solar activity, including a period of cooler and wetter climate at the end of the Bronze Age, c. 850 B.C. Such changes may have had considerable implications for land use, by affecting the extent to which "marginal" upland and low-lying areas could be farmed. In the Netherlands, for example, some Late Bronze Age settlements seem to have been abandoned due to a rise in the water table at this time.

An intriguing aspect of environmental change in "marginal" environments in northwestern Europe is the extent to which climate, and hence human activity, may have been affected by major eruptions of the volcanoes in Iceland. In Iceland itself, the output of lava and ash (tephra) from such eruptions could engulf entire settlements, a fate that befell the farmstead of Stöng in southwestern Iceland during an eruption of Hekla in A.D. 1104. Could the volcanic gases from such eruptions have had more wide-ranging effects? The debate arises from the observation by the dendrochronologist (tree-ring dating specialist) Michael G. Baillie that particularly narrow rings (reflecting poor growth) in trees from Irish peat bogs and other sites in western Europe appear to be contemporary with peaks of acidity in the Greenland ice sheet resulting from gas emissions from major volcanic eruptions. Such eruptions may have caused climate deterioration by reducing transmission of the sun's energy, leading to a fall in temperature of perhaps a few tenths of a degree. Some of these "narrow ring events" appear to coincide with periods of change in the archaeological record, such as the abandonment of extensive Bronze Age field systems in upland areas of northern and western Britain. This has led some archaeologists to suggest that trees and humans were responding to the same episodes of climate deterioration. Others remain skeptical of a link, however, noting that the scale of change argued for parts of upland Britain is sometimes greater than that thought to have resulted from the same eruptions in Iceland itself.

Another mechanism by which Icelandic eruptions might have affected distant environments is soil acidification. In areas where soils are already acidic and marginal for agriculture, the "acid rain" following a volcanic eruption can acidify the soil further and push the ecosystem beyond the threshold at which it can be farmed.

NATURAL CHANGES IN PLANT AND ANIMAL COMMUNITIES

The climatic warming at the end of the last glacial period triggered major changes in plant and animal communities, which would have affected the availability of food and other resources to the human population. Parts of northern Europe that had remained free of ice during the glacial period were covered in sparse tundra, but, as the climate warmed, trees began to spread across the landscape from refuge areas in the Mediterranean. Evidence for this spread of woodland comes from analysis of pollen grains preserved in lake sediments and peat bogs (fig. 1). By c. 8000 B.C. much of Europe was covered in dense woodland, the composition of which varied by soil type and climate. In many areas hazel (*Corylus avellana*) woodland was dominant, and hazelnuts seem to have provided an important food source for Mesolithic people, as they are a common find on sites of this period. At the later Mesolithic site of Staosnaig, on the Hebridean island of Islay in Scotland, thousands of charred hazelnuts were found, suggesting that this resource was harvested systematically.

The spread of woodland was accompanied by changes in animal communities. Tundra species adapted to cold, such as reindeer, were replaced by animals more suited to forest conditions, including roe deer, wild boar, and beaver. Several of these species were hunted by Mesolithic and later peoples, sometimes to the point of local extinction.

HUMAN IMPACT ON THE ENVIRONMENT

The nature and scale of human impact on the environment have changed considerably over time, ranging from the creation of small woodland clearings and the burning of vegetation in the Mesolithic period to major woodland clearance for agriculture in the later Neolithic period and after. Evidence for this impact comes from a variety of sources, both archaeological sites and natural deposits.

One of the principal techniques used to reconstruct the interaction between human activity and the environment is pollen analysis. Many plants produce large amounts of pollen that may be preserved for hundreds of thousands of years in waterlogged deposits. The identification of this pollen makes it possible to reconstruct the original plant communities. The technique can be used to show natural changes in vegetation, such as woodland colonization of the landscape after the last glacial period, as well as the impact of human activity.

Human activity may be detected from pollen sequences in a variety of ways. For example, Mesolithic hunting and gathering peoples created small clearings in the dense woodland that covered much of the landscape of Europe, and these clearings can be detected in the pollen record as a decline in the abundance of tree pollen and an increase in that of sun-loving herbaceous plants, such as grasses. Sometimes these changes may be difficult to distinguish from the effects of large grazing mammals, such as wild cattle, or even the tree-felling activities of beaver. In such cases human presence may be established by the presence of microscopic charcoal particles in the deposits. Major natural fires seem to have been rare in prehistoric northwestern Europe, but fire was used by Mesolithic and later peoples to modify the environment. An example is provided by the Early Mesolithic site of Star Carr. The original research by Grahame Clark was followed in the 1990s by a detailed program of biological analyses designed to shed new light on the interaction between people and the environment at the site. High-resolution pollen analysis (samples at intervals of one to two years) was used to look for short-term vegetation changes linked to human activity, combined with charcoal particle analysis to verify the use of fire. This research suggested that people were deliberately burning reedbeds around the lake c. 9000

B.C., perhaps to encourage animals to graze on the lush regrowth. This may be the earliest example of deliberate environmental management in Europe.

Other indications of human activity given in pollen sequences can come from the presence of pollen of "anthropogenic indicators"—plants that are strongly associated with human activity. One example is ribwort plantain (*Plantago lanceolata*), a plant growing on grazed grassland or fallow arable land. It often first appears in pollen sequences in the Early Neolithic period, when woodland clearings were being created for grazing and small-scale crop cultivation. Other plants linked to human activity include arable weeds and, of course, crops such as cereals. Most crops produce very little pollen, so they are very underrepresented in the pollen record, but the spread of crop cultivation across Europe can be traced by the presence of cereal grains preserved by charring on Neolithic sites.

An intriguing event recorded in many pollen sequences spanning the Early Neolithic period in northwestern Europe is the "elm decline." This was a major drop in the abundance of elm (*Ulmus*) pollen, from about 10 percent to 1 percent of the total pollen, c. 3800 B.C. Several hypotheses have been proposed to explain it. Originally, it was thought to reflect a response to climate deterioration, but the fact that usually only elm is involved made this hypothesis unlikely. Subsequently, the frequent association of the decline with the first occurrence of cereal pollen led to the view that it represented the spread of Neolithic agriculture: farmers selectively cleared elm woodland growing on the best soils. Cereal pollen dating to several centuries before the elm decline has been found at some sites, however, which suggests that cereal farming was already established.

Another opinion was based on the practice, still employed in some mountainous areas such as Norway, of collecting leafy branches of trees to feed cattle in winter. If elm was used as a source of leaf fodder in the Neolithic period, this might account for its decline in the pollen record, since the removal of leafy branches would reduce pollen production. Archaeological evidence for the use of tree leaves to feed cattle comes from the excavation of early Neolithic cattle barns at Weier in northeastern Switzerland, though here elm was just one of several tree species that had been collected, and one of the least abundant. Leaf fodder collection is unlikely to explain a decline confined to elm, especially since the elm decline was so widespread, even in areas where human populations were probably sparse.

Fig. 1. Pollen grain of pine from Mesolithic lake sediment, c. 9000 B.C. COURTESY OF PETRA DARK. REPRODUCED BY PERMISSION.

Important evidence for the timing of the elm decline has come from annually layered lake sediments from Diss Mere in Norfolk, England. Here the elm decline occurred over a period of just six years. The rapidity of the event suggests it is unlikely it was due entirely to human activity, but there are similarities with the effects of recent outbreaks of tree disease such as chestnut blight in North America and Dutch elm disease in Europe. There is no direct evidence for a disease of elm trees in Neolithic Europe, but remains of the beetle responsible for the spread of Dutch elm disease (*Scolytus scolytus*) have been found in Neolithic deposits from Hampstead Heath in London, England, and wood showing the characteristic burrows made by the elm bark beetle has been found at Weier and other Neolithic sites in Switzerland and Denmark. The beetle acts as a vector for the fungus that causes the disease (*Ceratocystis ulmi*). The remains of the fungus have not been found but this is unsurprising, as fungi are rarely preserved in the archaeological record.

The disease hypothesis accounts for the speed and wide geographical range of the elm decline, but at many sites an association with human activity is suggested by the presence of cereal pollen and other "anthropogenic indicators." It seems that the elm decline may have been caused by a combination of disease and human activity: as Neolithic people removed elm branches for leaf fodder or building purposes, they damaged the trees and provided points of entry for the disease, thus encouraging its spread. The spread of the disease may itself have encouraged Neolithic people to clear woodland by killing trees and creating natural openings in the dense woodland canopy.

The Neolithic elm decline provides a useful example of the multiple hypotheses that often need to be considered to understand the past relationships between human activity and environment and the range of different types of evidence that can be used to support them.

Several aspects of prehistoric environmental change probably reflect a combination of human activity and natural factors. The expansion of moorland vegetation across previously wooded parts of upland northwestern Europe is another example. Peat formation in such areas may have been triggered by increased rainfall, leading to the replacement of trees by wetland plants such as mosses and sedges, but in some areas human activity is implicated. On Dartmoor and the North York Moors in England, for example, the presence of charcoal and sometimes Late Mesolithic flint artifacts immediately below the peat suggests that people were present and were burning the local vegetation before peat formation began. In such cases it has been suggested that the removal of trees and the use of fire may have altered the hydrological balance of the sites, leading to a rise of the water table, which killed the remaining woodland and triggered peat formation. Thus many of the wild and seemingly "natural" moorland landscapes of parts of Europe may owe their origin, at least in part, to human activity.

Human activity, through burning and grazing herds of animals, also seems to have been involved in the creation and maintenance of other treeless landscapes, such as the heathlands of southern Britain and Denmark. Excavations of ancient land surfaces buried beneath burial mounds (barrows) indicate that woodland had been cleared and soil changes were occurring well before the barrows were built in the Bronze Age.

RESOURCE USE AND SEASONALITY

In addition to the natural deposits that document major environmental changes, evidence for the ways in which prehistoric and early historic peoples modified their environment and exploited its resources is provided by the biological remains from archaeological sites.

Mesolithic peoples lived by hunting, gathering plants, and fishing, and may have moved around the landscape following herds and exploiting seasonally available resources. A characteristic result of later Mesolithic activity in coastal areas is shell middens—large piles of shells, such as cockles and limpets—left from shellfish consumption. Such middens often include remains of other plants and animals used as food, including hazelnuts and fish bones. Archaeologists have attempted to use the animal remains from such middens to shed light on which seasons of the year people were living on the coast. Study of growth lines formed in shells, for example, can show whether shellfish were collected in summer or winter. Ear bones of fish (otoliths) provide another source of seasonal information, as demonstrated by analysis of Late Mesolithic shell middens on the Scottish island of Oronsay. The size of the otoliths was used to assess the age at which the fish were caught, and thus the season during which the midden sites were occupied.

Finds of Late Mesolithic and Neolithic fish traps from the Danish Storebælt provide some of the oldest evidence that early peoples managed woodland to provide wood for specific uses. The thin interwoven rods used to make the traps seem to have come from woodland that had been coppiced (fig. 2). Coppicing involves cutting down trees almost to ground level, after which the new shoots are left to grow for approximately five to ten years (depending on required size), before they are cut again. The resulting stems are of uniform size and suited for various purposes, from basketry to woven (wattlework) wall panels. Coppiced wood was widely used in pre-

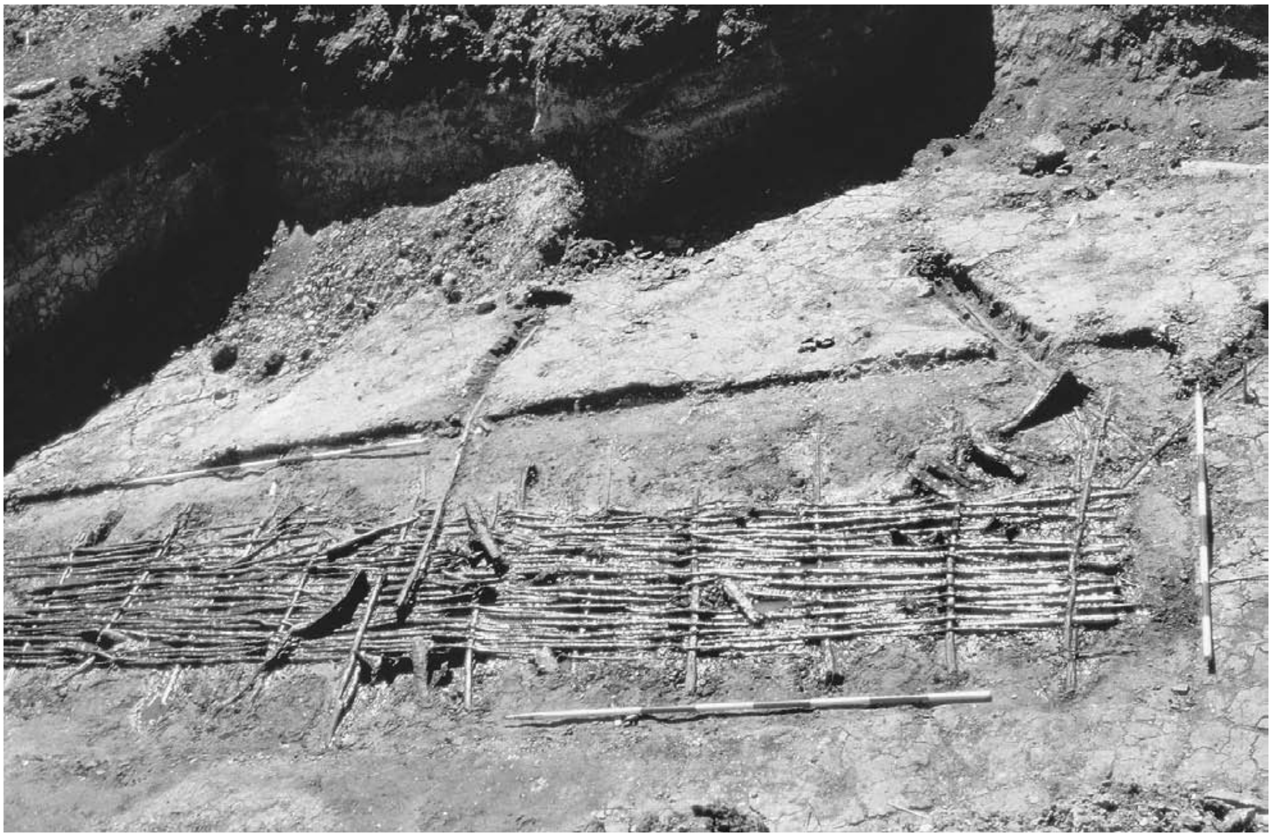

Fig. 2. A Neolithic fish weir from Oleslyst, Denmark, made from coppiced wood. COURTESY OF LISBETH PEDERSEN, KALUNDBORG REGIONAL MUSEUM. REPRODUCED BY PERMISSION.

historic and early historic Europe, and has been found in excavations of many waterlogged sites, such as the Neolithic, Bronze Age, and Iron Age trackways across the wetlands of the Somerset Levels in southwestern England.

DOMESTIC ENVIRONMENTS, FROM FARMSTEAD TO TOWN

Where plant and animal remains are well preserved, they can provide evidence not only of the environmental setting of a site and the resource use by its inhabitants but also of their domestic living conditions and state of health. Insect remains have been used to assess the level of hygiene on domestic sites, ranging from Norse farms in Greenland and Iceland to urban centers such as Dublin, Ireland, and Oslo, Norway. Different species of insect may be associated with various types and quantities of decaying organic material or may be parasites of particular hosts. An example is provided by the Viking Age town of York in northern England. Here the tenth-century town consisted of closely spaced wooden tenements with waste pits, which yielded huge quantities of organic remains. Analysis of the insects indicated that there were substantial quantities of rotting organic material left lying around town, including waste products from cloth manufacture and dyeing, and from the butchering of animal carcasses and the manufacture of objects from bone, antler, and leather. Analysis of the contents of cesspits indicated not only that the diet was rich in a mixture of cereals, fruit, and meat, but also that the people of the town suffered from intestinal parasites such as whipworm (*Trichuris trichiura*) and mawworm (*Ascaris lumbricoides*). External parasites were also commonplace, including human lice (*Pediculus humanus*) and fleas (*Pulex irritans*). Parasitic infections seem to have been less common away from towns, probably because the lower population densities in the countryside were less conducive to their spread.

CONCLUSION

Evidence about the nature of the environment, from the domestic to the global scale, is essential for understanding past human behavior. The range of techniques that can be applied in obtaining such evidence is expanding rapidly. Biomolecular techniques, such as analysis of ancient DNA (deoxyribonucleic acid), are improving and will play an increasing role in isolating and characterizing tiny quantities of degraded molecules; isotopic analysis of bone can shed light on diet and provide clues to the movement of people between different landscape zones. The specialized scientific nature of much of this research requires close collaboration between archaeologists and scientists and promises to produce many new insights into human-environment relations.

See also **Tollund Man** (*vol. 1, part 1*); **Star Carr** (*vol. 1, part 2*); **Muge Shell Middens** (*vol. 1, part 2*); **Viking York** (*vol. 2, part 7*).

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PETRA DARK

SETTLEMENT PATTERNS AND LANDSCAPES

The archaeology of settlements has grown progressively in its scope and methodology over the long history of the discipline, so that the modern study possesses a wide range of topics and approaches. The general public is still naturally fascinated by images and reconstructions of monumental, nondomestic sites, such as burial mounds, temples, and fortified centers, which were the main focus of pioneer research into archaeological landscapes during the sixteenth through nineteenth centuries A.D. Even in those times, however, more everyday insight into the landscapes and settlements of ordinary people came with unusual archaeological discoveries, such as the wonderfully preserved, volcanically sealed small Roman town of Pompeii or similarly preserved, but water-sealed Swiss prehistoric lake villages.

Indeed, most modern research into past communities and their surroundings is focused on the farms, villages, and even field systems of ordinary people in the past, who were, for the most part, agriculturalists and herders. This aspect of settlement archaeology really took off in the first half of the twentieth century in Europe, as in many other regions of the world, and for interesting reasons is still relevant today. On the one hand, there has been wider public education, the increased involvement of amateurs in archaeology from all social classes, and the influence of trends in the study of history toward a greater concern with the everyday life of people of all social classes. This trend has been coupled, on the other hand, with the wide impact of such technical developments as aerial photography. (In this respect, both world wars were major stimuli for European landscape archaeology.) Together, these factors all have contributed to making contemporary settlement archaeology a very "democratic" field of the discipline.

Typically, investigations into where and how people lived in the past begin with the intensive study of the layout of domestic residential sites. This is followed by the plotting of systems of settlements across the countryside, with special emphasis on their relationship to the natural environment and land use and the combination of the two in social and economic terms. In parallel, environmental archaeology (the study of animal bones, plant remains, and the physical environment of the past) provides a direct link between the debris found on settlements or in palaeosols (fossil soil horizons) connected to other monuments and contemporaneous landscapes, and the type and degree of human impact.

Some researchers turn to settlement archaeology in the search for cross-cultural regularities—preferably with a very exact or even mathematical form, in the light of a global science of human settlements. The internal form of domestic settlements (intrasite study) should express in constructed space the workings of the social group it housed. The analysis of settlement systems across the landscape (intersite study) should reveal strong, regular settlement patterning correlated with quantifiable environmental variables and with the attempt to define rather abstract laws of human motion in space (e.g., site catchment analysis, discussed below) and a patterning of a geometric kind reflecting a very ordered spatial patterning of human settlements at the regional scale (locational analysis inspired by developments in human geography).

These aims are part of modern approaches to past societies, but for many archaeologists they seem too mathematical and deterministic as a way to view human behavior. In fact, they developed and became most popular in the 1960s, when many social scientists were attracted to searching for laws of human society that might parallel the laws of natural science and mathematics and that could be found through applying the new science of computing. A similar fascination with the "geometry" of settlement forms a strand in archaeology's cousin discipline of geography, a topic that was at its most popular in the 1960s in a field of study that was termed the "new geography."

Modern scientific analysis of human behavior in space, as it applies to archaeological studies, has even more powerful computerized applications to test for patterns within and between settlements or in relationship to different aspects of the natural environment. These are largely scientific spatial techniques adopted from geography since the 1990s, primarily a method of rapidly evolving computerized mapping called GIS (Geographic Information Systems).

A different approach within contemporary settlement archaeology begins with a contrasting perspective. Rather than using modern technology to detect abstract patterns in ancient settlement systems, which may not have been apparent to these past communities, this alternative method tries to reconstruct how past peoples built their settlements and lived in their landscapes, following ancient ways of seeing the world that doubtless diverged significantly from our own. This equally important type of study can be linked to a shift of interest within the humanities since the 1970s. This view has moved away from the modernists' hard scientific approaches and reliance on mathematics and computing toward more "humanistic" or "human cultural" insights, often termed the "postmodern movement" in the social sciences. How does this approach work in practice? At the individual site level, house and settlement plans are studied as reflections of ancient ways of seeing or categorizing the social world. At the landscape and regional level, an attempt is made in the study of settlements and other monuments to recover the "mental maps" or "sacred geographies" portraying the wider landscape in peoples' minds that were part of a past peoples' shared culture.

Although at times the enthusiasts for scientific, computerized settlement archaeology and those who favor a more anthropological and cultural form of investigation seem to be pursuing incompatible approaches, there is actually no reason why the two cannot work alongside each other. One could use GIS not only to compare the location of ancient farms with varying soil types, exposure to sunlight, and dominant winds but also to pursue human visual or aural experiences of the countryside (the ways past people imagined, visualized, and even heard the world around them).

INTRASETTLEMENT ARCHAEOLOGY

Analysis of past settlement sites generally relies on combining various methodologies. Very rarely are such sites totally excavated, especially if they are larger than single farmsteads. Thus, inferences are made by linking windows of detailed information from dug sectors (if available) with wider site coverage, utilizing surface artifact survey, aerial photos, and a battery of geophysical and geochemical techniques. The primary aim is to define the boundaries of domestic activity and its varying character across the site and in each period of occupation. A secondary aim is to define the forms of economic activity carried out at the site. Third, and usually most difficult, is the attempt to reconstruct the social organization and mentalities or worldviews of the site's residents.

A significant theoretical and methodological stimulus has been research into the social logic of space with "access analysis," pioneered by Bill Hillier and Julienne Hanson. The ways in which individuals navigate around a settlement or within a house can tell much about public versus private spheres of life, the physical separation of people of different social or political classes, and the attitudes to gender in a society. Often, the preserved plans of structures and communities form maps that reveal the fossilized traces of these past social norms. Examples from the study of early-farming periods in the Near East and later prehistoric Sicily illustrate the increasingly sophisticated approaches being developed to push our interpretative frontiers in these more challenging directions. In these cases growing family privacy and household economic specialization can be followed through the careful analysis of the dynamics of settlement plans.

INTERSETTLEMENT ARCHAEOLOGY

We can make a useful distinction in most cases between the relationship of a settlement to its immediate landscape and its relationships with neighboring and more distant settlements. By the 1930s, and increasingly in later decades, archaeologists and geographers investigated the location of domestic and other sites with respect to the qualities of their surrounding physical landscapes. The focus was on geology and soils, with the aim of testing whether past peoples selected habitation places because of the proximity of certain types of cultivable or grazing land and mineral or other resources. By the later 1960s a series of studies by human geographers and anthropologists had suggested that the characteristics of landscape exploitation by humans around settlements were similar to those of the territorial behavior of many animal species. Moreover, such exploitation was constrained by the economics of daily travel to fields or pastures remote from home.

During the course of the twentieth century, geographers found that clusters of rural farming and stockbreeding settlements in medieval and early modern times were serviced by regularly spaced "central places" that provided administrative and commercial functions. In some elaborate state societies these service centers might be ordered in hierarchies, each level with its own spatial logic. The fundamental idea behind the study of the extent of territory exploited from individual farming settlements without service roles, that travel time is a major consideration for daily work in the fields (the "friction of distance"), is also important for focal communities. Take the examples of market towns and Roman forts. In the former case it can be shown that peasants prefer markets that are accessible within a day's return to their homes, a two- to three-hour journey each way, thus producing rural towns at intervals of 20–30 kilometers or less. The same intervals might be reproduced in military control centers, allowing a fort under attack to be reached by a relieving force from adjacent bases that lay within a day's march.

The study of an individual site's "territory," in cases where the main daily activity was agricultural and pastoral exploitation of the immediate hinterland, took off in the 1970s as "catchment analysis." (The term derives from the area of land draining into a particular river and hence reminds us that rural settlements usually live by bringing in products from a defined block of surrounding countryside.) When the method was invented, its originators were keen to demonstrate that past peoples were practicing a very rational form of economics in deciding where to place their settlements. Criticisms rightfully were raised from the 1980s onward that we should not ignore alternative social and symbolic explanations for settlement location, but we can surely combine these approaches without sacrificing the usefulness of one type of territorial analysis of a past settlement in its landscape.

Catchment analysis seeks to determine the types of resources accessible at increasing distances from the domestic habitations of communities that are thought to have obtained their livelihood mainly through exploiting the site's hinterland. This method may reveal that a group of sites in a particular region and period all lay in a highly rational location to maximize efficient use of particular types of land or landscape. Equally, the same locations may be revealed to have been chosen with defensive, religious, or other noneconomic factors as the primary concerns and thus perhaps were less than desirable in terms of quick access to arable fields or meadows for grazing flocks.

Anyone who has worked for years among farming communities of varied cultures will be struck by the farmers' intimate and detailed knowledge of the properties of every field and hillside in their landscape. These communities have a keen sense of the advantages and disadvantages of the local terrain for bringing in a successful subsistence crop or salable product from their cultivated plants and domestic animals. Yet settlement archaeologists today are also correctly aware that they must balance the rather easier task of reconstructing the daily toil of past farmers and herders, and its effects on the form and placement of settlements, against the ways in which religious and social ideologies may have been marked in the landscape. As previously noted, with the assistance of GIS there now exists a more adaptable form of catchment analysis. Basic parameters, such as environmental and climatic conditions or prevalent technology, can be enriched through considering the interplay of neighboring settlements, relations to strategic or religious monuments or landscape features with symbolic value, and such factors as intervisibility of domestic, religious, and strategic places and related forms of landscape perception. In this context intervisibility refers to the ways in which ancient people could observe and thus visually participate in events, ceremonies, and symbolic links to different parts of their spatial world, and be observed themselves by other people.

A great deal still can be achieved through the continuing study of the systematic patterning of basic rural communities of the hamlet or village class across past landscapes. When we observe, for example, how a region fills up with settlements in the long term, the size of communities and distances between them form patterns that often are the same in widely differing cultures and from very different time periods. A significant threshold is crossed again and again when we note the crystallization, out of networks of such primary nucleations (concentrated groups of people in a single settlement node), of so-called corporate communities of the village-state or proto-city-state type. These seem to mark a common giant step from small rural settlements with similar political standing to the emergence of the "state."

This neatly brings us to the "central place" theories in archaeological settlement studies. Developed in the first half of the twentieth century by geographers, this concept goes well beyond the simple observations that most rural settlements cluster around market towns where various important services are available and that such foci tend to be within easy reach of most rural dwellers. Some geographic theorists, inspired by the desire to find a set of human behavioral laws and mathematical patterning comparable to the laws of physics and the geometry of many aspects of the natural world, have suggested that there is a detectable tendency toward highly elaborate and overlapping regular designs in the layout and spacing of district and regional foci of political and economic control. It has become apparent, however, that the extremely complex geometry that illustrates the theoretical schemes for central places by such human geographers as Christaller, Loesch, and others rarely agrees with geographical reality. It is therefore not very surprising that although settlement archaeologists have tried to find parallels in premodern societies, they have found that archaeological central places are spread in a regular pattern over past landscapes only in very simple terms.

For example, administrative centers in the European Iron Age can be classed into giant, medium, and small-scale foci; each part of Europe had different combinations of these foci, and the patterns often changed by phase. Strong uniformity can be identified in the scale of territory focused on each distinct level of a center, and in some regions where all types are present, they seem to be nested within each other like Russian dolls. Quite basic methods can highlight such structures. One method involves drawing Thiessen polygons. In a particular region, sites considered to be administrative or market centers of equivalent status, each with surrounding rural communities for which they provide varied services, are taken as a set of spatial points, the aim being to suggest the likely boundaries of the regions they dominated. Lines are drawn between all adjacent centers, and at the midpoints a putative boundary is sketched in at right angles to the communicating line. Connecting all these midpoint boundaries leads to the creation of polygons around each center, taken to be a reasonable approximation of the division of control over rural settlements. The advent of GIS has refined such spatial tools, since this computer technology can replace a simple distance boundary between two centers with a more realistic one based on the calculated walking times, allowing for the variable terrain being crossed.

TOTAL LANDSCAPE HISTORY

So far we have examined the internal plans of settlements, the way their occupants moved out to exploit a site's environment, and the dependency relationships between central places and the lesser rural communities they serviced. But also, how does one find, map, date, and interpret the vestiges of past settlements? It might seem relatively simple. Particularly in western Europe, beginning with the antiquarians of the Renaissance and continuing for some five hundred years, scholars and amateur enthusiasts have been traveling the countryside, noting evidence of ancient humans. By the nineteenth century, registers of ancient sites were being made on a national and parish basis, together with the first legislation to explore and protect them. Today these records contain not only the localized observations of many generations of skilled observers and the locations of finds reported to museums but also more recent evidence such as thousands of sites revealed through aerial photographs. Moreover, through redevelopment in town and country, accidental discoveries have been made. With such a history of research, the uninitiated might think that we would have a fairly complete picture of all the premodern settlements and other monuments.

Nothing could be further from the truth. In the 1960s a new form of settlement archaeology developed in the United States, which was to be transported and elaborated in most countries of Europe in the 1970s and 1980s—the regional surface field survey. In its more rigorous form, such a study involves teams of field walkers stretched out in close parallel lines, scouring a landscape field by field. They look not only for the obvious surface evidence (often recorded by previous survey), such as barrows, banks, and architectural debris, but also more particularly for the minutiae of everyday past life, such as potsherds, stone tools, fragments of glass, and coins. Normally, the most common surface artifacts are pots and lithics. Where such intensive surface studies have been carried out, the results generally have been to increase the density of known sites many times over. Because people living in ancient settlements deposited artifacts across the landscape as they exploited the hinterland of their homes, these painstaking methods also began to document the "offsite archaeology" resulting from such behavior. Such items include household rubbish spread across fields through fertilizing and flint tools discarded during hunting trips.

Regional surface survey has rapidly filled in the countryside with a density of sites, especially domestic settlements—an entirely unexpected result. Furthermore, the scientific plotting of finds across these sites and their laboratory study enables the archaeologist to date the periods in which people were active at these sites. Through rigorous analysis it is even possible to distinguish times when only a part of the settlement was in use or when the site was merely a temporary habitation or a nonresidential focus of rural activity.

Additionally, such surface techniques have proved invaluable in the intensive study of previously known sites, especially large ones. As archaeological techniques have become more painstaking and deliberate, the time frame required for total excavation of an ancient urban site, even a village, has grown beyond an archaeologist's lifetime. Increasingly, sites are being dug only if they are otherwise about to be destroyed through land development, and larger sites often can be protected from such a fate. The result is that for most nucleated settlements, there is no real prospect of total excavation. In this case, surface and nondestructive sub-surface prospection or geoprospection can come into play (i.e., ways to probe for information below the soil without digging). In a few short seasons of work, a city 1–2 square kilometers in extent can be gridded and a detailed collection made of its surface finds and architectural remains. Often this can allow for a general overview of the main phases of activity and their localization over different parts of the settlement. Sub-surface geoprospection (e.g., resistivity, magnetometry, and radar) can reveal such details as street or house plans, public buildings, defense walls, and industrial zones. With resistivity, electrical currents passed through the soil outline walls as strong resistance features and ditches as weak while magnetometry heavily magnetized patches of soil are detected as areas where hearths, kilns, or other industrial activities may have taken place. Finally, with georadar, sound waves passed into the soil can show at different depths the presence of archaeologyical layers, walls, and other solid divisions.

Excavation and total surface and sub-surface prospection, together with the reassessment and renewal of anthropological and historical models for intrasettlement analysis (social and economic, symbolic, and religious activities) continue to enrich understanding of the nature of life within past settlements. This encourages cross-cultural comparisons and contrasts, with reliable empirical and theoretical foundations, for human settlement behavior.

Despite the increasing intensity of surface survey, the resultant filling in of the landscape with past activity traces does not seem to be reaching the point of decreasing returns. This prompts the realization that even in Europe we are still at an early stage of understanding the degree of detail that is retrievable in reconstructing settlement and land

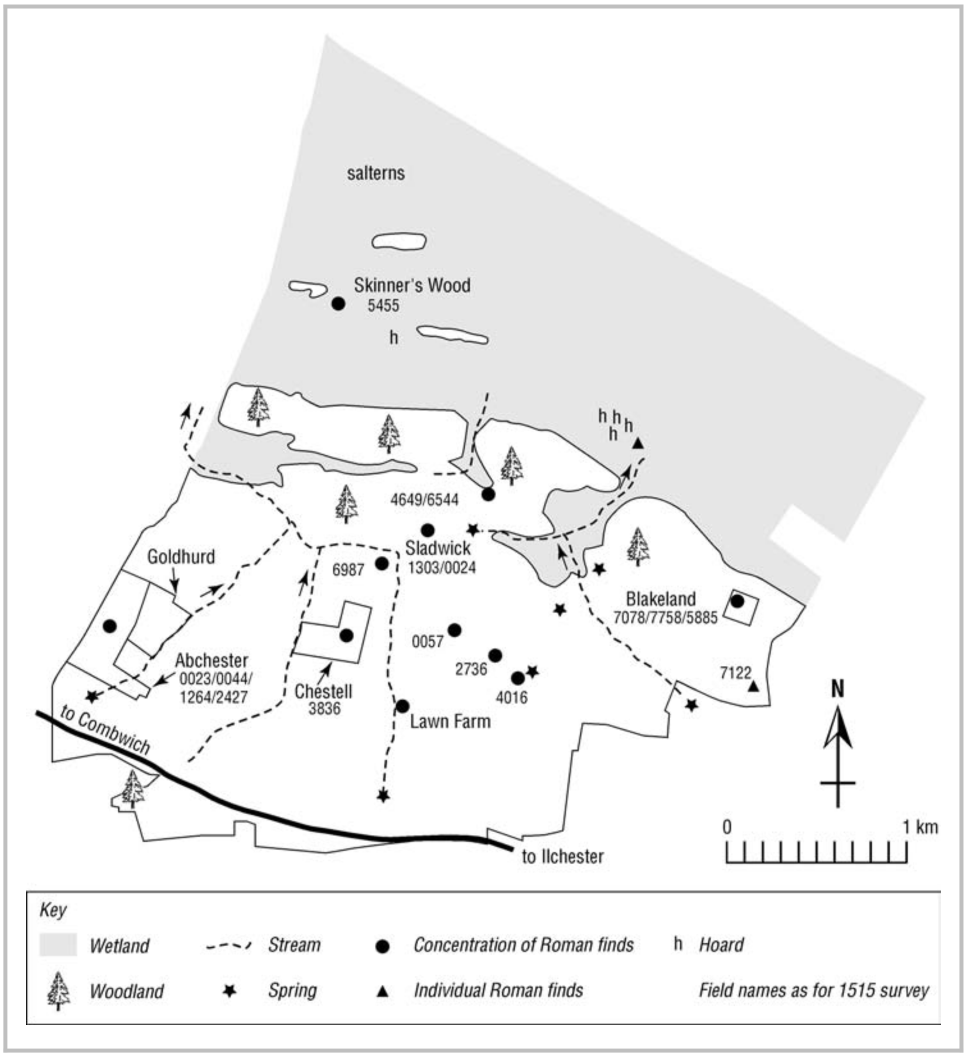

Fig. 1. Roman landscape of Shapwick parish, Somerset, England. ADAPTED FROM ASTON AND GERRARD 1999.

use history at the microlevel (parish or commune). In just a handful of tiny landscapes within Europe have truly exhaustive investigations of individual parishes been undertaken, with the perhaps predictable result that yet another level of detail has become visible for landscape research, beyond that of intensive survey.

One example is the complete survey of the parish of Shapwick in southwestern England undertaken by Michael Aston and Christopher Gerrard. There, every field was walked for surface traces, shallow test pits (shovel testing) were widely deployed in areas where surfaces were obscured by vegetation, the gardens of village residents were sampled by test excavation, all parish toponyms from maps and villagers' memories were studied down to the intrafield level, and major excavations were carried out at the locations of the most significant settlement traces. An immensely detailed prehistory and history of the parish represents the outcome, from hunter-gatherer vestiges up to the long and complicated development of the modern village settlement (fig. 1). Another excellent example involves massive clearance by rescue excavation of large parts of the district of Oss in the Netherlands, where generational changes in household numbers and their domestic location can be followed through meticulous excavation by Harry Fokkens and his project team (figs. 2, 3). Until such studies are replicated in all the major landscape types across

Fig. 2. Micro landscape settlement evolution trade through large scale resue excavation in the district of Oss, The Netherlands. Shown here is the distribution of farmsteads and other features dating to the Middle Iron Age (500–250 B.C.). The houses represent four or five dispersed farmsteads (a population of about thirty people) that have been replaced almost every generation. They were clustered around a central burial that already had been used as a "loose" cemetery for centuries. In the Middle Iron Age sanctuaries were raised in this area connected to burials. The area measures 2 × 2 km, with about 60 hectares excavated. FROM FOKKENS 1996. COURTESY OF DR. H. FOKKENS. REPRODUCED BY PERMISSION.

Europe, one cannot begin to imagine that we have correctly determined even the main lines of settlement and land-use evolution.

MAJOR THEMES IN THE EVOLUTION OF EUROPEAN SETTLEMENT SYSTEMS AND LANDSCAPE USE

One can highlight several themes in the development of settlement analysis, at the present time, some of which show the influence of abundant results from intensive field survey and the rise of micro-analysis of the landscape. In terms of intrasettlement studies, attention is being drawn to the material evidence that might help us recognize certain forms of internal social organization of a particular settlement. The relative importance of nuclear or extended families and wider real or fictitious social divisions (clans, moieties, and so forth), together with linked issues having to do with public and private space, feature prominently in current research. They stand alongside older, established types of analysis that looked at the physical segregation of elite groups or craftspeople and the evidence of communal planning (streets, defenses, public spaces, and communal buildings). Techniques such as access analysis are providing insights into the social behavior of past societies and the way it can be traced in the built environment. Patterning in the distribution of artifacts or ecofacts (animal bones, seeds, and the like) across settlements is used to indicate where different tasks were performed and whether different social classes had varying diets. It is also possible to trace links to other communities (through the exchange or importation of food or industrial products and access to prestige items). In line with a heightened interest in the symbolic

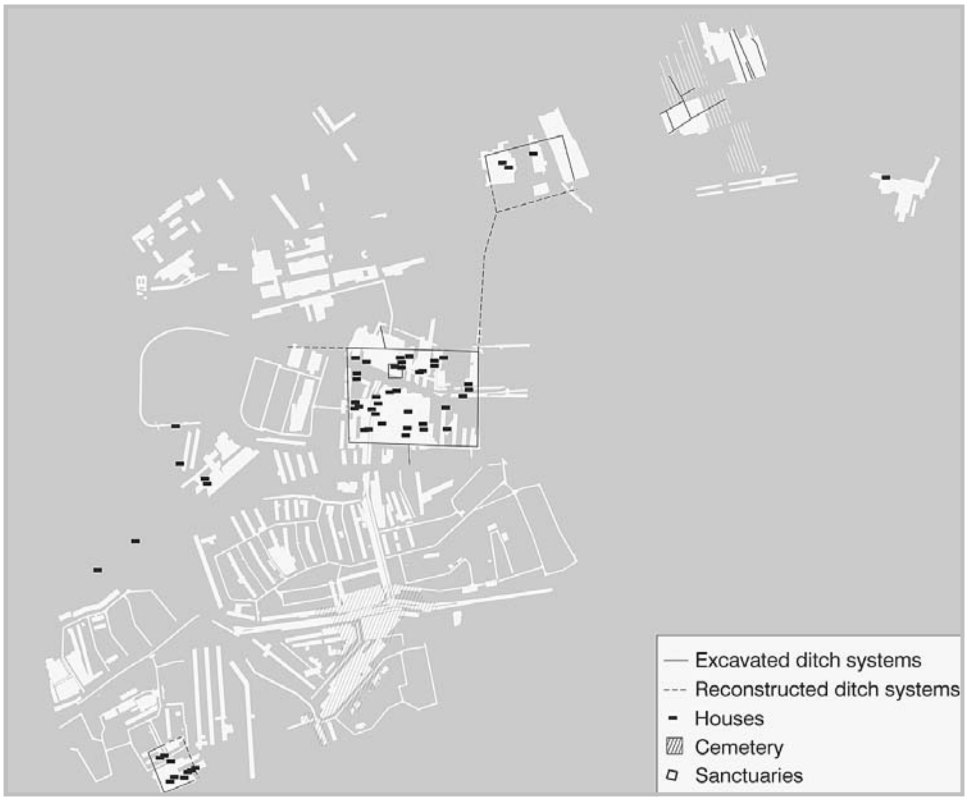

Fig. 3. Micro landscape settlement evolution trade through large scale resue excavation in the district of Oss, The Netherlands. Shown here is the distribution of farmsteads and other features dating to the Roman period (12 B.C.–A.D. 250). Three nucleated settlements and one "wandering" farmstead are now present in the area. The settlements are enclosed and connected by open ditch systems (not defensive). A communal cemetery is present in the southeast. FROM FOKKENS 1996. COURTESY OF DR. H. FOKKENS. REPRODUCED BY PERMISSION.

world of past communities, the deep penetration of settlements by ritual activities has been much researched, with a growing consensus that many aspects of everyday life in rural communities did not respect our own division between functional and symbolic forms of behavior.

In the long term, there remains strong evidence at the most general level, from settlements and from other contexts, notably burials, that increasing levels of social stratification in Europe developed over time, with perhaps limited social distinctions for most communities in Mesolithic and earlier Neolithic times. This was followed by growing social inequality in the later Neolithic and especially into the Bronze Age. By the Iron Age social hierarchies commonly were associated with elaborate settlement hierarchies and large-scale political units.

Research at the intersettlement level has given rise to various intriguing models that, in many ways, mesh well with the broad trends in social organization just outlined. In most, but not all, parts of Europe, hunter-gatherer settlement systems emphasized mobility and flexibility of exploitation of the landscape. The Neolithic and Early Bronze Age frequently seem to be represented by small and short-lived rural sites, relocated again and again in relatively small areas of countryside without fixed land boundaries. Some scholars see this pattern as having more in common with preceding hunter-gatherer attitudes to settlement and landscape exploitation than with subsequent ways of using the land. In many regions the later Bronze Age and the Iron Age are associated with more permanent and often larger domestic sites, which are associated with the rise of increasingly elaborate land divisions. These trends toward greater fixity of settlement and property divisions (both within settlements and in the countryside) are compatible with more rigid, hierarchical forms of sociopolitical organization.

The potential interactions between modifications to the form of human settlements, formally structured landscapes and social and economic power, offer exciting opportunities to comprehend fundamental processes within European history and protohistory. For those who object to this kind of social evolutionary approach as harking back to the way in which the scholars of the Victorian era saw themselves as standing at the top of a pyramid of such social development, one can point out that this cycle of elaboration very probably is reversed in the post-Roman centuries, followed by the commencement of a new evolutionary cycle. Indeed, many parts of Europe seemed to evidence shifting settlement patterns in the Early Middle Ages, before the High Middle Ages reinvented fixed nucleated settlements and firm land divisions once again.

In line with earlier comments on the preoccupation of archaeological research with symbolic representations in the past, the landscape around settlements and the relationships between settlements are being investigated in ways that extend well beyond purely economic and social factors. To what extent are settlements and monuments placed to achieve a visual effect to impress outsiders or to mark sacred points or routes in the landscape? Through the tool "Viewsheds," GIS computer methods allow us to map what could be seen from a certain ancient site and how visible the site was to others. What activities in the hinterlands of settlements were related primarily or significantly to symbolic goals instead of or in addition to the functional needs of food, industry, and defense? Much research is being carried out on these new aspects of the landscape, but some caution is required to ensure a proper balance is maintained in our urge to find new perspectives.

Historical ethnography warns that in the vast majority of recorded historical societies, the great majority of the population are primarily concerned with ensuring a secure food supply and the economic stability of their families and with fostering positive social relations within their communities. Much less time and attention were paid to ritual behavior and symbolic representations, although they were never overlooked entirely. Naturally, the lifetime quest for a good income and social success often called on supernatural assistance through rituals and frequently achieved symbolic expression.

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JOHN BINTLIFF

TRADE AND EXCHANGE

Ancient trade is a major focus of archaeological research, as its study may reveal not only economic aspects of ancient societies but also the social and political setting within which it occurred. In the last quarter of the twentieth century and into the present, advances in analytical methods have greatly improved the methods of determining the source of archaeological materials, while more sophisticated theoretical approaches have affected the ways in which archaeological data relevant to trade systems have been interpreted. These advancements are reflected in the goals, design, and implementation of modern studies of ancient trade and exchange in Europe. Determining the origin or provenance of archaeological artifacts, which requires following a number of scientific principles and prerequisites, is itself not the end of a trade study but establishes only the first link in a chain that also may include procurement, transport, manufacture, use, recycling, and disposal. The reconstruction of this entire sequence of activities is necessary for a full understanding of the associated human motivations and types of behavior. In Europe and the Mediterranean, many successful studies of trade and exchange have been done on stone (obsidian and marble), ceramics (amphorae and decorated pottery), and metals (copper, lead, and silver), providing important information about interregional contacts and social and economic systems and the manner in which they changed over time.

TRADE AND EXCHANGE

In modern economics, trade is defined as the mutual movement of goods between hands, but in the archaeological record, it is only the movement of the goods themselves, rather than their ownership or possession, which is easily recognizable. Anthropologists ultimately seek to establish a cultural biography for these goods, starting with the procurement of their raw materials and ending with their disposal. Furthermore, their exchange is not simply an economic transaction but also involves social relationships that may be the main purpose of the activity.

Anthropologists have defined three modes of exchange: reciprocity, redistribution, and market exchange. Reciprocity refers to balanced exchange between relatively equal individuals, whether it involves everyday items or a gift that creates an obligation for a reciprocal return gift later on; this exchange occurs in all societies. Redistribution, however, requires a centralized organization in the acquisition of goods and typically is associated with chiefdom or state-level societies. The centralized authority may acquire goods through control of production, taxation, or tribute collection. Market exchange combines the existence of a central location where trade can take place with a sociopolitical system in which free bargaining is possible.

Archaeological interest in trade and exchange has been very high since advances in analytical instrumentation in the 1960s and 1970s made it possible to chemically characterize or "fingerprint" such materials as obsidian, greenstone, marble, ceramics, copper, lead, and amber. Much effort has been devoted to the methods used to source artifacts, obtaining results for specific materials and places, and to their interpretation.

Among the early models proposed to explain trade are the gravity model, used to describe interaction zones in which different sources "compete" for market share, and falloff curves, in which artifact frequencies are graphically plotted against source distance. The shape of the falloff curve is determined by particular exchange mechanisms, and the slope or angle of falloff is determined by such factors as demand, transportation costs, and the availability of alternative materials. While such simplistic models may be useful in an exploratory sense, the circumstances surrounding ancient trade, as represented in the archaeological record, may have been quite complex. For example, exchange may have been sporadic, disrupted at times, or otherwise dynamic on a seasonal or other basis; populations and settlements may have grown or changed size; and several exchange mechanisms may have been in effect at the same time. Objects may have moved alone, as trade or gift items; along with individual people (traders, craftspeople, or brides); or with groups (migration, colonization, war, or foraging). Nevertheless, while interpretations of ancient trade mechanisms and circumstances may change, the determination of the source of a traded item will always demonstrate that at least indirect contact existed between two places and that cultural ideas, knowledge, and materials not preserved in the archaeological record probably also were moving about.

Flaked-stone artifacts are among the most common in the archaeological record and often are made from materials that do not occur locally (e.g., obsidian and flint). They are the products of several distinct types of behavior, which may have occurred at different times in different places:

- acquisition of the raw material
- preparation of a core
- flaking, trimming, and shaping
- use
- maintenance or modification
- disposal

In addition, their presence at a particular site will have been affected by such variables as the rarity of the raw material, the number of production stages necessary, whether specialists played a part in production, and how long a tool retained its usefulness. Finally, the movement or trade of these stone artifacts may not have been strictly for their utility as tools but instead as prestige items used only by select individuals or under special (such as ritual) circumstances.

Stone used for axes and other ground, rather than flaked, tools also was often traded over great distances in prehistoric Europe, under the constraints of a similar set of factors and variables. By the Iron Age (the first millennium B.C.), however, stone tools largely were replaced by metal ones, and by Roman times the stone material most widely traded was marble, used mainly for sculpture. Besides the complex sociopolitical systems of classical Greece and Rome that created this demand, large labor forces and advanced transportation methods were able to support the trade of many tons of marble from sources in diverse areas of southern Europe.

Ceramics are very common at archaeological sites beginning in the Neolithic period (by the seventh millennium B.C. in southeastern Europe and somewhat later in the rest of Europe). The finished product, like flaked, ground, or carved stone, was the result of significant effort by experienced craftspeople. Production was even more complex, in that it involved the acquisition not only of clay, which probably was available locally, but also of temper and, in many cases, pigments for painting as well as fuel for firing. Unlike the attributes of stone tools, some of the most important properties of ceramics (form and decoration) were determined entirely by their makers. While ceramics may have been traded because of variance in these characteristics, in many cases it was the contents of ceramic vessels (e.g., amphorae) that were the primary materials being traded over large distances.

Metal artifacts also were the result of considerable effort and transformation from the raw ore. Unlike clay, most metal ores were not readily available, and it was necessary to expend significant effort in their acquisition; an even greater amount of flux and fuel was necessary for the smelting process, not to mention the furnace and its accessories. While the subsequent melting of already purified metal for casting artifacts was less complex and could have been done in any village settlement, smelting would have required greater labor organization. By the Copper and Bronze Ages (fourth through second millennia B.C.), both purified metals (lead, silver, gold, copper, and tin) and finished, often alloyed (for instance, bronze) artifacts were traded over great distances in Europe and the Mediterranean. Unlike stone tools and ceramics, metal artifacts could be entirely recycled and turned into new objects.

Although stone, ceramics, and metals may be the most common materials found at archaeological sites, they were not the only materials traded in prehistoric Europe, nor are they the only ones for which one can potentially establish a source. Among the other trade items that have been studied are amber, a natural resin, and glass, another pyrotechnological product that became common only in the Roman period. As will become evident, however, trade studies have focused on ceramics and a few types of stone and metals because of their properties that allow artifacts to be matched scientifically with the source of their raw materials. European trade in obsidian and copper is discussed in further detail later.

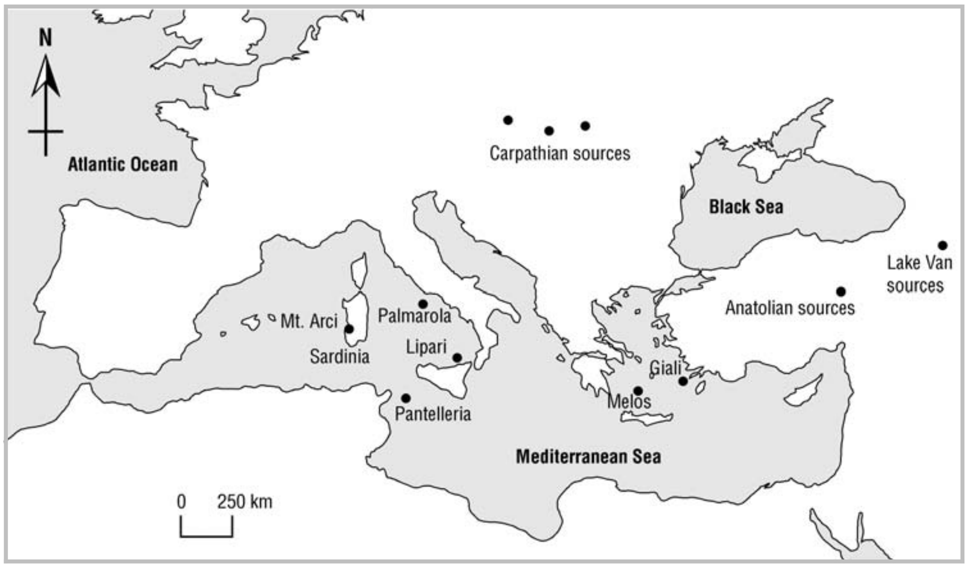
PRINCIPLES OF PROVENANCE STUDIES

For a provenance study to be successful, there are several prerequisites: all relevant sources must be known; these sources must be characterized in terms of the physical properties or parameters (e.g., mineralogical, elemental, or isotopic composition) that are to be measured for the artifacts; one or more properties must be homogeneous within an individual source; measurable, statistically valid differences between sources must exist for one or a combination of these parameters; and these differences must be measurable using analytical methods appropriate for archaeological artifacts. In general, provenance studies are most successful when the number of possible geological sources is naturally limited. While many potential sources may be effectively excluded because of geographic distance (especially in certain time periods), a situation in which artifacts from “unlikely” sources are never identified as such must be avoided. With fewer natural sources, there is less chance of additional sources remaining unknown, there is a smaller total number of specimens to be characterized (advantageous in terms of time and cost), and the likelihood of finding a parameter that meets the last three prerequisites cited earlier will be much greater. The characterization of obsidian in Europe, the Mediterranean, and the Near East is the classic success story for just these reasons.

ANALYTICAL METHODS

For stone materials, characterization begins with macroscopic observations and measurements of such properties as color, luster, other aspects of appearance, density, hardness, and refractive index. One of the few examples where these properties have been sufficient by themselves to distinguish reliably among sources is in Malta and the south-central Mediterranean, where dark green obsidian is from Pantelleria and black or gray obsidian most probably is from Lipari (which only occurs on Lipari and not the other Aeolian islands). Microscopic examination of a petrographic thin section, which allows for identification of the mineral grains and inclusions, commonly is used both for stone and ceramic materials, but it is destructive to the artifact, since a sample at least 1 square centimeter must be removed. There are many examples where petrographic analysis alone has been enough to distinguish lithic sources, for example, greenstones in the Alpine region and in southern Italy. Some success also has been achieved in establishing the source of flint using a combination of macroscopic and microscopic analysis. Petrographic analysis of ceramics usually cannot identify a particular geological source unless it has very uncommon mineralogical characteristics; strong matches, however, can be made between ceramic artifacts from different sites, including discards, or “wasters,” from unsuccessful firings.

Since the early 1960s instrumental methods of chemical analysis have been used very successfully in archaeological provenance studies. Obsidian has proved to be ideal for such studies, although success also has been achieved with other stone materials, ceramics, and even certain metals. Numerous different analytical methods have been employed with good results in provenance studies. The most common elemental methods of analysis currently in use are neutron activation analysis (NAA), x-ray fluorescence spectroscopy (XRF), proton-induced x-ray



European and Mediterranean obsidian sources. DRAWN BY ROBERT H. TYKOT.

and gamma-ray emission, and inductively coupled plasma spectroscopy (ICP–S, or just ICP).

Isotopic methods include thermal ionization mass spectrometry (TIMS), used for precise measurements of the isotope ratios of heavy elements (e.g., lead and strontium); stable isotope ratio analysis for light elements (among them, carbon and oxygen); and ICP mass spectrometry (ICP–MS), which measures the abundance of both elements and isotopes for a large range of elements. Isotopic methods are particularly useful for provenance studies, because elemental composition may be quite different between a raw material (a metal ore) and a finished product (a metal artifact), whereas the relative abundance of the isotopes of most elements remains unchanged. TIMS has been employed extensively for lead isotope analyses of copper, lead, and silver objects in the Mediterranean, while ICP–MS with a laser ablation device is now being extensively used on a large range of materials.

With all chemical studies, sufficient samples from each potential source must be analyzed to establish its variability before artifacts can be reliably attributed. For Mediterranean obsidian, bivariate plots of certain trace elements often are sufficient to assign artifacts to well-defined source groups, but multivariate statistical analysis is necessary in provenance studies of most other materials.

OBSIDIAN

The first successful provenance study of obsidian relied on trace element concentrations of barium, zirconium, niobium, and yttrium, measured by optical emission spectroscopy, to differentiate many, but not all, of the sources in Europe and the Near East (see map). More detailed examination of the Mediterranean sources in the 1970s and 1980s, using NAA and XRF, was completely successful not only in attributing artifacts to specific islands (Giali, Lipari, Melos, Palmarola, Pantelleria, and Sardinia) but even in distinguishing among multiple flows in a single volcanic complex, usually the result of multiple eruptions over a geologically short span of time, on some of the island sources and the complex sources of central Europe and Anatolia. It was only in the 1990s, however, that the sources in Sardinia were fully identified and characterized and large numbers of artifacts were analyzed from many sites in the central Mediterranean. These studies began to reveal patterns in the exploitation of the different obsidian sources and thus emphasized the importance of assigning artifacts to specific source localities. In Sardinia, it is possible to distinguish chemically among several geographically specific sources in the Monte Arci area. Three (Sardinia A or SA, Sardinia B2 or SB2, and Sardinia C or SC, each a chemically distinct subgroup and a physically distinct flow or outcrop location) were used widely and have distinctive characteristics that might have been important in their exploitation by prehistoric peoples (such as accessibility, size, and quantity of source material; color, transparency, and luster; and fracture properties).

Exploitation of the obsidian sources in Anatolia and on the island of Melos began in the Upper Palaeolithic period, the latter source demonstrating that sea travel began very early. While obsidian was not used prior to the Neolithic in the central Mediterranean, by the sixth millennium B.C. it was being traded several hundred kilometers from the island sources, reaching as far as southern France, northeastern Spain, Dalmatia, and North Africa. Ten or more artifacts have been analyzed from about fifty sites in this region and allow for hypothesis testing and interpretation that was not possible with limited numbers of analyses. For example, it might have been expected that, during the Early Neolithic (c. 6000–5000 B.C.), less-organized selection of source material would result in the use of obsidian tools from many sources. By the Late Neolithic (c. 4000–3000 B.C.), however, procurement would have been better organized, focusing on the glassier Lipari and SA obsidian and featuring more efficient reduction technology in the production of cores and blades. Instead, at such sites as Filiestru Cave in northwestern Sardinia, the use of SB2 obsidian from the western flanks of Monte Arci declined over four Neolithic cultural periods, while the use of an opaque, less-glassy type of SC obsidian from the northeastern part of Monte Arci increased. Type SA is never more than 20 percent of the assemblage. At the same time, even though the similar frequencies of the Sardinian sources at sites in Sardinia, Corsica, and northern Italy is consistent with a down-the-line type of exchange system, the fact that more than 90 percent of the Sardinian obsidian found at sites in southern France is of type SA suggests differences in obsidian use or exchange mechanisms there.

These different obsidian use patterns—both geographic and chronological—imply that the cultural factors and exchange mechanisms involved in the life history of Mediterranean obsidian artifacts were complex. Obsidian may not always have been dispersed through simple down-the-line transactions from its respective source zones. It also is possible that maritime contacts between Sardinia and the mainland were not necessarily routed across the shortest open-water crossings (from Sardinia to Corsica to Elba to Tuscany and then northward along the coast to Liguria and southern France). Differences in what obsidian tools were used for, especially if considered in the context of locally available alternative lithic resources, may correlate with obsidian selection and can be investigated through the integration of provenance determination with typological and use-wear analysis. Continued research in this area will go beyond the documentation of the provenance and quantity of obsidian that was exchanged during the Neolithic and will provide significant contributions to the understanding of exchange itself and the cultural system in which it operated.

COPPER

By the Late Bronze Age (c. 1600–1200 B.C.), bronze tools and weapons were in high demand in many societies. In the eastern Mediterranean, much of their production and trade must have been to satisfy the needs of the state-level societies of Greece, Crete, Anatolia, and Egypt. While the tin sources are still unclear, archaeological and analytical evidence points to Cyprus (from which the word "copper" is derived) as the most important copper source in this region. Several sites on the island have produced evidence for smelting of copper ores, including slag, tuyeres, and crucibles.

The best evidence for trade in Cypriot copper, however, comes from a characteristic style of pure copper ingot found off the island. Copper oxhide ingots, weighing, on average, about 30 kilograms and resembling the stretched-out hide of an ox (most likely shaped that way to facilitate carrying), are known from sites in Cyprus, Crete, Greece, Turkey, Israel, Egypt, Albania, Bulgaria, Sicily, and Sardinia as well as the famous shipwrecks at Cape Gelidonya and Uluburun in Turkey (fig. 1). Most of the known ingots come from shipwrecks or from coastal sites, suggesting the importance of seaborne traffic for their distribution. Excavation of the shipwrecks at Uluburun and Cape Gelidonya, of the fourteenth and thirteenth century B.C., has indicated that large cargoes of copper and tin ingots, glass ingots, ivory, ostrich eggs, ebony logs, myrrh and frankincense, and probably resins, olive oil, and wine were transported regularly over great distances in the eastern Mediterranean. The personal possessions found onboard both wrecks point to the Levant as the home

Fig. 1. Oxhide ingots from the Cape Gelidonya shipwreck. COURTESY OF ROBERT H. TYKOT. REPRODUCED BY PERMISSION.

of the crew. The locations of these wrecks and the main cargo items on board indicate that they were heading west, while archaeological evidence and ancient texts suggest that shipments also must have headed south to Egypt.

While copper sources also existed in many of these areas, copper is a refined product, ready for alloying and casting, and thus would have been immediately useful and exchangeable for other goods at any Bronze Age settlement regardless of its location. Nevertheless, it also is possible that local copper was used to make "oxhide" ingots, under the control of Aegean or Levantine prospectors, or simply to imitate a recognized standard type. Modern mass spectrometers are sensitive enough to measure copper and silver artifacts containing trace quantities of lead in addition to lead objects. The lead isotope ratios determined for copper artifacts thus can be matched directly to known ore samples, because the ratios of the isotopes do not change during the smelting or refining process, although the quantity of the element does.

In the last two decades of the twentieth century an extensive database of lead isotope ratios for copper and other ores throughout Europe and the Mediterranean was established, and many ingot and artifact collections were tested. The results obtained strongly indicate that Cyprus was the source of the vast majority of the copper oxhide ingots, including those found in Sardinia, an island with its own significant copper sources. At the same time, the lead isotope ratios for artifacts and other shaped ingots match those of the local ore sources, although there is also evidence that artifacts may have been made of mixed ores or recycled copper and bronze. Since oxhide ingots (though they are of pure copper) could not have been made in a single smelting but must have been remelted, they, too, could have mixed lead isotope ratios. This possibility has generated some debate over the reliability of the lead isotope approach, since the mixture of ores from two different sources might result in values similar to a third that has not yet been found or documented. It is always possible that some artifacts were made from small ore deposits that are now worked out, but these items should constitute only a fraction of the overall production, and for the most part, the analyses of the oxhide ingots have produced very consistent results. Mycenaean-style ceramics found at many of the same sites where oxhide ingots have been found also have been chemically tested and shown to match Aegean clay sources. Thus, it is socioeconomically likely that copper ingots and many other materials were traded together with these ceramics and their contents, both by land and by sea.

CONCLUSION

Many lessons can be learned from the few examples of European provenance studies presented here. First, the obsidian case study highlights the importance of complete characterization of all relevant geological sources before the analysis of archaeological artifacts. In addition, the analysis of large numbers of artifacts from good archaeological contexts lends greater significance to the results obtained and to their interpretation, which varies geographically and chronologically. From an analytical perspective, obsidian is ideal because many techniques can produce the desired results, and methods that are minimally destructive or nondestructive can be selected. The second case study, on copper, reveals the greater complexity—in terms of both methodology and interpretation—of studying trade in materials that have been changed radically from their natural sources. Nevertheless, when ore sources have not been mixed, the trade in copper, lead, and silver can be reconstructed. In both examples (obsidian and copper), the trade in these particular items must always be considered in the context of other materials that also were likely to have been exchanged, keeping in mind that stone, ceramics, and metal are the main items left behind in the archaeological record.

See also **Trade and Exchange** (*vol. 2, part 7*).

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ROBERT H. TYKOT

STATUS AND WEALTH

FOLLOWED BY FEATURE ESSAY ON:

In the later prehistory of Europe, archaeological indicators of status and wealth disclose a profusion of differences among individuals. While differences can be recognized as early as Upper Palaeolithic times, it is with the food production economy, settled village life, and the beginnings of the accumulation of quantities of materials that archaeological signs of differentiation begin to be drawn more sharply. During the Bronze Age distinctions in status and wealth are clear in some groups, but in the Iron Age (800 B.C. to the Roman conquest) the most abundant and unmistakable indications of status and wealth in prehistoric times appear.

THE ARCHAEOLOGICAL EVIDENCE

Early in the development of European archaeology, investigators were confronted with the material evidence of differences in status and wealth among the communities of the prehistoric past. Excavations of cemetery sites, in particular, showed that different people were accorded different objects placed in their burials. For example, in the excavations at the Early Iron Age cemetery at Hallstatt in Austria, which took place in the middle of the nineteenth century, researchers emphasized the distinct inventories among the nearly one thousand burials investigated. In the latter part of that century, investigators in diverse parts of Europe explored the large burial mounds that mark many landscapes. In some cases they found quantities of gold, fine bronze, and pottery vessels from Greece and Italy, and lavish ornaments. In east-central Europe early discoveries were made in what is now Slovenia of objects ornamented in the style known as Situla art. Researchers believed that the scenes portrayed on these bronze vessels and belt plates showed the lives of an elite in prehistoric society, not the lives of the majority of people.

Thus, from early in the systematic development of prehistoric archaeology during the latter half of the nineteenth century, investigators realized that societies of later prehistory were differentiated, just as the societies of nineteenth-century Europe were. The problem was to understand the principles of differentiation and the role that differences in status and wealth played in the functioning of those societies. Writers used such terms as “king” and “prince” to characterize the individuals represented in the richest graves. Before World War II, models for understanding and representing the social systems of which these differentiated individuals were part tended to be sought in one of two contexts—the classical world of Greece and Rome and medieval temperate Europe. Some investigators drew for their models on the pictures of Greek society presented by Homer and then by the Classical period

Greek writers. Others based their reconstructions on historical accounts of the feudal system in western and central Europe. Over the past half-century, approaches have broadened and become more systematic.

SOCIAL SCIENCE AND SOCIAL DIFFERENTIATION

Two main approaches to the formation of distinctions in social status and wealth may be distinguished. One group of approaches sees these differences in society as the result of individuals' and groups' aims to promote themselves—to achieve power and resources greater than those of their fellows. The thinking is that many, if not most, people desire higher status and more wealth than others, and some, but not all, are willing to compete to acquire them. Once they achieve such status, they are unlikely to give it up willingly, and they pass it along to their descendants, thereby creating a system in which status and wealth are hereditary.

The second group of approaches views differentiation in society as a natural consequence of growth in society's size and complexity. The larger an organization becomes, the more energy must be devoted to administering and managing the system. In this model, the higher status and wealth acquired by certain people can be understood as social investment in the management of society as a whole. The greater differentiation apparent in later prehistory thus can be explained in terms of larger investment in infrastructure for coordinating the increasingly complex economic, social, and political needs of communities.

These are, of course, highly simplified characterizations of two complex groups of models. In operation, they are not mutually exclusive. They are useful for suggesting how one might think about the social role of the status and wealth differences apparent in later prehistory.

INDICATORS OF STATUS AND WEALTH

There are three main categories of archaeological evidence for status and wealth in later European prehistory. By far the most apparent and most often discussed is burial evidence. The other two are deposits and settlements.

Burials. Within this category, three topics can be identified—grave contents, grave structure and burial topography, and the funerary ritual. The first attracted the attention of the earliest researchers, whereas the second and third received much attention in the last decade of the twentieth century.

The most basic connection between burial analysis and the issue of status and wealth is in the quantity and character of material in a grave, the "grave wealth." When the rich chamber burials of the latter part of the Early Iron Age were discovered in southwest Germany, for example, investigators designated them *Fürstengräber,* or "princely burials." They contained gold neck rings, gold bracelets, decorated daggers and lavish bronze vessels, four-wheeled wagons, and a variety of other objects that did not occur in the majority of graves. This concept of the *Fürstengrab,* developed in 1877, has been adopted throughout Europe. Used in the general sense, the term means a grave distinguished from the majority by special goods that usually include gold ornaments and bronze vessels and often weapons and vehicles.

In the Early Iron Age of temperate Europe the archaeological evidence shows remarkably similar developments of richly outfitted burials in distinct regions, especially between 600 and 400 B.C. Most thoroughly investigated are those in west-central Europe, but similar groups occur in Iberia, Bohemia, various parts of the former Yugoslavia, and the lands north of the Black Sea. Specific forms of expression of status and wealth vary regionally. For example, characteristic of the graves in west-central Europe are gold neck rings and other ring jewelry and four-wheeled wagons, whereas in the Scythian region north of the Black Sea gold scabbards and horses and their harness equipment are standard.

This basic dichotomy between rich graves and others has dominated discussion of status and wealth in late prehistoric Europe. Researchers are not always precise as to what they mean by rich graves. Most often the distinction between graves considered rich and other graves is qualitative: if certain objects are present, such as gold neck rings and imported bronze vessels, the grave is considered rich. The distinctions rarely are sharply defined, however. Another approach is quantitative, establishing means for calculating the total value of objects in a grave or the energy expended in manufacturing or otherwise acquiring them.

Furthermore, the meaning of the rich graves themselves, the relationships between them and other burials, needs to be considered. Traditionally, in the interpretation of rich Iron Age burials, investigators have assumed that grave wealth mirrors status and wealth in society—that is, that people buried in rich graves were rich and powerful individuals, and people in modest graves were typically farmers. Until the last decades of the twentieth century, this assumption lay at the base of nearly all interpretations of grave wealth and social systems.

Studies in the United States and Britain have challenged this assumption. People do not bury themselves. The placement of objects in a grave was done not by the deceased but by his or her survivors. People may leave instructions about how they wish to be buried, and in some instances they even oversee the construction of their burial monuments during their lifetimes, but the final disposition of the burial ultimately is the result of choices and decisions made by other people.

Grave goods may be not so much a reflection of society as agents in the creation of society. Many archaeologists, as well as cultural anthropologists, have become concerned with the way in which people use material culture in social negotiation. Material culture is understood as an active agent for social action and manipulation. From this perspective, the choices made in the outfitting of a burial may result from conscious efforts on the part of those conducting the ceremony to represent status in a particular way, perhaps to strengthen the political position of a particular group of survivors.

Rich burials are not characteristic of all phases of the Iron Age, nor do they occur in all regions. In places where richly outfitted burials are common in the period 600–400 B.C., such as west-central Europe and Bohemia, from the following centuries there are very few such distinguished graves. Some investigators have noted that the conditions that stimulate expression of status through lavish burials are times of unusual social competition. Put in simple terms, when social and political circumstances are relatively stable, people who possess special status and wealth do not need to display it in highly visible ways. When conditions are unstable, however—because of unusually rapid social change or because of a new factor, such as intensified relations with outside groups—special displays of status and power serve to promote particular interests over others. In this more active interpretation of rich graves, they are indicators of social change more than of existing differences in status and wealth. If this model is correct, the distribution of richly outfitted burials through time and space may indicate situations of upheaval and those of relative stability.

The significance of rich burials in special contexts also must be considered. Most of the richly outfitted graves of Iron Age Europe are associated with settlements that were larger than most, that were defended by walls, and that show substantial manufacturing and commercial activity but were situated in regions of good agricultural potential. In other circumstances rich graves may have a different significance. The cemeteries at the salt-mining complexes at Hallstatt and on the Dürrnberg, both in Austria, include many graves that are richer than average Iron Age burials. Ludwig Pauli, a distinguished German specialist in Iron Age archaeology, has suggested a special explanation for this wealth. Clearly, the extraction and trade of rock salt represented a profitable enterprise in Iron Age Europe. Pauli argues that in agricultural communities successful farmers probably would invest profits in their land or livestock. Salt miners had no such resources to invest in, so they invested in bronze ornaments and vessels, gold jewelry, Etruscan bronze vessels, and gold, amber, and glass ornaments, with which they were buried. Following Pauli's argument, rich graves at Hallstatt could not directly be compared with those at the Heuneburg because the bases of economic life and wealth were fundamentally different. Thus, each situation needs to be considered independently.

The contents of some graves suggest a special status that is different from the status attributed to others. A woman's grave dating to about 400 B.C. found at Gündlingen, near Freiburg in southwest Germany, contained a unique assemblage of objects that probably served as amulets or charms. A bronze bracelet decorated with human faces suggests that the woman possessed above-average status in her community, but the deposit of charms is unique. Next to her lower left leg (probably originally placed in a leather or textile bag) were a small bronze figure of a bull, a geode, a once broken but repaired water-worn piece of limestone with a natural hole in the center, two dog jaws, a miniature bronze knife, a pebble the size and shape of a hen's egg, and two amber beads. These were all categories of objects that, in medieval and modern times, have served as magical devices. Archaeologists have suggested that this woman was a magician or healer, her special status represented by this unusual set of objects in her grave.

Relatively little attention has been paid to understanding patterns of status and wealth suggested by graves other than those in the richest category. There has been a tendency to think of burial evidence in later prehistory as either belonging to the richest category or not. After the disappearance of the rich category of graves in much of temperate Europe after 400 B.C., most of the landscape is characterized by flat-grave cemeteries with burials that show much less differentiation. In one important study based on cemeteries dating between 400 and 200 B.C. in Slovakia, however, Jozef Bujna, a specialist in the Iron Age archaeology of eastern Europe, demonstrated that although the differences in grave wealth are not as clear as in the earlier contexts, they are still very real.

Bujna identified five categories of graves. In the first were men's graves with sets of weapons, personal ornaments, and pottery and women's graves with bronze link belts, brooches, ring jewelry, and glass beads. In the second were men's graves with single weapons and women's graves without link belts but with a few bronze, iron, and glass ornaments. The third consisted of men's graves with no weapons and small quantities of ornaments and pottery and women's graves with few ornaments. The fourth category comprised graves that contained only pottery. In the fifth were graves with no grave goods at all. The significance of this study is that it shows that significant variation occurs even in cemeteries that can appear to be quite uniform.

During the final century B.C., at the time when interactions with the Roman world intensified among communities throughout temperate Europe, richly outfitted graves again became common. They share features with the rich graves of the Early Iron Age, but they also differ in important ways. Along the Rhine this new group is characterized by weapons and wagons and in southeast Britain by Roman tableware and amphorae, as in the burials at Welwyn, north of London.

Grave structure and burial topography also are key. In addition to the wealth of objects placed in graves, the situation of the grave is an important factor in assessing status and wealth. Rich grave goods tend to correlate with wooden burial chambers, large pits in the ground, and large and sometimes complex mounds above them. Chambers and mounds represent expenditure of labor and thus can be understood in terms similar to those of displaying precious objects in the grave. If the construction of rich burial assemblages is seen from the perspective of the survivors, who were using material culture to create their positions in the social system, then the construction of the chamber and the mound can be understood in the same way. The mound has the additional significance of being a permanent monument on the surface. Graves set underground disappear from the sight of the living; only the funeral ceremony can be remembered. A mound constructed above the grave, however, remains a visible monument for the living, a way for them to be reminded of the funerary ritual and its significance for establishing present social circumstances. The mound may be a permanent memento of how those in power established their legitimacy. In Scandinavia stones often were set in the shape of a ship over richly outfitted burials.

With the recent discoveries of the life-size stone statues at Vix in eastern France and the Glauberg in central Germany (fig. 1), it has become apparent that monumental sculptures of people are signs of status and wealth. In those two cases the statues show the same personal ornaments as those of the individuals buried in the rich graves near which the statues were erected. Stone sculptures have been found with other Early Iron Age burial mounds as well (e.g., Hirschlanden, Hochdorf, and Kilchberg), but many of these sculptures are not as clearly representations of specific individuals.

In many cemeteries, mounds are of very different sizes. A good example is the Early Iron Age cemetery at Kleinklein in southern Austria, where mound sizes vary from quite large to extremely small. Members of the living community whose ancestors were buried in those mounds were reminded constantly of whose ancestors were buried under large mounds and whose under small ones.

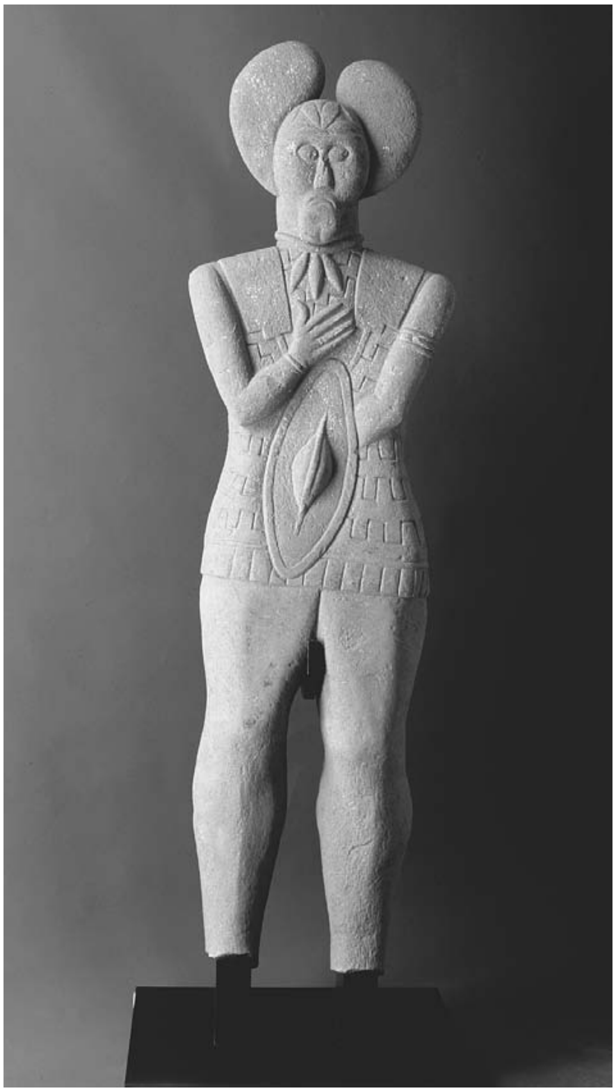

Fig. 1. Stone statue from the Glauberg in Germany, found associated with a rich burial in a mound that was part of a complex constructed landscape. HESSISCHES LANDESMUSEUM DARMSTADT. REPRODUCED BY PERMISSION.

In some large communal mounds, the topography of grave arrangement expressed information about the social system. At the huge Magdalenenberg tumulus near Villingen in southwest Germany, the large central grave was set inside a wooden chamber and covered with a cairn of stones. In the outer parts of the great covering mound, 126 subsequent burials containing members of the community were arranged concentric to the central chamber burial. These later graves all were outfitted very modestly. Here the status and power of the individual in the center were expressed through the topographic relationship between that grave and the others in the mound.

Archaeologists now have turned their attention to examining evidence pertaining to the funerary ritual of which the burial was a part. The grave that the archaeologist excavates is the material expression of a final stage in a funeral ceremony. Studies of mound construction and of landscapes around burial mounds have yielded promising new information about the structure and character of these rituals. The effort devoted to such rituals can provide significant data about the status and wealth of the deceased.

At Hochdorf, through examination of the structure of the mound, Jörg Biel has been able to draw important conclusions about the ritual activity that preceded the placing of the dead man in the grave chamber. At Vix archaeologists have excavated an enclosure near the rich grave, at which ceremonies apparently were performed in connection with the burial. Studies at the Glauberg, near Frankfurt in Germany, have revealed a complex set of earthworks constructed for the funerary ceremony. In the Ukraine great quantities of feasting debris from the ditches around the outside rim of the great *kurgans* (eastern European burial mounds) attest to lavish ceremonies performed on the occasion of the burials in those monuments.

Deposits. Deposits of precious objects in pits in the ground and in bodies of water also are understood as expressions of status and wealth. Interpreting these finds is more difficult than interpreting graves because of the lack of clear evidence of the link between a person or a group and a particular deposit.

From the end of the prehistoric Iron Age, a substantial number of hoards of precious metal have been found in temperate Europe. Their character varies, but they most often include gold coins, silver coins, ring jewelry, or combinations of these materials. A series of deposits from the final century B.C. contain a regular set of gold objects—a neck ring and two bracelets and sometimes coins of local or Roman origin. Among the best documented of these ring-and-coin deposits are those from Niederzier in northwest Germany and Tayac in southwest France. In the central regions of the continent, hoards of gold coins are common, often with hundreds of little-used coins in a single deposit. Comparable and roughly contemporaneous finds from Britain include the gold, silver, and bronze rings, coins, and bars, totaling some 40 kilograms, found in eleven pits at Snettisham in East Anglia (fig. 2). At Llyn Cerrig Bach in Wales one deposit contained a variety of objects that one might expect to find in rich burials, including swords, spears, shields, cauldrons, and ornate fittings for horse harnesses and chariots. In the year 2000, near Winchester, two sets of gold jewelry, including neck rings, fibulae, and bracelets, were discovered. Although the character of these deposits varies, many contain objects that in other contexts appear in rich graves, but in times and places in which outfitting rich graves was not customary they were buried as deposits.

The majority of these precious metal deposits were made in contexts in which richly outfitted burials were rare or unknown. This display of wealth in the form of gold rings and coins is similar to the expression of wealth as gold in rich burials. The frequency of the combination of neck ring and two bracelets suggests a link with the gold jewelry that accompanied many persons in rich graves. Very little is known about the circumstances or the procedures through which precious items were deposited. Like the investigations of the landscapes around wealthy burials, future research on the land surrounding these precious metal deposits may provide information about the performances that accompanied these deposits.

Settlements. Compared with the evidence from graves and deposits, little settlement evidence for status and wealth distinctions has been identified. Hilltop settlements enclosed by walls of earth, stone, and timber often are regarded as settlements of elites, but in most cases there is little direct information that people with greater status and wealth inhabited hilltop locations. For the most part in later European prehistory, researchers lack indications of unusually lavish or large residences associated with status, such as are recognizable in other archaeological and historical contexts. Several investigations show that such patterns are present, though they often are subtle.

At Hodde in Denmark excavations showed that among the twenty-eight dwellings within the settlement enclosure, one, which was separated from the rest of the settlement by its own enclosing fence, was built more sturdily that the others. Sherds of pottery found with it were of finer ware than the pottery in the rest of the settlement. The excavator, Steen Hvass, has interpreted these distinctions to indicate that this was the residence of a family of higher status than the other members of the community.

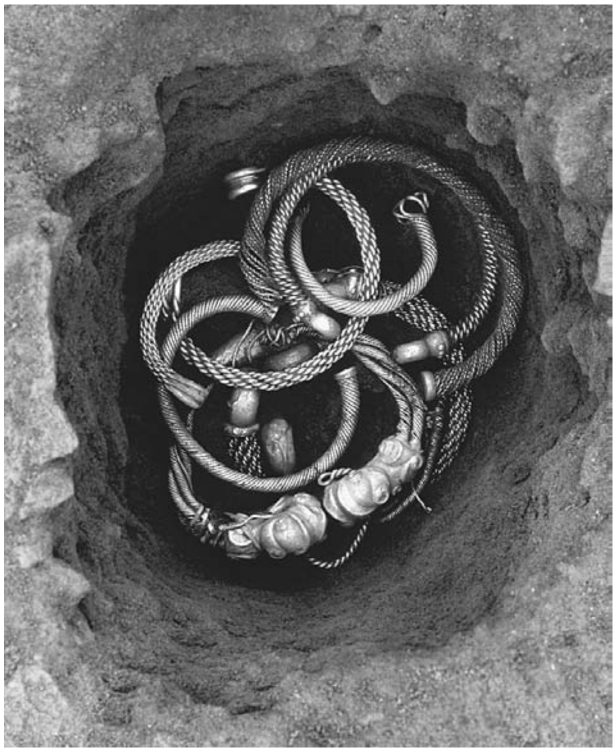

Fig. 2. Gold and silver rings from pit L at Snettisham. © Copyright The British Museum. Reproduced by permission.

In her excavations at the Early Iron Age settlement at Geiselhöring in southern Germany, Cordula Naglier-Zanier identified significant changes in the physical structure of buildings and enclosing fences during the occupation from about 750 to 625 B.C. In the third phase, for example, the number of dwellings inside the settlement enclosure was reduced, although the larger size of the enclosure indicates a greater commitment of labor for the benefit of a smaller number of people. In the fourth and final phase, there is evidence that the enclosure was given a more grandiose character, with bastions constructed along the ditch to create a visually striking boundary. These series of changes in the structure of the settlement can be interpreted as an increasing status display on the part of the resident families.

Another indicator that settlement evidence has much to contribute to the understanding of differentiation in status and wealth is the remarkable discovery at Gussage All Saints in southern England. The size and physical layout of the settlement are typical of small farming communities of Late Iron Age Britain, but at Gussage the excavators found abundant evidence of the production of ornate bronze fittings for chariots, vehicles used by the elite. This finding raises important questions about the relationship between small farming communities and the elites that possessed and used the elaborate chariots of this period. Could high-status individuals have been inhabitants of these very modest settlements? Or were the farming and craft-working communities merely closely linked with elites, for whom they produced objects that displayed status and wealth?

ARCHAEOLOGICAL INDICATORS AND SOCIAL SYSTEMS

The interpretation of all of these indicators of status and wealth ultimately depends on the investigator's ideas about the nature of prehistoric society. These ideas can be implicit—in some cases the investigator can be unaware of the assumptions he or she makes. Alternatively, they can be explicit—considered and stated.

For interpreting the rich burials of the Early Iron Age, many investigators have applied a model based on the Middle Ages, implicit in the coining of the term *Fürstengrab* in the nineteenth century. In the 1970s and 1980s certain archaeologists adopted the social framework introduced by the American cultural anthropologist Elman Service, examining late prehistoric societies from the perspective of his delineation of a chiefdom. In one influential study, Susan Frankenstein and Michael Rowlands developed a prestige-goods model for the circulation and consumption of valued objects in Early Iron Age Europe. Some archaeologists have adopted core-periphery frameworks to understand the social changes at Early Iron Age and Late Iron Age centers, with the Mediterranean societies representing the cores and the smaller-scale societies of temperate Europe the peripheries. One debate revolves around the contexts from which models should be drawn for the study of status, wealth, and social organization in late prehistoric Europe. The question is whether these models should be based on societies that are close to the Iron Age societies in time and space, such as the classical societies of the Mediterranean or those of early medieval Europe, or on more general ethnographic models drawn from different parts of the world.

See also **Hochdorf** (*vol. 1, part 1*); **Hallstatt** (*vol. 2, part 6*); **Vix** (*vol. 2, part 6*); **The Heuneburg** (*vol. 2, part 6*); **Iron Age East-Central Europe** (*vol. 2, part 6*); **Winchester** (*vol. 2, part 7*).

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HOCHDORF

In the village of Hochdorf, north of Stuttgart in southwest Germany, a richly outfitted Early Iron Age burial was discovered in 1977 and excavated in 1978 and 1979. Excavation revealed one of the best-preserved Early Iron Age burials in Europe. The great majority of rich graves of this period had been robbed in ancient times by people who tunneled into the center of mounds where the primary graves were situated, and archaeologists usually find only minor items left behind by the looters and sometimes fragments of lavish burial goods. The Hochdorf burial escaped this fate, perhaps because of the special arrangement of layers of timbers and stones above the chamber.

Excavation showed that the mound originally had been about 60 meters in diameter, with a circle of stones defining its perimeter. It probably stood about 6 meters high. Underneath the center of the mound was a hole 11 by 11 meters and 2.5 meters deep. Inside was a square chamber 7.5 meters on a side built of oak timbers, and inside that was another oak chamber 4.7 meters on a side. The spaces between the chambers and above the outer chamber were packed with stones weighing a total of 50 metric tons.

Hochdorf is one of about forty richly outfitted graves known from Early Iron Age west-central Europe, but it is unusual in being undisturbed. In the meticulous excavation by Jörg Biel, the skeletal remains of a man of about forty years of age and 1.85 meters (a little over six feet) tall were found on a unique bronze couch arranged against the western wall of the chamber. The couch is 2.75 meters long and made of six sheets of bronze riveted together and supported by bronze rods. Eight bronze figures of women, all with small wire earrings and coral-inlaid lines of holes marking positions of bracelets, necklaces, leg rings, and belts, support the couch. Their feet rest on the axles of wheels, allowing the couch to be rolled along the ground. On the back of the couch are scenes in repoussé, two showing men wielding swords and shields and standing on wagons drawn by pairs of horses and three showing pairs of men facing each other holding swords aloft—perhaps fighting or dancing. The deceased man rested his head on a pillow of plaited grass, and under him were textiles woven from hemp, badger hair, and horsehair as well as furs of badger and other mammals.

Other objects in the grave include personal ornaments, a wheeled vehicle, and feasting equipment. The man was outfitted lavishly with gold ornaments, about 600 grams altogether. Around his neck was an ornate neck ring of sheet gold, decorated with four rows of tiny horse-and-rider motifs. He wore two gold fibulae—brooches with pins and springs that worked like modern safety pins—a gold bracelet, and a large decorated gold plate on the front of his belt. Even his leather shoes were decorated with geometrically ornamented gold. On his belt he wore an iron dagger, the hilt and scabbard of which were covered with sheet gold. A cloth bag on the man's chest contained a nail trimmer and three fishhooks. Also with him were a quiver and fourteen arrows, an iron razor, and a wooden comb.

No remains of his clothing could be identified, except for a conical hat made of birch bark and decorated with incised patterns similar to those on his gold belt plate. The birch-bark hat matches in shape the hat on a life-size sandstone statue found next to a burial mound at Hirschlanden, 6 kilometers to the south-southeast, suggesting that perhaps this rarely preserved object was a special sign of status and authority.

Along the eastern wall of the chamber was a four-wheeled wagon (largely covered with sheet iron), 4.5 meters in length (including its pole). With it were a yoke of maple wood for attaching two horses, along with bronze harness fittings. On the wagon were nine bronze plates, three basins, and an axe.

Matching the bronze plates in number were nine drinking horns that hung on the south wall of the chamber. One, 1.23 meters long, was made of iron with sheet-gold bands around it. The other eight were smaller, made from horns of aurochs (wild cattle), and also decorated with gold bands. At the northern end of the couch was a bronze cauldron fashioned in a Greek workshop, decorated with three cast bronze lions lying around the rim. One is different in style from the other two and may have been made locally to replace a missing original figure. The diameter of the cauldron was 1.04 meters, and it could hold about 500 liters. Analysis of residue on the bottom suggests that it contained a beverage such as mead, made from plants that ripen in late summer, perhaps indicating the season of the burial. With the cauldron was a small gold bowl.

Many fragments of textile survived in contact with metal objects. Besides the fabrics on the couch, specialists have identified textiles dyed bright red and blue, often in complex geometrical patterns, hanging on the chamber walls and wrapping the man's body, the couch, the cauldron, and the wagon. The style of both locally made objects and the imported Greek cauldron indicates that the man was buried c. 550 B.C.

There is debate concerning the question of the identity of this man, buried in such a lavish style. The answer depends upon how the social and political system of which he was a part is understood. Current interpretations consider individuals buried under large mounds, in elaborate wooden chambers with abundant gold, feasting equipment, and links with the Mediterranean societies as chieftains in societies in which ranking was important to the economic and social functioning of communities.

See also **Status and Wealth** (*vol. 1, part 1*); **Greek Colonies in the West** (*vol. 2, part 6*); **Vix** (*vol. 2, part 6*).

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GENDER

Archaeologists have long been interested in the lives of prehistoric women and men. Many of these discussions are based, however, on uncritical generalizations, such as the idea that men make stone tools and women weave cloth. A surprising amount of archaeological literature is vague about the actual people using stone tools, building houses and tombs, firing pottery, and so forth. Much of the literature is dominated by an androcentric (that is, male-focused) bias that relegates women to passive and often invisible roles in past societies. An explicit interest in gender in archaeology developed in the late 1970s, associated with post-processual archaeology; this broad school of thought emphasizes, among other things, the importance of individuals in prehistory and the diverse and potentially conflicting roles and interests of individuals within each ancient community. Another inspiration for an "engendered archaeology" is the development of feminism as a sociopolitical movement within universities and in the wider society.

Engendered archaeology began with a focus on discovering women in the past, inspired by the realization that traditional archaeological accounts focused almost exclusively on the activities of men. By the beginning of the twenty-first century the topic had expanded to include a broader interest in gender as a theoretical topic and in the interrelationships of men, women, and others in past daily lives. While the majority of authors on the topic have been female, the number of men writing about gender has increased as the topic has become incorporated into mainstream research.

In Europe, Scandinavian scholars pioneered gender studies in archaeology in the late 1970s. In addition archaeologists working at Anglo-American universities have been major contributors. By the late 1990s the field had matured to the point where several published overviews were available. For European archaeology specifically, *Women in Prehistory* by Margaret Ehrenberg, *Gender and Archaeology: Contesting the Past* by Roberta Gilchrist, and *Gender Archaeology* by Marie Louise Stig Sørensen are starting points for inquiry from authors who take diverse points of view. Another significant area of engendered research is the examination of women's status and participation in the work world of archaeology. Chapters in *Excavating Women: A History of Women in European Archaeology* by Margarita Díaz-Andreu and Sørensen show that different national traditions of scholarship as well as idiosyncrasies of individual life histories have influenced women's participation in archaeology as a career.

WHAT IS GENDER?

As archaeological interest in gender expanded beyond simply seeking evidence for women's activities in the past, the major theoretical discussion has been about the definition of gender itself and the complex interrelationships of gender, sex, and sexuality. In *Gender and Archaeology,* Gilchrist defines gender as "cultural interpretation of sexual difference," while Sørensen, in *Gender Archaeology,* emphasizes that "gender is a process, a set of behavioral expectations, or an affect, . . . not a thing." Clearly different authors emphasize different aspects. Throughout the 1980s and 1990s there was a reasonable consensus on differentiating sex and gender: the former refers to biological characteristics, while the latter refers to cultural interpretations of biological categories and characteristics. As a theoretical concept gender includes, at a minimum, gender identity, the defining characteristics of different genders in a society; gender role, the culturally defined appropriate activities and behaviors associated with each gender; and gender ideology, the symbolic values assigned to each gender. Regarding gender identity, scholars emphasize that despite conventional understandings of modern Western society, more than two genders can exist within a society, and they probably did in prehistoric cultures. Following ethnographic research, these other groups are known variously as third genders, *berdache,* or two-spirit, among other terms.

By the end of the 1990s scholars were challenging this conceptualization of "sex ≈ biology/gender ≈ culture." They argued that sex and gender are culturally constructed; that there is more biological variation in human primary and secondary sexual characteristics than is widely understood; and that the dominant model of two dichotomous sexes is a culturally specific conceptualization, which is found in Western societies only since the eighteenth century. It is unclear at present how this theoretical development will become incorporated into archaeological practice. In addition there is expanding interest in sexuality and sexual orientation in prehistory.

While these diverse conceptualizations of sex, gender, and sexuality enrich archaeological scholarship, it also has been argued that identification of "third genders" can simply be another, albeit theoretically more sophisticated, way to deny visibility to women in the past. This discussion is particularly relevant to analysis of mortuary remains, especially those where the osteological (bone) identification of the sex of the skeletal remains conflicts with the cultural identification of the gender associations of the grave goods.

SOURCES OF DATA

The most important archaeological sources of data are skeletal remains, artifacts, and structures of mortuary remains; figurines, sculptures, and representations in rock art of human figures; architectural patterning of houses and tombs; and spatial distributions of artifacts and features within domestic sites and between domestic and nondomestic sites (e.g., ritual, extractive, and so on). In addition, collaboration with scholars in anthropology, history, and biology is important for the study of gender. New DNA and chemical analyses of skeletal remains give promise of evidence about migration patterns of populations and genetic relationships between individuals in a tomb or cemetery. The early classical authors, such as the Greek Stoic philosopher Posidonius, Julius Caesar, and the Roman historian Cornelius Tacitus, also provide information about gender roles and relationships. These sources cannot be taken at face value and must be interpreted, but they are important complementary data sources for the Iron Age. It remains a contested question how far back in time they should be applied. For later periods some researchers use medieval written sources as complementary data, whereas other scholars have turned to sagas, mythology, and folklore.

Ethnographic data from traditional societies across the globe also have been influential. Regarding gender, ethnographic evidence underlies broad generalizations about the division of labor, production of material goods, status of women in different political systems, and role of women in ritual, for example. While these generalizations sometimes are simplistic and may be based on an uncritical use of the source material, it would be foolish to eliminate ethnographic data from research. These data provide an enriched understanding of the variations in human cultures and societies and may help establish diverse cross-cultural patterns that assist in interpreting the archaeological record. Close reading of ethnographic literature can provide counterexamples to entrenched androcentric assumptions.

Despite the theoretical literature about the subtleties of gender, sex, and sexuality, most empirically based literature on gender focuses straightforwardly on women and men and their activities, statuses, and relationships in different prehistoric settings. Although the traditional chronological terms probably oversimplify the cultural developments of prehistoric Europe, they provide a convenient framework for reviewing gender research.

MESOLITHIC

For the Mesolithic period (beginning about 9000 B.C. and ending between 7000 and 4000 B.C., depending on the area of Europe), research relies significantly on ethnographic analogy with foraging peoples. Stone tools dominate the archaeological record. A division of labor often is assumed between men who hunt and women who gather plant foods, bird eggs, and shellfish. Hunting usually is assigned more cultural importance, and stone tools almost always are assumed to have been produced by men, although the ethnographic record is in fact not homogeneous on this point. Joan Gero points out that women who moved around the countryside independently, actively gathering more than half the diet, preparing most of the meals as well as creating clothing, basketry, housing, and other items of material culture were hardly likely to have waited for men to fashion the tools they used every day. There is nothing about the physical demands of stone tool production that women could not have accomplished.

During the Mesolithic recognizable cemeteries appeared. Much discussion of these cemeteries focuses on the question of whether or not incipient ranking appears in the Mesolithic, presaging social developments in later periods. The grave goods may include stone, bone, and shell objects. Evidence from Brittany and from southern Scandinavia suggests that in some situations gender is highlighted symbolically in grave structure and grave goods, but in other cases mortuary practice does not differentiate between men and women. In some cases burials indicate more differences between adults and juveniles than between men and women. Evidence for any kind of ranking is limited, however, unless one assumes—as some archaeologists do—that certain objects, such as axes, have an intrinsically superior symbolic value.

Certain Mesolithic burials from Sweden and southwestern Russia, which are atypical in burial posture and artifact richness and which mix male-associated and female-associated grave goods, may be of shamans, individuals who held both special religious powers and distinctive gender positions in the society. Robert Schmidt reviews ethnographic evidence from northern Eurasia that suggests shamans often were people who did not fit into dichotomous conceptions of sex, gender, or sexuality. Some were transvestites, some were intersexual, others were believed to change from male to female or from female to male, and still others participated in both heterosexual and homosexual encounters.

Lepenski Vir, along the Danube River in the former Yugoslavia, is a well-known Late Mesolithic site (c. 4500 B.C.) with numerous house foundations, burials, and unusual carved stone boulders often interpreted as ritual objects. The excavators describe a prehistoric culture in which women were passive and men were the active players in subsistence, leadership, art, and ritual. Russell Handsman posits, however, that this androcentric interpretation ignores what must have been the diverse, active contributions of women. He interprets the changes in the architectural remains over time (perhaps extending into the earliest Neolithic) as demonstrating growing inequality between lineages and expanding elaboration of the domestic sphere, perhaps indicating an increasing symbolic valuation of the domestic activities of women.

NEOLITHIC

During the Neolithic period (approximately 7000–3000 B.C., but earlier in southeastern Europe and later in the northwest), cultivation and husbandry of domesticated plant and animal resources became dominant, permanent villages were established, population sizes increased, and new types of material culture, especially pottery, gained importance. There was significant regional variation in the material culture and social and cultural organization of Neolithic societies in Europe, and gender has important implications for each of these topics.

There is a vast literature on the beginnings of the Neolithic in Europe, debating the relative importance of climate change, local innovation, migration, and other causal factors. Gender has not been integrated explicitly into these discussions, but innovation usually is implicitly assigned to men. In the North American context, Patty Jo Watson and Mary C. Kennedy point out that the logical conclusion of the assumption that women were plant gatherers in preagricultural periods is that they were the most knowledgeable about plant species and life cycles and thus most likely the innovators in terms of cultivation of domesticated plants. While the situations are not identical (e.g., domesticated animals are present in Europe but not in North America), these authors emphasize that in any convincing analysis women must be recognized as active participants in daily life. There are no reasons to expect that women would be less innovative than men, and the unspoken presumption that child care somehow absorbed all of women's time and creativity is simply wrong. In fact even in traditional societies women do not spend their entire adult lives in active mothering.

The best-known material remains from the Neolithic that have been discussed from a gender perspective are the numerous figurines from southeastern Europe (dating to c. 5500–4000 B.C.). They include a broad range of animal and human or humanoid figures, some with a great deal of detail and others very abstract. More female than male forms are identifiable in the assemblage, although a large number of figurines are either neuter or unidentifiable with respect to sex. They derive from domestic and midden contexts and occasionally from apparent special-purpose rooms or structures that may have been shrines of some kind; they rarely come from burials. Although many scholars have discussed these finds, they are associated most closely with Marija Gimbutas and her interpretations of Neolithic and Copper Age cultures in what she referred to as "Old Europe." Almost alone among archaeologists of the 1950s and 1960s, Gimbutas incorporated what is recognized as a gendered perspective into her interpretations, though without any explicit theoretical attention to the topic.

Gimbutas found evidence within this assemblage for a religious cult focusing on a "great goddess" (fig. 1). She then extended her analysis to claim that the Neolithic cultures of the region were peaceful, egalitarian, and matriarchal communities that took their values from the female-dominated religion. According to Gimbutas's interpretation, this cultural pattern was destroyed during the following Copper and Bronze Ages by incursions of patriarchal, metal-using, horse-riding nomads from the steppe regions to the east who established the hierarchical and militaristic social patterns that have dominated Europe virtually ever since.

There have been two kinds of responses to Gimbutas's interpretation of southeastern European Neolithic societies. On the one hand, in the 1970s and 1980s her work became popular among nonacademic audiences, predominantly women, who found an image of a kind of "paradise lost" that allegedly existed in the past and could be reclaimed through women asserting their ritual powers. On the other hand, archaeologists either ignored or criticized these interpretations. As explained by Lynn Meskell, feminist archaeologists have found themselves in something of a dilemma regarding Gimbutas's work. Gimbutas was innovative in the 1960s and 1970s in escaping an androcentric perspective and highlighting the role of women in prehistoric ritual, but her interpretations rest on very broad generalizations that ignore the variations in the figurines and the contexts from which they were recovered. Furthermore the power of prehistoric women, in Gimbutas's interpretation, rested exclusively on their biological capacity for reproduction, a narrow viewpoint and an unpopular perspective with most feminist archaeologists. Other archaeologists have tackled the assemblage of figurines from southeastern European Neolithic sites, working on a more nuanced understanding of the finds. The figurines probably had diverse functions, including parts in ritual, play, education, and cultural symbolism.

Houses and tombs are the major sources of data for the book *The Domestication of Europe: Structure and Contingency in Neolithic Societies* by Ian Hodder. He links the beginning of domestication to changes in symbolic structures that came to emphasize issues of social and cultural control of both nature and people. Painting with a broad brush, Hodder underscores the symbolic opposition of *domus* (the concept of house/culture/control) with *agrios* (the concept of field/nature/wildness). He also suggests gender implications of this opposition as *domus* ≈ female/*agrios* ≈ male. Ironically, while focusing on dramatic gender-linked symbolic oppositions in most European Neolithic societies, he is unwilling to examine the actual daily-life roles and statuses of men and women.

The latter part of the Neolithic, after c. 4000 B.C. (and the following transitional period, known as the Copper Age or Chalcolithic), often is characterized by the development of the Secondary Products Revolution, which is the use of domesticated animals for resources other than meat: wool, milk, dung, and traction. This economic development probably had an impact on both women's and men's labor, as textile and dairy production might have absorbed women and plowing and transport might have occupied men. In eastern Hungary, John Chapman suggests that "increased divergence of economic resources in the Copper Age stimulates the emergence of a more gendered division of labor." At the same time differentiation in burial patterns between men and women increased in this region. At the end of the Copper Age new burial patterns in large mounds appeared, and the primary burials were all male; archaeologists have not found female graves. Thus Chapman suggests that around 3000 B.C. women were made symbolically invisible.

Fig. 1. "Goddess" figurine from Vinča culture, c. 5000 B.C., Bulgaria. ERICH LESSING/ART RESOURCE, NY. REPRODUCED BY PERMISSION.

BRONZE AGE

Building on themes developed in Late Neolithic and Copper Age studies, the central topic of Bronze Age (c. 2500–800/500 B.C. in temperate Europe) research is the development and nature of hierarchical societies. There is evidence of "prestige goods economies," where important labor goes into producing and displaying status symbols, especially of bronze and gold. Much of the Bronze Age literature is implicitly androcentric, with an emphasis on metalworkers, traders, warriors, and chiefs who were all putatively male; there is little discussion of what the other half of the population was doing. In fact given that most of the male population were not chiefs or warriors, the literature tends to focus on what must have been a very small segment of the population while ignoring, to a large degree, the daily life of most people. The emphasis in most Bronze Age literature on hierarchy and chiefs tends to diminish attention to potential horizontal factors of social differentiation, such as gender, which also would have contributed to social complexity.

The rich Bronze Age cultures of southern Scandinavia have inspired several gender-focused analyses. Unusual preservation conditions, including oak-coffin burials and bog finds, have yielded clothing and wooden objects, and a rich bronzeworking tradition produced numerous artifact types. Some apparently are clearly associated with women and others with men, and certain artifact types are not gendered, including rich feasting equipment in both bronze and gold. The rock art shows a significant number of phallic human figures as well as nonphallic ones (fig. 2). Almost all have been assumed by many researchers to be male, because among other things, they are shown with swords; there also are suggestions that the nonphallic figures might be third-gender individuals. The obvious care that the artists took to differentiate phallic and nonphallic figures suggests that some or many of the latter could be members of the major nonphallic category of humans: women.

The burial analyses indicate that in the earlier Bronze Age more males than females were buried in archaeologically visible situations (especially earthen mounds), but these conclusions are based on many burials for which there is no independent osteological assessment of the sex of the skeletal material. In the later Bronze Age, when cremation was universal in the region, very rich hoards of female-associated objects are known, often from watery places. They frequently are interpreted as ritual deposits of some kind.

Sørensen shows that in Bronze Age Scandinavia cloth and clothing was not much differentiated between men and women, but head coverings and metal ornaments and equipment were distin-

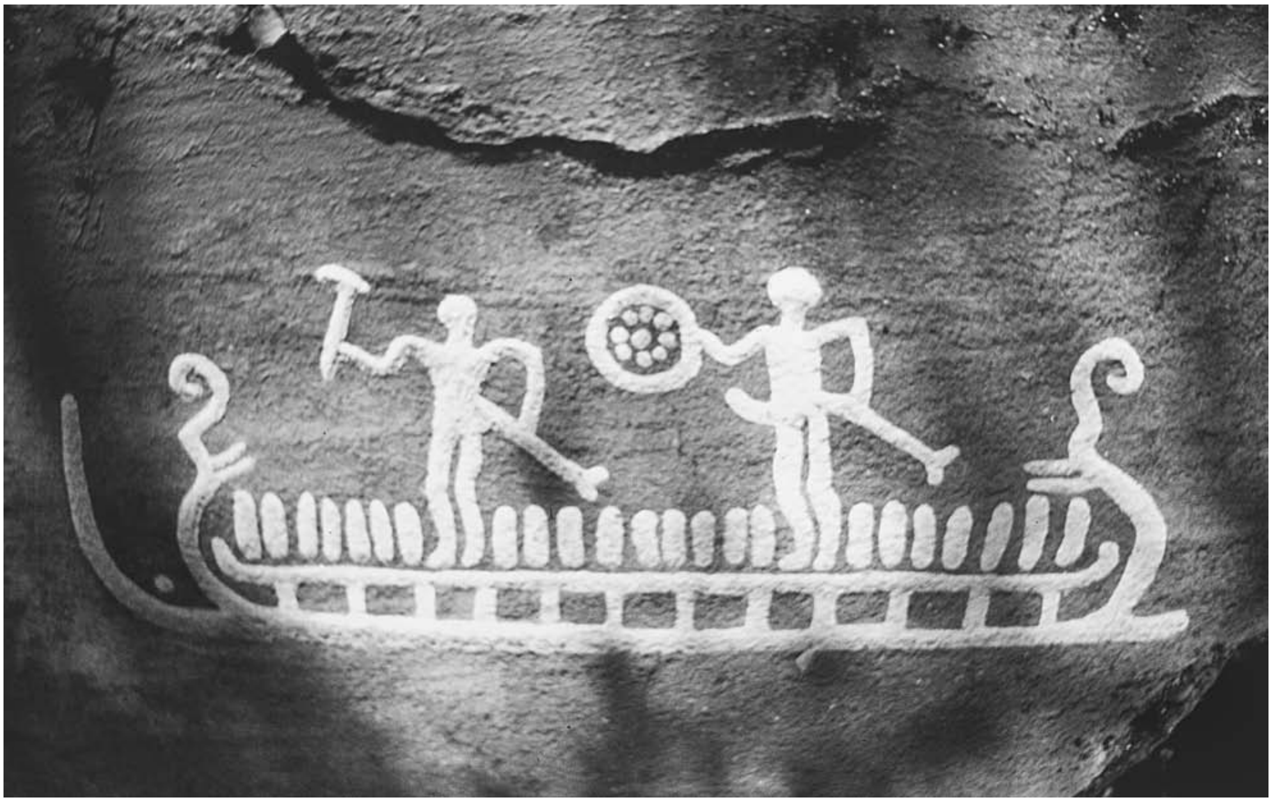

Fig. 2. Bronze Age rock art panel from western Sweden, showing boat and two armed figures, one phallic and one not. VITLYCKE MUSEUM. REPRODUCED BY PERMISSION.

guished. At least two female styles of costume are known, but there is only one male style. The female costumes might have identified rank or marital status. The emphasis in the later Bronze Age on male figures in the rock art and female-associated objects in ritual deposits suggests that males and females participated in different kinds of rituals and may have gained status in different ways. Even the common association of men with metalworking probably is overly simplified. The metalworking technological style required several steps, including creating molds out of stone and clay, processing and casting metal, and engraving objects after casting. There is no reason to assume that all of these tasks were accomplished by one craft worker or by one gender.

No other region of Europe has attracted as much gender research attention for the Bronze Age, but individual projects are contributing to a richer understanding. Elizabeth Rega analyzed a large Early Bronze Age cemetery, Mokrin, in the northeastern part of the former Yugoslavia. Only some grave goods had clear gender associations, but adult males and females were differentiated clearly by body position; the position of children suggests that they were gendered in death as well. Analysis of bone chemistry and paleopathologic conditions show that there were no dietary differences between women and men. The structure of the cemetery suggests that some sort of kin groups were distinguished symbolically. This analysis, integrating evidence from grave structure, artifacts, skeletal biology, and overall cemetery organization is a fine model of interdisciplinary research that can contribute to an engendered archaeology.

IRON AGE

Research in the Iron Age continues to focus on the development of stratified societies as well as on the growth of the first towns and interregional connections. Iron Age studies are influenced strongly by information from classical written sources. These sources can provide information about the daily life of both men and women, but because they all apparently are written by men and based on men's observations and testimonies, they cannot be assumed to be complete pictures of Iron Age society. Nevertheless the sources give us intriguing information about marriage patterns, property, and women's roles in agriculture, religion, and warfare.

The archaeology of villages and towns is well developed in Iron Age studies. Food preparation, weaving, potting, metallurgy, and other crafts are all evidenced in the archaeological record. Some authors have tried to distinguish male and female domestic spaces within households, but this differentiation is based on simplistic assumptions about division of labor. Almost certainly different tasks had different gender associations, and many may have followed modern conventional understandings, but this remains to be established. The potential for an engendered analysis is great.

Some of the best-known archaeological finds are the so-called princely graves of the Hallstatt culture (c. 800–400 B.C.) from southern Germany and adjacent areas. While the occupants of these graves often are assumed to be men, it has been determined that the tomb at Vix in eastern France is the burial of a woman accompanied by extraordinary wealth and imported items comparable to the other "princes." Traditional accounts explain this burial as a wife or daughter of a powerful male ruler, but Bettina Arnold points out that this is special pleading: everywhere else, this grave structure and these goods are said to designate a powerful leader. Only a very simplistic view of human societies would insist that leadership could not be invested in women in some cases. If rank and power were more important than gender in this case, one would expect to find just what has been recovered. In fact Vix is not unique; for example, at least one woman was buried with chiefly grave goods, including a complete chariot, in northern England, c. 300–100 B.C.

LATER PERIODS

Although classical historians have conducted some gender research, the Roman period in temperate Europe (c. 200 B.C.–A.D. 400) has received little attention from archaeologists interested in gender. The burial record from the medieval period, after A.D. 400, is very rich in some parts of Europe and has significant potential for gender research. Wealthy female graves, as in other cases, often are attributed to the status of the deceased's male relatives. Keys found in some female burials in the early centuries A.D. and weighing equipment from Viking period female burials suggest, however, important aspects of some women's economic power in both the private domestic realm and the public realm of the marketplace. Various authors see archaeological evidence for female control of textile production. In contrast, the underrepresentation of female graves in many Viking contexts (c. A.D. 800–1200 in Scandinavia) may reflect preferential female infanticide. Problems remain in mortuary analysis where burials are assigned to a sex based on grave goods rather than biological analysis. This perspective, found widely in medieval archaeology, which emphasizes dichotomous sex categories and simplistic associations of males with weapons and females with jewelry, can be improved by recognition of the complexities of gender role and symbolism.

For example, a chronological overview of burial evidence from southern Norway from the Roman through the Viking periods shows that the visibility of men and women changes over time and that gender distinctions between grave goods are minor in the earlier phases and become sharper over time. Age may have an impact on burial symbolism as well. Other evidence suggests that the religious emphasis changed during the medieval period in Scandinavia from a focus on fertility to a focus on warriors, a shift that may be related to changing gender values as well.

Within medieval archaeology there is interest in churches and other religious institutions. As in other research, women's roles have been neglected, but there is interesting architectural evidence about nunneries, monasteries, walled gardens, cloisters, and church decoration that is relevant to a variety of roles of religious women and men. As Roberta Gilchrist notes, the spaces of the church reflect both gender roles and ideology.

CONCLUSIONS

Over the last two decades of the twentieth century archaeological attention to gender expanded dramatically. Within European archaeology, the emphasis has been on gender ideology and symbolism, although there also have been discussions of the division of labor and status relationships as well as theoretical attention to the definition of gender. There is room within an engendered archaeology for those who seek to expand the understanding of women's roles in past societies as well as for those who are interested in more complex topics. The challenge is to integrate theoretical discussions with empirical evidence.

The trends of current research are twofold. First, archaeologists are trying to grapple with the complexities of human statuses and roles in the past, recognizing that one cannot study gender or status or age alone but must integrate them into analyses. Second, scholars realize that gender archaeology should not be isolated from other studies; virtually every archaeological research question—the beginnings of agriculture, development of new technologies, migration of populations, evolution of social complexity, and role of interregional exchange, among others—can be enriched by incorporating an engendered perspective. The gender relationships and ideologies of past societies cannot be assumed based on simplistic generalizations that have typically made women passive or invisible. Rather, the complexities of gender must be incorporated into ongoing attempts to use archaeological remains to illuminate the human past.

See also **Bronze Age Coffin Burials** (*vol. 2, part 5*); **Bronze Age Cairns** (*vol. 2, part 5*).

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JANET E. LEVY

RITUAL AND IDEOLOGY

FOLLOWED BY FEATURE ESSAY ON:

The study of prehistoric religion and ideology emerged as part of a reaction against the emphasis on "hard" facts, environmental reconstructions, settlement patterns, and subsistence data prevalent in archaeology beginning in the early 1960s. This newfound interest in the meaning of the past led to attempts to understand the cognitive basis for social action—the mental structures and framework of ideas that people internalize and use, often without reflection. It became apparent to archaeologists that, because such mental frameworks provided the basis for everyday behavior, their traces could be found in even the most common material remains they had already studied but without realizing their significance for cognitive research. It was this linking of microlevel material culture (pottery decoration, house orientation, burial posture) to macrolevel mental structures that made the study of prehistoric religion (often glossed as "ritual") and ideology possible. In addition, this linkage demonstrates the importance of religion—as a series of principles for the understanding of both long-term structures and everyday social action.

Traditional archaeologists tended to view prehistoric religion and ideology as the Holy Grail of their discipline, and as the most difficult nonmaterial elements to be identified from material remains. Processual archaeologists were more optimistic, identifying the cognitive, which included ritual and ideology, as one subsystem within a total behavioral system of human communities. It was only in the 1980s, with the advent of post-processual archaeology, that the cognitive moved center stage and the pursuit of meaning began to dominate accounts of prehistory. This led to a different kind of archaeological writing, in which the grand narrative became less important than detailed, interpretative accounts of often small-scale patterning.

MEANING OF TERMS

Because it is difficult to find properties to distinguish ritual from secular acts, many prehistorians adopt the view of ritual as an all-encompassing phenomenon, a view that originated with the French anthropologist Émile Durkheim (1915). These authors leave themselves open to the criticism that they cannot exclude any kind of structured formal behavior (e.g., the game of cricket) from the ritual domain. The opposite problem lies in establishing a rigorous dichotomy between ritual and secular, or symbolic and practical, action, as in Colin Renfrew's 1985 study of the shrine at the Aegean Bronze Age palace of Phylakopi. If ritual is bracketed out and studied in isolation, it becomes difficult to understand how social agents moved between political and ritual domains. One alternative is to build on

John Barrett's 1991 insight that ritual and symbolic knowledge is constructed from the same material conditions as daily life and that participants create ritual by situating their own bodies and the symbolic associations that color everyday life within that ritual. Similarly, Joanna Brück maintains that the beliefs underlying ritual are expressions of the values, aims, and rationales that shape everyday practical action, so that rituals represent people's practical engagement with material conditions—a way of causing desired things to happen. Thus rituals can mark important social transitions and renewals through the creation of relationships between this world and the other world, between people and time, and between people and place.

The classic Marxist position that ideologies were used to maintain relations of dominance and thus had to be concealed from the people—that ideologies promoted "false consciousness"—was challenged by the French Marxist Louis Althusser (1984), who saw the material existence of ideology in all human practice as mediating between consciousness and action. This view of ideology, however—as a particular way of understanding the world, a set of cosmological beliefs and values for getting on in the world—tends to lead to the undesirable outcome of excluding social power from consideration.

A useful distinction can be drawn between ideology as theory and ritual as practice: they are not diametrically opposed, but each creates and re-creates the conditions for the existence and growth of the other. Nevertheless, a prehistoric society's ideology can be neither consistent nor unified; it will contain both internal and external contradictions and many different readings of the "same" rituals—differences that can be used by prehistoric communities and individuals as a source of power.

FORMS OF EVIDENCE

Colin Renfrew identifies four classes of evidence pertaining to ritual: (1) verbal testimony about religious activity, (2) direct observation of cult practices, (3) study of nonverbal records (depictions), and (4) study of material remains of cult practices. The last two classes are relevant for later prehistory. Most prehistorians agree that the context of discoveries and their relationships are key elements in using material evidence; now that the meaning of ritual and ideology has been broadened, it is possible to employ a far wider range of evidence than the British prehistorian Christopher Hawkes had in mind when he established his infamous "hierarchical ladder of inferences," with religion as the most difficult stage to reach. Rather than a chronological approach, this discussion takes a biographical approach, looking successively at things, individuals, dwellings, sites, and monuments and landscapes, making use of a wide range of temporal and spatial scales of analysis.

THINGS

The artifact, or item of material culture, lies at the heart of the archaeological enterprise. Until the late twentieth century, however, it was often treated as an inert result of the application of technology. Now that closer relations have been detected between things and people and things and places, the metaphorical significance of artifacts—what they can stand for—is better appreciated. An important strategy, which depends on the material persistence of artifacts, is termed "presencing": here an artifact can bring absent people and places into their immediate context. Thus an exotic Neolithic flint axe found in Austria can convey the prestige of a successful exchange and can presence its makers and traders in Scandinavia.

Each stage of transformation in the life of an object, as in that of a person, is surrounded by ritual and often secrecy. Karen D. Vitelli's study of some of the earliest pottery made in Europe—the seventh-millennium B.C. pottery from the Franchthi Cave in Greece—shows how pottery making itself was a prestige activity, based on esoteric knowledge, with each vessel carefully shaped and fired individually. Several different potters produced a few pots each year for ritual usage on special occasions rather than for everyday cooking or storage. Pottery was ideologically important because it was a completely new kind of object in the material world of early farmers, the beginning of a local tradition.

Pottery can also stand metaphorically for social relations and even architecture. In his study of the Late Neolithic pottery for the Barnhouse village on Orkney, Andrew Jones demonstrates that large decorated vessels kept in house niches for the storage of barley appear in the same relative place as the skulls stored in the niches of nearby communal tombs. When archaeologists match each stage in the making of a vessel with a stage in round house building, they also reveal the metaphorical wealth of material culture in its linking of pottery, food, dwelling, and death in the Neolithic worldview on Orkney.

Jan Apel's study of the beautifully crafted flint daggers of the Late Neolithic of Scandinavia (fig. 1) shows how a stoneworking tradition became the vehicle for the dominant social values of the community, which were transmitted from generation to generation through the manufacture of the daggers. He argues for a hereditary fraternity whose members manufactured rough forms of daggers in places near flint sources remote from the settlements; master knappers then finished them off at home, in the full view of the community. As symbols of male prestige, the daggers were traded from the Arctic to the Alps. Hence specialized craft production and long-distance trade were two ways in which tangible objects could be charged with intangible, supernatural powers that brought their owners honor and prestige.

Richard Bradley has identified a long-term trend (3500–1 B.C.) in later prehistoric Europe—the disposal of artifacts and human body parts in watery places such as bogs, rivers, and lakes. Regional practices alternated over time between predominantly dryland burial in graves and wetland disposal; these alternating practices sometimes involved changes in artifact type, from weapons to ornaments to tools, or different preferences regarding sacrifices of persons or animals or offerings of things. This practice of structured deposition perpetuates a significant relationship between people, places, and objects.

The example of miniature fired clay figurines from the fifth millennium B.C. Cucuteni group in Romania and Moldavia shows how making and breaking are conceived as part of a single ritual cycle of birth and death. The making of the figurines (fig. 2) from three equal-sized balls of clay pressed together facilitates the breaking of the body into several fragments, each standing for the whole figure and for the social relationships that link their owners and users. Most of the figurines have been deliberately broken in settlements and the fragments reused before final deposition—a negotiation of social roles using objects.

INDIVIDUALS

Recent research into the fundamental ideological question of what constitutes a person has recognized three possible conceptions: (1) a Western conception, in which the individual is "bounded" by her or his skin and seen as someone separate from all other individuals; (2) a Melanesian conception, in which the person is figuratively divided between all other persons with whom she or he has a social relation; and (3) an Indian conception, in which the person changes gender over the course of her or his life through the metaphorical and actual exchange of bodily fluids. Prehistorians have identified examples of such "partite" beliefs about personhood in the Neolithic of northwestern Europe, where the bones of the deceased are often moved around the landscape, and in the Neolithic of southeastern Europe, where figurines can change gender by having their sexual parts broken off.

Rituals surrounding key human rites of passage—birth, age grades, marriage, and death—are ubiquitous in anthropology, but it is difficult to identify the first three in prehistory (for birthing rituals, see Beausang 2000). Joanna Sofaer Derevenski has overcome the difficulties of sexing children's skeletons by extrapolating from the strongly gendered burial positions of adults. The result for the fourth-millennium B.C. Copper Age cemetery of Tiszapolgár-Basatanya in Hungary is a series of artifacts—tools, ornaments, or pottery—each associated with a different life stage for each gender. This shows how things can symbolically represent people, just as persons are consistently linked to objects.

It is important to distinguish between ancestor rituals, those used to transform the deceased into ancestors, and funerary rituals, those used to bury the dead. Two explanations are advanced for the piles of bones, frequently disarticulated, found in the megalithic "tombs" of the northwest European Neolithic. The ossuary hypothesis states that primary excarnation (removal of the flesh from the bones) occurred elsewhere, with burial of selected bones in the megalith. In the second explanation, the megalith was the place of primary burial, with bodily decomposition occurring in the tomb and selected bones being removed after the fact. Both explanations imply that the transition from deceased to ancestor required the loss of flesh and the survival of the bones alone.

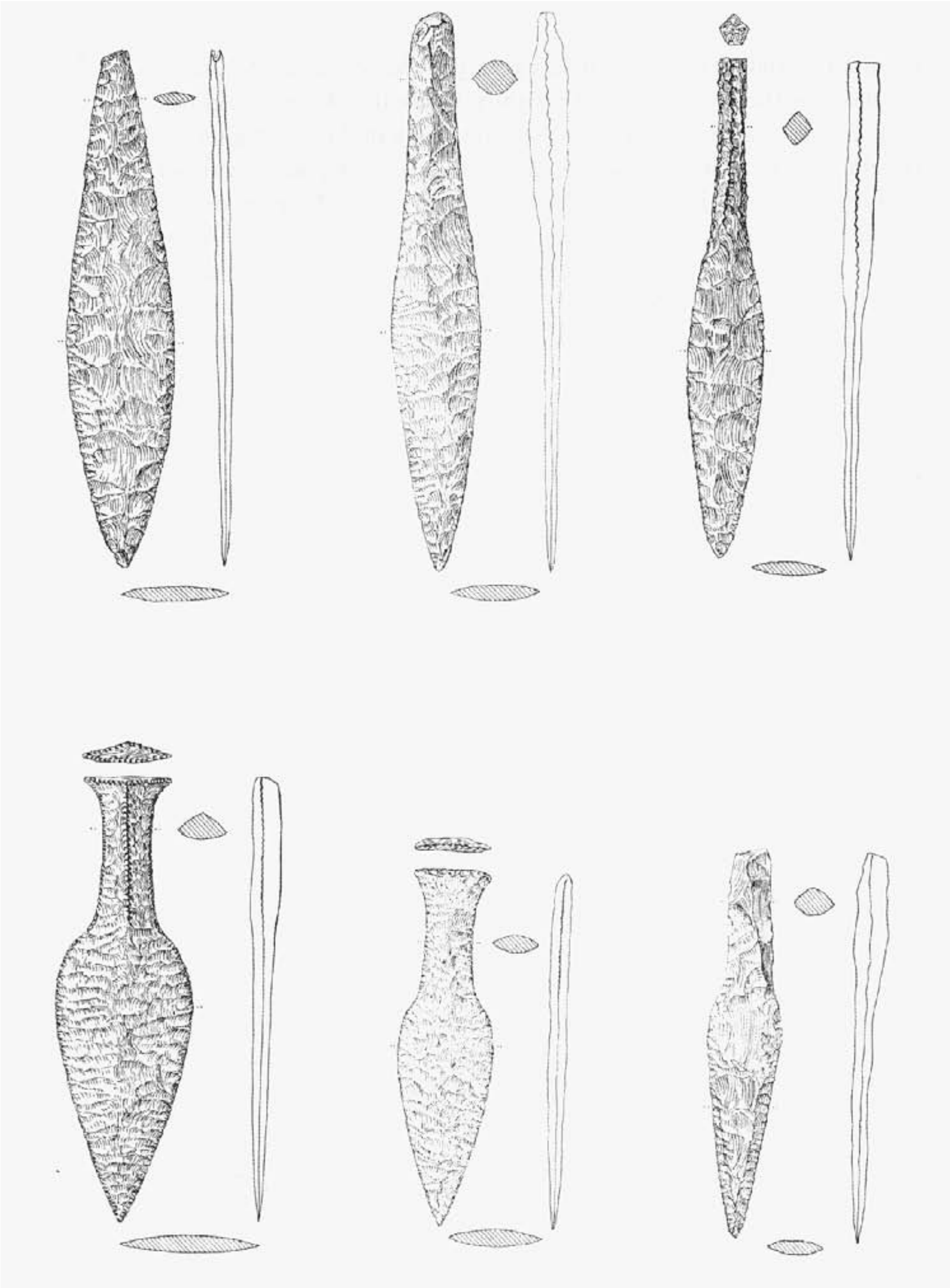

Fig. 1. Late Neolithic bifacial flint dagger. COURTESY OF JAN APEL. REPRODUCED BY PERMISSION.

Bo Gräslund posits the idea of multiple souls—a body soul that leaves the body at death and a dream soul that is released in the transition to the other world—to explain a set of practices in Bronze Age and Iron Age funerary ritual in northern Europe that differs from those of the Neolithic. Grave goods in inhumations are never burned, but grave goods are burned in cremations or are absent altogether. He suggests that, to be of any use on the spirit journey, the grave goods have to be placed near the corpse at the very moment when the dream soul sets out on its journey (in the grave or on the funeral pyre).

In the European Bronze Age, there is a major shift from an ideology of place and community to one privileging individual identity and personal display. A concern with the body and its appearance

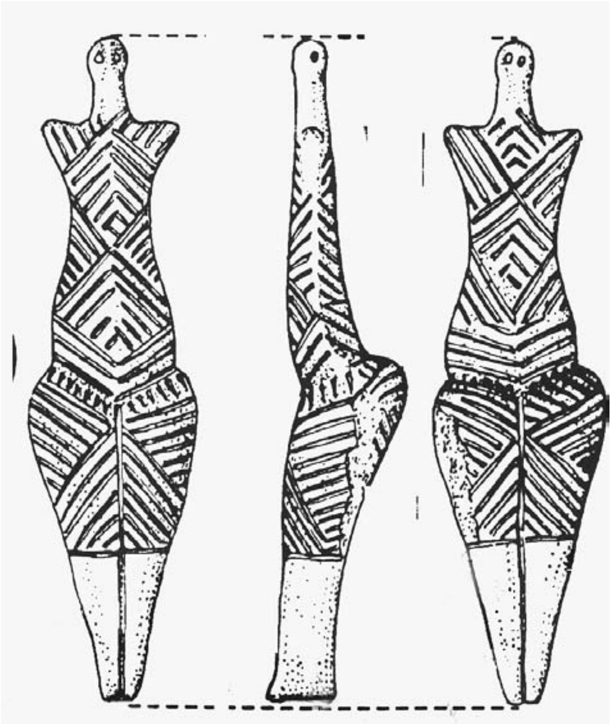

Fig. 2. Cucuteni fired-clay anthropomorphic figurine. COURTESY OF DAN MONAH. REPRODUCED BY PERMISSION.

can be seen in the adoption of new toilet articles (razors, tweezers, and so forth) designed to fix in death the image of warrior beauty. These visual stimuli aiding in social categorization are apparent in personal costume and clothing; Marie Louise Stig Sørensen identifies a proliferation of ornaments designed to accentuate the body and its movements in the Middle Bronze Age (c. 1800 B.C.). The weapons, costumes, gold ornaments, and mirrors of the Iron Age accentuate the visual signs of this ideology of external appearance, often in the context of warrior graves that contain exotic drinking sets imported from Mediterranean states.

DWELLINGS

The dwelling not only embodies personal meaning but also expresses and maintains the ideology of prevailing social orders. The geographer Yi-Fu Tuan sees architecture as the "pre-text" for handing down traditions, rituals, and cosmology. In small-scale societies, localized cosmologies often embed the uniqueness of time, locality, and place in their architecture. Since dwellings resemble people in their birth (construction), growing up (use life), and death (destruction or dilapidation), the body often acts as a temporal metaphor for the dwelling. In addition, the orientation or cardinal points of the dwelling are frequently linked to cosmological schemes.

Ian Hodder's important long-term study of 1990 explores changing Neolithic social structure through the concepts of the *domus*—the importance of domesticity, the home, fertility, and productivity—and the *agrios*—the outside zone of hunting, warring, drinking, and exchange. Hodder identifies the groups in Neolithic Europe that place a high symbolic and practical value on dwellings, contrasting them to a sizable number of more mobile communities that do not build impressive structures. He interprets the tensions between the *domus* and *agrios* principles as a driving force for cultural change in much of Neolithic Europe.

One of the most remarkable sites in sixth- to fifth-millennium Europe is Lepenski Vir, in the Iron Gates gorge of the Danube in Serbia. Here pottery-using foraging communities that lived close to early farming groups constructed trapezoidal dwellings whose shape resembled the nearby mountain of Treskavac and matched the form of an unusual burial. Lepenski Vir neatly illustrates the significance of color symbolism: the dwellings' red limestone floors were metaphorically linked to the red ocher powder used in human burials, the red paint or burn marks on the monumental sculptures placed inside the dwellings, the predominantly red Neolithic pottery, and the dazzling red of the autumnal forests of the gorge. In this way, the living, the dead, nature, material culture, and architecture were integrated within a single ideological structure.

The well-preserved sandstone dwellings of Late Neolithic Orkney reveal a symmetrical plan, with a central hearth of symbolic as well as practical importance, especially during the long winter darkness. The division between the left and right sides of the house has been interpreted as a gendered division of space, based on available light and artifact disposal. As in the megalithic tomb of Maes Howe, whose passageway is oriented toward the setting of the sun on the shortest day of the year, the hearths in the houses are oriented to the sunrise and sunset of the winter and summer solstices. Thus the cosmology of Orcadian society is built into the inhabitants' daily lives, as a framework for dwelling.

An important long-term ideological concept in the British Bronze and Iron Ages is the circular house plan, which remained consistent for two millennia. Here the key architectural focus is the entrance, sometimes emphasized through a deposition of objects near the door. In the Bronze Age, the doorway faced east, toward the midwinter and equinoctial sunrise; inside the household space was divided into two gendered halves based on household activity. Nevertheless, in the Middle Iron Age, c. 500 B.C., the doorways of the more impressive houses were shifted to face the center of the hillfort, to recognize the prominence of a central person, perhaps the community leader. Thus a profound reorientation in Iron Age society is seen in a change in the orientation of the basic dwelling unit, the house.

The death of a house can be peaceful and accidental, or violent and deliberate, as in the burning of Neolithic houses in southeastern Europe. At Opovo, a Neolithic site in Serbia, each of the houses was burned down individually, with different firing temperatures and different fire paths, each requiring the addition of fuel to complete the destruction. Often amounting to several hundred objects, the artifacts in a burned house were laid out formally, probably as "grave goods" by the "mourners." House burning must have been the centerpiece of a spectacular rite of passage for the whole village.

European prehistorians have often debated the relationship between Neolithic longhouses (for the living) and long barrows (for the dead). Richard Bradley has interpreted the mound formed by the collapse of a longhouse, with its flanking clay pits, as the visual parallel of a long barrow. Hence a settlement could contain a variety of houses—some active and some dead, with enclosure ditches sanctifying the space around a dead house. Both of these examples indicate how close houses for the dead were to houses for the living.

SITES AND MONUMENTS

If individual houses offer a stage for the unfolding drama of ritual life and constitute the underpinnings of ideological structures, entire sites and monuments provide a wider arena for the expression of the community worldview through everyday social practices. Recent approaches to sites and monuments identify two important themes: the transformation of space (natural, unoccupied) into places (meaningful, cultural, and lived in); and the ways that communities related past, present, and future to their own lives through those places.

Many societies have "domesticated" natural caves by performing an underground ritual. Ruth Whitehouse's study of the complex Neolithic and Copper Age cult cave of Porto Badisco in southern Italy shows how people divided up the space with stone walls, left pottery to catch water from dripping stalactites, and painted almost one thousand motifs on the cave walls. The paintings comprise abstract motifs, artifacts, and handprints but especially figural motifs, both human and animal, most of them in hunting and gathering scenes. The largest and most accessible chambers featured figures, both women and men, most in scenes, while the more remote chambers featured the juxtaposition of men and abstract designs symbolizing the most secret transformations of elements in ritual narratives.

On Mont Bego, at an altitude of 2,900 meters in the French Alps, Copper Age societies engraved an estimated 100,000 figures onto an expanse of soft-colored and polished schist, thus marking a natural place with complex cultural symbols. Parallels to the motif combination of adult male, metal dagger or halberd, plow, and draft oxen are found on gravestones and in tombs in the adjacent lowlands. This suggests an ideological emphasis on male warfare and agriculture. Because of snow cover, the mountain was accessible only during the six summer months, when shepherds or pilgrims made the ascent, perhaps as part of a male initiation rite.

The Bronze Age settlement of Leskernick in southwestern England comprised a series of dry stone-walled houses and enclosure walls on a rocky granite hillside, overlooking a standing stone complex. The ritual significance of the rocks for every aspect of daily life could be seen throughout the settlement—in situ boulders incorporated into house walls, enclosure walls joining up dense boulder patches, stones cleared away from impressive rocks, and the base of other boulders surrounded by smaller stones. Communal knowledge of the significance of rocks tied the settlement to the timeless granite structure of the moors.

A very different type of settlement is the tell, an artificial mound of occupation debris rising above lowland plains in southeastern Europe. The fifth-millennium B.C. tell of Polyanitsa in Bulgaria exemplifies the practice of building one's house above where one's ancestors once lived, to link everyday action to traditional, ancestral lifeways. The higher the tell, the greater the time-depth of previous occupations, time-depth being the basis of ideological power in a tell-filled landscape. Polyanitsa also illustrates, with a clarity rare in prehistoric Europe, formalized village planning based on the *axis mundi* (axis of the world).

Megalithic tombs link current usage not only to the past, through the ancestors, but also to the future, through the construction of a monument made to last for many generations. This is well exemplified by the massive Neolithic monument of La Hougue Bie in the Channel Islands. The original Middle Neolithic conical cairn was faced with smooth stones and stood 19 meters high with a diameter of 60 meters, far larger than any contemporary dwelling. The cairn's monumentality was enhanced by buttresses and a perfectly symmetrical horned entrance to the forecourt. In the Late Neolithic, a single body buried in a cist within the chamber symbolized the change toward an individualizing ideology. Height and monumentality continued to attract people to the monument; two medieval chapels were built on top of the mound and were in turn incorporated into a Regency folly.

The impressive mound of Hochdorf concealed one of the very few Early Iron Age "princely" graves not robbed in antiquity; its monumental bulk masks a diversity of timescales in the funerary ritual. The wooden burial chamber itself took five years to build. Some grave goods (clothing and jewelry) belonged to the deceased in his lifetime, others were made after death, some in the actual chamber (gold coating on shoes, drinking horns); still others were introduced at the moment of burial (a wagon was dismantled to fit through the door and then reassembled). Then, long after the main burial, those seeking to be associated with the famous prince were buried in the side of the mound. The interplay of different timescales and artifacts with various biographies creates a narrative richness comparable to the material wealth in the tomb.

LANDSCAPES

Felipe Criado Boado and Victoria Villoch Vázquez define four fundamental dimensions of landscape: physical space, social space (for human use), symbolic space, and perceptual space. By "perceptual space" they mean the way the landscape is sculpted and shaped, which in turn shapes individual perceptions. Many other prehistorians are equally concerned with the ways individuals understand and interpret the landscape—a major divergence from past approaches to landscapes. Both groups, however, agree that the landscape is socially constructed, shaped by people's social practices, including rituals. One elaboration of this approach is to designate landscapes dominated by public monuments as "ritual landscapes"; however, this notion simply reinstates the sacred-profane dichotomy, which Brück and Barrett dispute. An important advance is the recognition that the landscape itself, especially rocky outcrops, waterfalls, and pools, is the source of the sacred.

Criado Boado and Villoch Vázquez conclude that the placement of Neolithic megaliths in a Galician upland zone, northwestern Spain, articulates and organizes the entire cultural landscape through their permanence and high intervisibility on all major routes across the uplands. Along the north-south axis of movement, there is a series of basins with poorly visible megaliths alternating with flatland containing megaliths located for high visibility; on either side of the axis of movement are contrasting viewscapes, high, open hills to the east, low depressions to the west. The paths across the landscape connect the settlement world of the living to the megalithic world of the dead, with circular territories strongly expressing the domain and control of the megalith builders and their descendants.

An approach based more on individual perception of the landscape is Vicki Cummins's demonstration of the close visual relationship between mountains and Neolithic megaliths in southwestern Wales. Most megaliths have excellent views of dominant mountains and rocky outcrops on the skyline—views that often crystallize as one approaches the monument. The visual similarity of megaliths to skyline outcrops suggests that these monuments represent an early stage in the creation of a mythical past by the living through the appropriation of a timeless nature. A later stage of appropriation involves the removal of rocks for monument construction, such as the bluestones taken from Wales to Stonehenge.

Christopher Tilley identifies two dramatic natural features on the south coast of England—the Isle of Portland, with its immense limestone cliffs, and the 15-meter-high storm beach of Chesil Beach—as the landscape inspiration for Neolithic monuments on the nearby Maiden Castle, a high chalk "island" standing out from the surrounding low terrain at the end of a long ridge. The Neolithic enclosure on Maiden Castle hill resembles the Isle of Portland in its shape, just as the steep sides of the hill resemble the Portland cliffs. The unusual bank barrow (a linear mound 547 meters in length) on top of Maiden Castle hill so closely resembles Chesil Beach in size and morphology that the barrow can be said to represent the beach. These visual metaphors help clarify how Neolithic communities used the dominant features of their landscape to construct their own cultural worlds. The visual links between the monuments on Maiden Castle and the coastal features are reinforced by the plentiful finds of coastal shells and Portland chert tools inside the enclosure.

In the Mediterranean, fourth- and third-millennium B.C. Malta was characterized by the construction of more than thirty temples, whose thick, ocher-painted stone walls created the atmosphere of a tomb. In his investigation of the rise of Maltese temple society, John Robb suggests that the temples were the meeting place for the below-ground world of the ancestors and the aboveground world of the living. Their flat, low, earth-covered exterior resembled an island when seen from a distance. Just as islands were inhabited metaphors—natural symbols of boundedness—so Maltese Copper Age communities not only lived on an island but also created one, a cultural island whose temples defined their local ritual identity.

It is not only nature that provides symbolic resources for prehistoric communities; it is also monuments from earlier periods. For example, in southwestern Ireland, there are more than one thousand known megalithic monuments, constructed in four cycles during the Neolithic and Bronze Age. William O'Brien explains that the Iron Age population of this region used the dominant orientation of all four main classes of megalithic monuments to the southwest—the sunset land of the dead—to maintain and develop the sun cult of the past. In this part of Ireland, the Iron Age inhabitants resisted most external innovations (except living in hillforts), instead emphasizing their own links to the past as represented by the ancestral monuments, which both surrounded them and provided the basis for rethinking and reinterpreting past and present.

CONCLUSION

This is not a grand narrative, a sweeping panorama of the evolution of ritual and ideology over six millennia of European prehistory. Instead, this essay seeks to identify signposts on the road, to explore how prehistorians have started to grapple with the implications of a major insight, namely, that ritual and ideology fill every aspect of our lives. The sea change in prehistoric archaeology in the last decade of the twentieth century and the first decade of the twenty-first consisted of a nuanced search for large-scale structure in everyday gendered social action. The ubiquity of ritual and ideology reinforces the key role they play in modern prehistory.

See also **Hochdorf** (*vol. 1, part 1*); **Franchthi Cave** (*vol. 1, part 2*); **Late Neolithic/Copper Age Southeastern Europe** (*vol. 1, part 4*); **The Megalithic World** (*vol. 1, part 4*); **The Neolithic Temples of Malta** (*vol. 1, part 4*).

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JOHN CHAPMAN

HJORTSPRING

In a bog just 50 meters across on the island of Als in southern Denmark, peat diggers discovered well-preserved remains of a wooden boat and spears in the 1880s. In 1921 excavations began that uncovered most of the boat and a large assemblage of weapons, all deposited in about 350–300 B.C. The practice of depositing weapons, and occasionally boats, in ponds and lakes of northern Europe became relatively common during the latter part of the Roman Iron Age, A.D. 200–500. Among the best-known sites of that period are Illerup, Nydam, Thorsberg, and Vimose. As vegetation grows into and across them over time, ponds and lakes often develop into bogs, where the waterlogged and acidic environment preserves organic materials exceptionally well. Hjortspring is the largest of the pre-Roman Iron Age weapon deposits.

The boat, only fragments of which survive, was made of lime (linden) wood, and was more than 19 meters long. Inside, the space for people and gear measured about 13 meters long by 2 meters wide by 0.75 meters high. The hull was made of five planks, all longer than 15 meters and about 70 centimeters wide. Ten ribs across the top of the boat had seats to accommodate two persons, suggesting that twenty rowed the boat. Wooden oars for paddling and two wide oars for steering were found. The boat would have weighed only about 530 kilograms and thus could have been carried easily by its crew. Its flat bottom permitted good maneuverability in the shallow waters around the Danish islands and peninsulas, and the crew could have driven it directly up onto the sandy beaches characteristic of those regions of northern Europe. At both bow and stern were double prows that may have been intended to ram boats of similarly light construction. The boat was found lying on its western side, oriented north to south. Some of the oars and spears apparently had been pushed down into the mud to stick up above the level of the water.

The weapons found with the boat constitute one of the most important assemblages of military equipment from Iron Age northern Europe. They not only indicate the kinds of weapons that were in use and permit study of the technology of weapon manufacture but also allow for the reconstruction of fighting units and of military organization. Eleven single-edged swords of different shapes were found, ranging in length from 33 to 70 centimeters. Scabbards were made of ash wood. Two of the swords had been bent deliberately before they were deposited, a practice characteristic of Iron Age ritual. Spears (including lances) were the most abundant of the weapons present—138 iron spearheads were recovered and 31 of bone or antler. The largest of the iron spearheads was enormous, at 43.5 centimeters long, but most were between 10 and 20 centimeters in length. Some of the spearheads had been broken off their ash-wood shafts before they were deposited; others were intact.

Shirts of chain mail and wooden shields make up the defensive part of the armaments. The fragmentary remains indicate ten or more shirts of mail—the earliest known chain mail in Europe. About fifty nearly complete wooden shields are represented, along with fragments of perhaps thirty more, forming the largest number of shields from any one site in prehistoric Europe. All are roughly rectangular in shape, some wider and some narrower, with rounded corners. Striking among these numerous weapons is their diversity in size and shape, indicating considerable variation in the equipment carried by soldiers of the time.

Other objects recovered include skeletal remains of a horse, a lamb, a calf, and two dogs, these last perhaps animals trained for battle. Vessels made of pottery, wood, and bronze as well as a large wooden spoon or ladle may represent objects used for food preparation and consumption by the soldiers who rode in the boat and carried the weapons. An axe handle and a mallet may have been employed for making repairs to the weapons and to the boat. Other objects include pieces of rope, a spindle for spinning textile fibers, wooden boxes, and wooden disks of unknown purpose.

Archaeologists believe that weapon deposits such as those of Hjortspring and the more numerous finds of the Roman Iron Age were offerings to deities made by victors in military conflicts—perhaps of the defeated armies' weapons, though it has not been possible to establish that the weapons found belonged to an invading force, as some scholars propose. There is strong archaeological evidence from all periods in northern Europe for the practice of sacrificing valuable goods by depositing them in watery places—lakes, ponds, and bogs. Greek and Roman texts from centuries following the Hjortspring deposit allude to the practice by peoples of northern Europe of offering the weapons of defeated enemies to their gods.

In his recent analysis of the Hjortspring material, Klavs Randsborg draws important conclusions about the military unit represented. Because the remains indicate the presence of some eighty shields and about twice that number of spears, the weapons in the deposit seem to represent roughly eighty fighters, each armed with a shield and two spears. The boat could accommodate about twenty persons; thus the weapon deposit seems to represent four boatloads of warriors—an army of some eighty fighters. In the character of the weaponry, Randsborg sees evidence for differentiation between commanders and infantry troops. The numbers of swords, spears with unusually large iron points, chain-mail shirts, and narrow shields can be interpreted as the fighting equipment of about eleven individuals who bore more specialized and finer weapons than the other men. The numbers of spears and wide shields suggest an infantry force of about seventy. This ratio—eleven specially armed troops to seventy general foot soldiers—is similar to ratios observed in the much larger weapon deposits of the Roman Iron Age, such as the four cited earlier. The Hjortspring bog find thus provides important evidence about a variety of interrelated topics from the pre-Roman Iron Age in northern Europe, including boatbuilding technology, weaponry, ritual practice, warfare, and social stratification implied by the differentiation in military equipment.

See also **Pre-Roman Iron Age Scandinavia** (*vol. 2, part 6*); **Boats and Boatbuilding** (*vol. 2, part 7*).

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PETER S. WELLS

ARCHAEOLOGY AND LANGUAGE

Sir William Jones, a British judge in India, first defined the Indo-European language problem in one famous sentence in 1786. Jones had arrived in Calcutta in 1783 to establish the rule of British law over both the excesses of the English merchants and the rights of their Indian subjects, who obeyed an already functioning and very ancient system of Hindu law. To understand Hindu law, Jones had to learn Sanskrit. His teachers, outstanding Hindu scholars, taught him to read the *Vedas,* the ancient religious texts that lay at the root of Hindu religion. The *Rig Veda,* the oldest Vedic text, was known to be more than two thousand years old, but exactly how much older, no one knew. Three years after his arrival in Calcutta, Jones presented a lecture to the Asiatic Society of Bengal, in which he uttered the following oft-quoted words:

> The Sanskrit language, whatever be its antiquity, is of a wonderful structure; more perfect than the Greek, more copious than the Latin, and more exquisitely refined than either; yet bearing to both of them a stronger affinity, both in the roots of verbs and in the forms of grammar, than could possibly have been produced by accident; so strong indeed, that no philologer could examine them all three, without believing them to have sprung from some common source, which, perhaps, no longer exists.

Jones concluded that Sanskrit had sprung from the same source as Greek and Latin, the classical languages of European civilization, and added that Celtic, Persian (Iranian), and German probably belonged to the same family. For Europeans the news was startling. The civilization of faraway India turned out to be a long-lost cousin. What was the parent language? Where had it been it spoken and by whom? What historical events made its daughter tongues the dominant languages from Scotland to India? Finally, just how big was the family?

These questions created a debate that has spanned two hundred years and has yet to be resolved. It has inspired episodes of genocide, dry academic discourses, and romantic fantasies. Scholars trying to solve this problem created the discipline of linguistics in the nineteenth century. Their principal interest was comparative grammar, sound systems, and syntax, which provided the basis for classifying languages, grouping them into types, and otherwise defining the relationships between the tongues of humanity, none of which had ever been attempted. They divided the Indo-European language family into twelve major branches, distinguished by innovations in phonology, or pronunciation, and in morphology, or word form, that appeared at the root of each branch and were maintained in all the languages of that branch. The branches included most of the languages of Europe (excluding Basque, Finnish, Estonian, and Magyar); the Persian language of Iran; Sanskrit and its many modern daughters (Hindi and Urdu); and numerous extinct languages, including Hittite and Tocharian. Modern English was assigned to the Germanic branch. The analytic methods invented by these philologists are used to describe, classify, and explain language variation all over the world.

In the 1780s the German Romantic philosopher Johann Gottfried Herder argued that language creates the categories and distinctions through which humans give meaning to the world. Each language therefore generates and is enmeshed in a closed social community, or "folk," that is meaningless to an outsider. After the 1859 publication of Charles Darwin's *Origin of Species,* the Romantic conviction that language was a defining factor in identity was combined with new ideas about social evolution. Race, language, and culture were interpreted as a package that endowed some nations with a superior biological-spiritual-linguistic essence and consigned others to the back row. The policies that forced the Welsh (including Sir William Jones) to speak English and the Bretons to speak French were rooted partly in the search for a "pure" national heritage derived from a single heroic and superior race of Anglo-Saxons or Gauls.

The theoretical mother tongue that gave birth to all twelve branches is called Proto-Indo-European. The speakers of the mother tongue soon were molded to fit a national-racial stereotype. The name "Aryan" began to be applied to them because the authors of the oldest religious texts in Sanskrit and Iranian, the *Rig Veda* and *Avesta,* called themselves Aryans. The term "Aryan" should be confined only to this Indo-Iranian branch of the Indo-European family. The *Vedas* were a newly discovered source of mystical fascination in the nineteenth century, however, and in Victorian parlors the name "Aryan" soon spread beyond its proper linguistic confines.

The gap through which the name escaped from India was provided by the *Rig Veda* itself: the Vedic Aryans described themselves as invaders who had conquered their way into the Punjab. A feverish search for the "Aryan homeland" began. Researchers have placed it confidently in places ranging from India and Pakistan to Russia, Turkey, central Europe, and even the North Pole and Atlantis. Some homelands were proposed not for innocent reasons but to provide a historical precedent for nationalist or racist claims to privileges and territory. In the 1920s the German scholar Gustaf Kossinna attempted to demonstrate on archaeological grounds that the Aryan homeland lay in northern Europe, centered in Germany. Kossinna illustrated the prehistoric migrations of the Indo-Germanic Aryans with neat black arrows that swept east, west, and south from his presumed Germanic core. Nazi armies followed his pen twenty years later.

The fundamental errors that led an obscure linguistic mystery to erupt into racial genocide were the equation of race with language and the assignment of evolutionary superiority to certain language and race groups. Indo-European, the linguistic phenomenon, became the "Indo-Europeans," a racial-spiritual fantasy. Prominent linguists have always pleaded against these ideas. The Aryans themselves, according to their own texts, used Aryan as a religious-linguistic category. The *Rig Veda* was a ritual canon, not a racial manifesto. Making the proper sacrifices to the right gods, which required performing the traditional prayers in the traditional language, made a person an Aryan.

Any attempt to solve the Indo-European problem has to begin with the realization that the term Proto-Indo-European refers to a language community. Race, poorly and inconsistently defined, cannot be linked in any predictable way with language. Because definitions are cultural, scientists cannot provide a true boundary between races. Moreover, archaeologists have their own, quite different definitions of race, based on traits of the skull and teeth that often are invisible in a living person. However race is defined, languages are not normally sorted by race—all racial groups speak a variety of languages. Culture, however, often is associated with language—the language a person speaks can lead others to make assumptions about one's character, religion, dietary preferences, and so on. These are stereotypes, of course, and people often confound them. How, then, do we connect language with culture in a reliable and predictable way?

LANGUAGE AND MATERIAL CULTURE

Many archaeologists think that it is impossible to identify a prehistoric language group, because language is not reflected in any consistent way in material culture. People who speak different languages might make houses or pots in the same way, and people who speak the same language often make pots or houses in different ways. Likewise, a language can spread without a corresponding change in material culture, and vice versa. Language and culture are correlated predictably under some circumstances, however. We have erred in trying to find a single class of material culture that correlates reliably with language; we should focus instead on *frontiers.*

Where we see a robust frontier represented in material culture—not just different pots but also different houses, graves, cemeteries, town patterns, ritual icons, diets, and dress designs—that *persists* in the same location for centuries or millennia, it tends to be a linguistic frontier as well. Persistent ethnolinguistic frontiers seem to occur under relatively few conditions, principally at ecological boundaries and at the end point of certain kinds of migrations. There was, for instance, a persistent ethnolinguistic frontier between English-speaking immigrants and the indigenous Celtic Welsh in Wales. This divide separated populations that spoke distinct languages (Welsh/English), built particular kinds of churches (Celtic/Norman English), managed agriculture in varying ways with different tools, used disparate systems of land measurement, employed different standards of justice, and maintained a wide variety of distinctions in dress, food, and custom. In cases such as this, where a clear material culture frontier persists in the same place for hundreds of years, language tends to be correlated with the boundary. This insight permits us to identify at least a few probable linguistic frontiers on a map of purely archaeological cultures, a critical step in finding the Proto-Indo-European homeland.

HOW RECONSTRUCTION WORKS

Historical linguistics gave us not just static classifications but also the astounding ability to reconstruct at least parts of early languages for which no written evidence survives. The methods that make this possible rely on regularities in the way sounds change inside the human mouth. For example, the sound *k,* as in "kiss" (or any consonant made with the back of the tongue), followed by the sound *e,* as in "set" (or any other vowel made with the tip of the tongue), is likely to shift forward on the palate toward the front vowel—to *ts-* and then to *s.*

This happened when the Latin word *centum* (meaning "hundred" and pronounced *kentum*) became the old French *cent* (pronounced *tsohnt*) and then the modern French *cent* (pronounced *sohnt*). A shift in the other direction, backward on the palate from *ce-* to *tse-* to *ke-,* is quite unlikely. Given the terms *centum* and *cent,* and no other historical information about them, we could say that the sound of the Latin word makes it the older form, that the modern French form could have developed from it according to known rules of sound change, and that an intermediate pronunciation *tsohnt* probably existed before the modern form appeared. Both words are from the same Indo-European branch, Italic, which produced Latin and from Latin all the Romance languages, including French. Indo-European words for "hundred" from different branches of the language family can be compared in this way to see whether all can be derived from a single hypothetical ancestral word. The proof that Latin *centum* in the Italic branch and Lithuanian *shimtas* in the Baltic branch are related in this way, that they are cognates, is the construction of the ancestral root.

Root forms converge on one unique "root" sequence of sounds that could have evolved into all of them by known rules. The comparative method cannot force a regular reconstruction on an irregular set of sounds; for example, if terms in several branches have borrowed sounds from local languages, those borrowings might not fit the expected rules of regular sound change. For this reason, much of the Proto-Indo-European vocabulary, perhaps most of it, never will be reconstructed. Regular groups of cognates permit archaeologists to reconstruct a Proto-Indo-European root for the word "eye" but not for "eyebrow," for "snow" but not for "rain," and for "foot," but not for "hand." Proto-Indo-European certainly had such words, but we cannot safely reconstruct how they sounded.

Still, linguists have reconstructed the sounds of thousands of other words. A reconstruction based on cognates that survive in eight different Indo-European branches, like **k'mtom-*, the Proto-Indo-European root for "hundred," is much more reliable and probably more true than one based on cognates in just two branches. The accuracy of reconstruction has been confirmed by archaeology. Three separate archaeological discoveries of ancient inscriptions have provided opportunities to test whether the sounds that had been suggested by linguists for ancient phases of three Indo-European languages—Hittite, Mycenaean Greek, and archaic German—actually appeared in the inscriptions. In all three cases the linguists were proved correct.

For example, linguists working on the development of Greek had proposed **k*^{w} (pronounced like the *kw-* in "queen") as the ancestral sound that developed into Greek *t* before a front vowel or *p* before a back vowel. The reconstruction remained hypothetical until the discovery and decipherment of the Mycenaean Linear B tablets, which showed that the earliest form of Greek, Mycenaean, had the predicted *k*^{w}, where later Greek had *t* or *p* before front and back vowels. Such discoveries have confirmed that many reconstructed terms can be regarded as more than just abstractions.

The extent to which reconstructed terms can be thought of as real is the subject of debate. We should not imagine that reconstructed Proto-Indo-European was ever spoken anywhere. After all, it is fragmentary (and most of the language this reconstruction represents never will be known). The reconstructed language, which averages centuries of change, is homogenized, stripped of many of the peculiar sounds of its individual dialects. The same can be said of the English language as presented in *Merriam-Webster's Dictionary.* This dictionary contains the word "ombre" (a card game popular in the seventeenth and eighteenth centuries) as well as "hard disk" (post-1978). Thus, its vocabulary brings together about four hundred years of English. No person has ever spoken this version of English. Nevertheless, many of us find the dictionary useful as a guide to spoken English. Reconstructed Proto-Indo-European is similar—it might not be a true language, but it certainly *refers* to one.

If a reconstruction is based on a large and diverse set of cognates from both Europe and Asia and includes a cognate from an ancient language, the only conclusion we can draw is that such a term existed in the parent language. Proto-Indo-European is a partial grammar and a partial set of pronunciation rules attached to the abundant fragments of a very ancient dictionary. To an archaeologist, that is more valuable than a roomful of potsherds. The reconstructed vocabulary of Proto-Indo-European is a guide to the thoughts, concerns, and material culture of actual people.

THE PRIZE: THE RECONSTRUCTED VOCABULARY

The reconstructed vocabulary includes word clusters that suggest that the speakers of Proto-Indo-European were farmers and stockbreeders: we can reconstruct words for "bull," "cow," "steer," "ram," "ewe," "lamb," "pig," and "piglet." There is a term for "butter" and perhaps one for "cheese." When these people led their cattle and sheep out to the "field," they walked with a faithful "dog." They knew how to "shear wool," which they used to "weave" textiles. They tilled the earth with a scratch plow, or "ard," which was pulled by "oxen" wearing a "yoke." They turned their threshed grain into flour by "grinding" it with a hand "pestle," and cooked their food in clay "pots." They had "bees" and "honey."

They divided their possessions into two categories: items that could be moved and those that could not. In fact, the root for "movable wealth" (**peku-*, the ancestor of such English words as "pecuniary") became the term for "herds" in general. Terms for male family members suggest that they inherited their rights and duties through the father's bloodline (patrilineal descent). The absence of equivalent terms for the wife's family indicates that wives lived with the husband's family after marriage (patrilocal residence). "Chiefs" probably supervised political relations within their kin group, and there were formally instituted "warrior bands." A male sky deity ("sky father"), a thunder god, and a pair of sky twins were worshipped. Two senses of the sacred seem to have been recognized: "that which is imbued with holiness" and "that which is forbidden." Many of these practices and beliefs are simply unrecoverable through archaeology. The proto-vocabulary offers the hope of retrieving some of these details of ritual and custom. Reconstructed Proto-Indo-European is a long, fragmentary word list left by people who lived in a time and place unilluminated by any other kind of textual evidence. The list becomes useful, however, only if we can determine from where it came. To do that, we must locate the Proto-Indo-European homeland. First, however, we must know *when* Proto-Indo-European was spoken.

DATING PROTO-INDO-EUROPEAN: THE *TERMINUS POST QUEM*

A dictionary is dated easily by its most recent words. The *terminus post quem,* the date *after which* reconstructed Proto-Indo-European must be placed, can be established in much the same way, by the vocabulary. Words for things that were invented at a known date, such "wagons" and "wheels," can have existed in a language spoken only after that date. Proto-Indo-European began to split into different branches after the date indicated by these reconstructed words.

The most important words from this perspective are the reconstructed words for the basic tools (ard and pot) and products of agriculture (field, grain, cow, bull, calf, ram, ewe, lamb, milk, and cheese), for "wagons" and their parts, and for "wool." The agricultural vocabulary establishes that the speakers of Proto-Indo-European could not have been hunters and gatherers.

The term for "wool" provides a more precise date. The reconstruction is based on cognates in almost all branches from Welsh to Indic, so it certainly was in the vocabulary before the breakup into branches began. Wool sheep are mutants, bred to produce fleeces made entirely of the fine, curly fibers that wild sheep originally had just as an undercoat beneath their long, hairy coats. The best estimate is that wool sheep were bred in Mesopotamia about 4000 B.C. and then spread westward into Europe, eastward into Iran and India, and northward into the Caucasus Mountains and the Russian/Ukrainian steppes. From the wool perspective, Proto-Indo-European was spoken after 4000 B.C.

The vocabulary for wagons provides stronger guidance. At least five terms can be reconstructed with great confidence: two nouns for "wheel," another for "axle," a noun for "harness pole" (a "thill"), and a verb meaning to "go or convey in a vehicle." Cognates for these terms occur in all the major branches of Indo-European. Furthermore, all words but "thill" are based on recognizable Proto-Indo-European roots. For example, one reconstructed "wheel" root, **kʷékʷlos* looks very much as if it was created from another root, **kʷel-*, a verb that means "to turn." Thus, **kʷékʷlos* is not just a random string of phonemes; it is "the thing that turns." This kind of cross-referencing within a reconstructed vocabulary increases confidence in both reconstructions. Finally, most of the reconstructed "wagon" terms turn out to have a kind of vowel structure called an "o-stem" that generally is thought to identify a late stage in the development of Proto-Indo-European, so the vocabulary is internally consistent in its phonology. The speakers of Proto-Indo-European had wagons and talked about them using words of their own invention.

Based on archaeological evidence it is fairly certain that the wheel-and-axle principle was invented after 4000 B.C., probably after 3500 B.C. A track preserved under a barrow grave at Flintbek in northern Germany might have been made by wheels and might be as old as 3600 B.C. All other evidence for wheeled vehicles—written signs, artistic images, three-dimensional clay models, and wheels themselves—first appears in the archaeological record between 3500 and 3000 B.C. Thus, late Proto-Indo-European must have been spoken after 4000 and possibly after 3500 B.C. Before then, no language had words for "wagons" or "axles."

DATING PROTO-INDO-EUROPEAN: THE *TERMINUS ANTE QUEM*

Proto-Indo-European has been created on the basis of systematic comparisons of all of the known Indo-European daughter languages. The terminal date for the reconstructed language—the date after which our reconstructed form becomes an anachronism—should be related in some way to the separation of its oldest independent branches. If Proto-Indo-European is defined as the language that was ancestral to *all* of the Indo-European daughters, then it is the *oldest* reconstructable form. The later daughters did not evolve directly from Proto-Indo-European but from some intermediate, evolved set of late Indo-European languages that preserved aspects of the mother tongue and passed them along.

Internal evidence—the appearance within a branch of phonological archaisms and innovations not shared with other branches—helps identify the oldest branches. All of the branches cannot be placed with confidence in a sequence, but most linguists agree that Anatolian was the first branch to separate. It appears in the oldest known inscriptions in any Indo-European language, dated 1920–1820 B.C., at Karum Kanesh II in Turkey. Anatolian is so archaic and idiosyncratic that it must represent a very early stage in Proto-Indo-European. Italic and Celtic also seem archaic and should be included within the next set of branches to form, although their earliest inscriptions are much later, about 600–500 B.C. Reconstructed Proto-Indo-European becomes increasingly anachronistic after the set of separations that includes Italic and Celtic. Greek, documented in Linear B by 1450 B.C., probably split off from a more evolved set of Indo-European dialects and languages centuries after the dialects that led to Italic and Celtic. The sound changes that identify Indo-Iranian emerged after the separation of the Greek branch. Old Indic Sanskrit had emerged from

Indo-Iranian by 1450 B.C., the date of the oldest Sanskrit inscriptions in the Mitanni texts. Common Indo-Iranian must be older than 1450 B.C., at least as old as 1700 B.C.

The older separations—Greek, Italic and Celtic, and Anatolian—form a sequence that must predate 1700 B.C. Although their exact place in the sequence is debated, Germanic and Tocharian certainly also split away before Indo-Iranian. The latest possible date for Proto-Indo-European can be set at about 2700 B.C., leaving just a millennium—almost certainly not enough time—for the evolution of Anatolian, Italic, Celtic, Mycenaean Greek, Germanic, Tocharian, and Indo-Iranian. Long before 1700 B.C., the language that has been reconstructed as Proto-Indo-European had evolved into something else or, more accurately, into a variety of late dialects that continued to diverge in various ways in different places. By at least 2000 B.C., and probably long before, what we know as Proto-Indo-European was a dead language.

LOCATING THE HOMELAND

It has been proposed that Proto-Indo-European was spoken in Anatolia in about 7000–6500 B.C. and then spread through Europe and eastward across the Eurasian steppes with agriculture and animal herding. This idea is appealing, but it cannot be correct. It requires a breakup into daughter branches in about 6500 B.C., when the first pioneer Anatolian farmers migrated to Greece, with subsequent branch formations and separations as the farming economy was carried northward into temperate Europe between 6000 and 3000 B.C. By 4000–3500 B.C. the Indo-European language family should have been quite diverse, according to this proposal.

For this chronology to be correct, we would have to assume that the wool and wagon vocabularies were created long after the breakup of the Indo-European branches and then were borrowed into each daughter branch. Linguists generally have rejected this accommodation, however, because the vocabulary does not exhibit phonological traits indicating that it was created within a later Indo-European language. No other technical vocabulary is known to have been borrowed in a standardized form into the Indo-European daughter languages after they were scattered from Scotland to India—for example, the vocabulary for iron technology is quite diverse in the daughter languages. The linguistic evidence is against the Anatolia solution.

If not Anatolia, then where? Linguists have long tried to find animal or plant names in the reconstructed vocabulary that refer to species that lived in just one part of the world. The reconstructed term for "salmon," **lók*s,* was once famous as a proof that the Aryan homeland lay in northern Europe. Animal and tree names seem to narrow and broaden in meaning easily, however. They are even reused and recycled when people move to a new environment. The most specific meaning that linguists would now feel comfortable ascribing to the reconstructed term **lók*s-* is "trout-like fish." Most linguists agree that the fauna and flora designated by the reconstructed vocabulary are temperate-zone types (bear, otter, beaver, lynx, and horse), not Mediterranean (cypress, olive, and laurel) or tropical (monkey, elephant, palm, and papyrus).

"Bee" and "honey," however, are very strong reconstructions. The term for "honey," **medhu-*, also was used for an intoxicating drink that played a prominent role in Proto-Indo-European rituals. Honeybees are not found in northern Eurasia east of the Ural Mountains, across Siberia, because the hardwood trees (lime and oak, particularly) that honeybees prefer as nesting sites become rare east of the Urals. That removes all of Siberia and much of northeastern Eurasia from contention, including the Central Asian steppes of Kazakhstan.

The horse, **ek*wo-*, is solidly reconstructed and seems also to have been a potent symbol of divine power for the speakers of Proto-Indo-European. Although horses lived in small, isolated pockets throughout prehistoric Europe, they were rare or absent in the Near East, Iran, and the Indian subcontinent and were numerous and economically important in the daily meat diet only in the Eurasian steppes. The term for "horse" removes the Near East, Iran, and the Indian subcontinent from serious contention, and it encourages us to look closely at the Eurasian steppes.

Finally, we can use the information that the speakers of Proto-Indo-European were familiar with agriculture and herding. In the northern forest zone of Russia and the Baltic, economies based on fishing, hunting, and gathering were retained until after 2500–2000 B.C. The switch to herding and farming happened after 2000 B.C. in the Siberian forest zone east of the Urals. That, too, eliminates Siberia and Kazakhstan and casts doubt on the Russian-Baltic northern forest zone. We are left with temperate Europe and the western steppes and perhaps the temperate parts of the Caucasus Mountains and Anatolia.

WHO WERE THE NEIGHBORS?

The neighbors of the speakers of Proto-Indo-European can be identified through words and forms borrowed between Proto-Indo-European and other language families. Proto-Indo-European shows strong links with Proto-Uralic, a key ancient language of the northern Russian forests, and weaker links with a language ancestral to Proto-Kartvelian, spoken in the Caucasus Mountains. Proto-Indo-European and Proto-Uralic shared two kinds of linkages. One, revealed in shared pronouns, noun endings, and basic vocabulary could be ancestral: the two proto-languages seem to have shared an ancient common ancestor, perhaps spoken by Ice Age hunters east of the Carpathians. The relationship is so remote, however, that it can barely be detected.

The other link between the two languages seems cultural: some Proto-Indo-European words (to wash, water, to give, merchandise, to fear) were borrowed by the speakers of Proto-Uralic, perhaps through a shared trade jargon. The fact that the reconstructed roots are similar in phonological form and meaning indicates that they were loans rather than inheritances.

These two kinds of linguistic relationship—a possible common ancestral origin and interlanguage borrowings—suggest that the Proto-Indo-European homeland was situated near the homeland of Proto-Uralic. Uralic is a broad language family, like Indo-European. Its daughter languages are spoken across the northern forests of Eurasia from Finland to the Siberian Pacific. The Proto-Uralic homeland is thought to have been in the southern part of the forest zone near the Ural Mountains. Many researchers believe that the best case can be made for a homeland west of the Urals, and some argue for the east side. Almost all agree that Proto-Uralic was spoken in the forests between the Oka River on the west and the Irtysh River on the east, probably before the adoption of a herding economy (2500–2000 B.C.). This leaves a possible contact zone south or southwest of the Ural Mountains.

Coincidentally, this is the direction in which we find the second neighbor. Proto-Indo-European interacted with the languages of the Caucasus Mountains, primarily those that are classed as southern Caucasian or Kartvelian, the family that produced modern Georgian. Many terms have been proposed as loanwords to Proto-Indo-European from Proto-Kartvelian (and even Semitic). The few such loanwords that are widely accepted (such as those for "silver" and "bull") might be words that were carried along trade and migration routes far from the Semites' Near Eastern homeland. The phonology of the loans suggests that none of these language contacts was direct—all of the loanwords passed through unknown intermediaries between the known three. One intermediary is required by chronology, since Proto-Kartvelian generally is thought to have existed *after* Proto-Indo-European and Proto-Semitic.

Who, then, were the neighbors? Proto-Indo-European exhibits strong links with Proto-Uralic and weaker links with a language ancestral to Proto-Kartvelian. The speakers of Proto-Indo-European lived between the Caucasus and Ural Mountains but had deeper linguistic relationships with the people who lived around the Urals. The region between the Caucasus and the Urals is the Russian and Ukrainian steppe—a place long identified as a strong candidate for the Indo-European homeland. Does contemporary archaeology support this solution?

THE ARCHAEOLOGY OF THE PROTO-INDO-EUROPEAN HOMELAND

In the North Pontic region, north of the Black Sea, the first farmers were Criş culture pioneers who migrated from southeastern Europe and the Lower Danube Valley. Their arrival created a cultural frontier northwest of the Black Sea in modern Ukraine, between the Dnieper and Dniester Rivers, that persisted for 2,500 years, from about 5800 to 3500 B.C. Two distinct cultural systems existed side by side, east and west of the Dnieper-Dniester frontier. Substantial differences in material culture distinguished the immigrants and their cultural descendants (Criş, Linear Pottery, and Tripolye) from the indigenous societies and their cultural descendants (Dnieper-Donets, Mariupol, Sredny Stog, and Yamnaya). The two traditions differed in house forms; settlement types; economy; ceramic style, decoration, and technology; stone tool types; mortuary rituals; the presence or absence of female figurines; and metallurgical techniques—in other words, they maintained distinctions in almost every aspect of material culture for millennia.

Another persistant cultural frontier coincided with an important ecological frontier. It separated the foragers of the northern forest zone west of the Ural Mountains, the probable Proto-Uralic homeland, from the cattle herders and sheepherders to the south, in the Pontic-Caspian steppes. This economic-ecological frontier, too, persisted for 2,500 years, from about 5000 to about 2500 B.C. A bundle of cultural distinctions defined the forest/steppe frontier, including variations in house forms, pottery types, stone tools, and burial practices.

Finally, on the eastern edge of the Pontic-Caspian steppes there was yet a third clear and persistent cultural frontier, a north-south line extending from the southern slopes of the Ural Mountains to the deserts north of the Caspian Sea. Long after herding was adopted in the Pontic-Caspian steppes (about 5000 B.C.), the societies of the Kazakh steppes to the east remained foragers—such groups as the Atbasar, Surtanda, and Tersek-Botai. They made quite different kinds of pots and stone tools, did not use cemeteries, and had distinctive house forms. Like the first two frontiers, this one persisted for at least 2,500 years, until about 2500–2000 B.C. In all three cases it is clear from published archaeological reports that the cultures on either side of the frontiers knew and interacted with each other, but rather than assimilating, they remained distinct for millennia.

The historic cases cited earlier suggest that these material-culture frontiers almost certainly were linguistic frontiers as well. They surrounded and enclosed precisely the region identified in other ways as the probable Proto-Indo-European homeland. While we should not make the mistake of assuming that *all* of the people of the Pontic-Caspian steppes were Indo-European-speakers, we can safely suppose that Proto-Indo-European was spoken *somewhere* in the Pontic-Caspian region between 4000 and 2000 B.C.

Archaeology thus reveals a set of cultures in this region at this time that fits all of the requirements of the reconstructed vocabulary: they sacrificed horses, cattle, and sheep; cultivated grain at least occasionally; drove wagons; and expressed institutionalized status distinctions in their funeral rituals. They occupied a part of the world, the steppes, where the sky is by far the most striking part of the landscape, a fitting environment for people who believed that their most important deities lived in the sky. Archaeological evidence for migrations from this region into neighboring regions is well established. The sequence and direction of these movements match those suggested by linguistics. Two movements toward the west could represent the detachment of the pre-Anatolian (Cernavoda I into the eastern Balkans) and then the pre-Italic/pre-Celtic dialects (Yamnaya into eastern Hungary), followed by a third movement toward the east (Sintashta-Petrovka) that could represent the detachment of Indo-Iranian. The archaeology of the region provides a new window onto the lives of the people who spoke Proto-Indo-European and the process by which it became established and began to spread.

See also **Celts** (*vol. 2, part 6*); **Germans** (*vol. 2, part 6*); **Etruscan Italy** (*vol. 2, part 6*); **History and Archaeology** (*vol. 2, part 7*); **Dark Age/Early Medieval Scotland** (*vol. 2, part 7*); **Early Medieval Wales** (*vol. 2, part 7*).

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DAVID W. ANTHONY

WARFARE AND CONQUEST

FOLLOWED BY FEATURE ESSAY ON:

Warfare has been defined in both broad and narrow terms. In the broad view, warfare is armed conflict between any social or political units. In this view, societies as diverse as bands of Mesolithic hunter-gatherers, Neolithic farming tribes, Celtic high chiefdoms, petty states, and the Roman Empire can conduct war. The narrow definition confines war to state-level societies—those with the hierarchical organization to centrally direct armies that are led by, if not consisting wholly of, full-time military specialists. This constricted view is historically misleading and anthropologically absurd. Roman legionnaires routed and killed by warriors of a Celtic hill tribe were just as vanquished as those beaten by a Persian army. Indeed, it took the Romans more time and manpower to conquer the small Celtiberian tribes of northern Spain (four to six legions and two hundred years of continuous fighting) than it took them to subdue Macedonia and Greece (two to four legions and, in total, about twenty years of intermittent combat). Under the narrow definition, the very terms "prehistoric warfare" and "tribal warfare" are oxymorons, which means that recent tribes such as the Apache, Maori, and Taureg never made war. For many reasons, then, the broad definition is preferable and is used here.

Archaeological evidence for warfare is recovered in four categories: human remains; fortifications; weapons and armor; and artistic representations. Only when classical authors begin to describe warfare of their societies with the so-called barbarians of more northerly Europe were there written accounts to supplement the physical evidence revealed by archaeology.

HUMAN REMAINS

Human remains often bear witness to the traumas caused by weapons. These include sword cuts, the indentations made by stone axes and adzes, and depressed fractures made by maces or other blunt-force weapons. The most common type of weapon traumas found on victims of early warfare are embedded stone or bone projectile points. Any of these types of traumas can be considered the cause of death, especially when there are no signs that the wound healed.

Archaeological evidence for warfare can also be seen in the treatment of the body after death. Bodies of war victims were often left where they fell or dumped into mass graves. Bodies that were not buried soon after death often suffered mutilation by animal scavengers. War victims were also mutilated in the course of hostilities. One common type of perimortem (i.e., about the time of death) mutilation is known as "overkill," which involves striking the victim with numerous blows or multiple projectiles—

any one of which would have been fatal. Another kind of mutilation involves the taking of war trophies—heads, hands, or other body parts—leading to burials with either too few or too many body parts for the individual interred. There is also sometimes evidence for cannibalization of the victims. These types of mutilation suggest that the victors wanted to either humiliate their victims or to acquire the victim's spiritual power.

When these stigmata co-occur, warfare was the certain cause. For example, more than 6,000 years ago, at the Early Neolithic site of Herxheim, Germany, more than three hundred people died violent deaths. Crania from these individuals were discovered at regular intervals in the two defensive ditches enclosing the site, indicating that victims were decapitated and their skulls thrown in the ditch or placed atop posts that later collapsed into the ditch. The crania bore traumas from axes and some type of blunt weapon. The Herxheim skulls thus evidence all of the signs commonly found on war victims—weapon traumas, mutilation, trophy taking, and atypical disposal of the dead.

Palaeolithic and Mesolithic. The bones of early European hominids show many healed and unhealed traumas. For example, Neanderthals seem to have been particularly accident-prone. But before the widespread use of stone and bone projectile tips by modern humans in the Upper Palaeolithic (c. 40,000–35,000 years ago), it is very difficult to determine whether these traumas were caused by human violence or other more prosaic causes. Evidence of homicide appears as soon as modern humans appear in Europe, such as the Grimaldi, Italy, child with a bone projectile point embedded in its spine (c. 32,000 years ago) and the mass grave of twenty individuals with head traumas at Predmost.

The appearance of true cemeteries consisting of many primary burials during the Mesolithic (c. 9600–4300 B.C.) increases the archaeological visibility of homicide and warfare. In France, Italy, Germany, Scandinavia, and the Ukraine, between 3 and 16 percent of the bodies excavated were of individuals with embedded projectile points. (By comparison, 3.3 percent of the French met violent deaths during World War I.) Evidence for trophy taking comes from the Late Mesolithic site at Ofnet Cave (7500 B.C.), in Germany, where two caches containing a total of at least thirty-three skulls were found, arranged "like eggs in a basket." Most of these crania had multiple holes knocked in them by stone adzes and many still-articulated neck bones showed marks from throat cutting. These men's, women's, and children's skulls were probably "trophies" from a single massacre. Smaller caches of skulls and associated neck vertebrae bearing similar traumas have been found at three other Late Mesolithic sites in Germany and northern France (Hohlenstein-Stadel, Kaufertsberg, and Mannlefelsen). These and other finds indicate that the economic and social landscape of Mesolithic Europe was highly disputed and violent. This evidence is clearly contrary to oft-repeated claim that foragers were peaceful and warfare only began with farming.

Neolithic. In the Neolithic period there is plentiful palaeopathological evidence for warfare. The skeletons of at least 6 percent and possibly more than 19 percent of Early Neolithic individuals of the *Linearbandkeramik* (LBK or Linear Pottery culture) exhibit traumas indicating a violent death. At Talheim, Germany, thirty-four bodies bearing weapons traumas were dumped haphazardly into a large pit. Like the skulls from Ofnet Cave, many of these were perforated, often several times (an example of overkill), with D-shaped holes of a type that could only have been made by a groundstone "shoe-last" adze of LBK design. The demography of the victims implies that an entire small village was killed, although there seem to be fewer young women among the victims than expected, possibly because they were taken as captives.

At Schletz-Asparn, Austria, an enclosed Early Neolithic (LBK) village was destroyed, along with most of its population. Archaeologists have recovered the fragmented skeletons of some one hundred people. Many skulls had fatal axe or club wounds, and there was evidence of animal gnawing, indicating that the bodies were simply left where they fell and that there was no one left to bury them. Only later were the partially disarticulated remains cast into the enclosing ditch and covered with earth. The clear underrepresentation of young women in the skeletal remains suggests that women were carried away, whereas the others were simply killed. Talheim, Schletz-Asparn, and the aforementioned Herxheim, alone, evidence the violent deaths of more than 500 LBK individuals, which—compared to the 1,500 or so excavated LBK burials showing no evidence of violent death—indicate that this period was particular bellicose.

There are also indications of clashes between Early Neolithic farmers and the Late Mesolithic hunter-gatherers living beyond their zones of settlement. Refuse pits at the LBK site of Vaihingen, Germany, contained a number of skeletons, often bearing violent traumas, whose physical features were more robust (that is, Mesolithic) than those of the villagers. In southern France, a few skulls bearing the hallmarks of decapitation were discovered on an Early Neolithic site of the Cardial culture. These skulls were more similar to the inland Mesolithic populations of that region than they were to the Cardial farmers. This suggests that, like the Mesolithics before them, and the contemporary LBK farmers of Herxheim, Cardial warriors sometimes collected the skulls of their enemies as trophies.

Further evidence of warfare comes from later Neolithic sites in Britain. At least two of them were attacked by archers and burned. The body of one man was discovered in the enclosure ditch at Hambledon Hill. He had fallen after being shot in the back with an arrow, crushing an infant he was carrying beneath his body. The burned palisade subsequently collapsed on them both.

During the Middle and Late Neolithic, the archaeological visibility of weapon traumas decreases, but that does not mean that armed violence was less prevalent. Almost all the famous Neolithic megalithic and tumulus-mound tombs in western Europe were plundered of their contents, including human remains, before archaeologists could investigate or record them. In other parts of Europe, the common later Neolithic practices of cremation and secondary burial (burial after the bones had been disarticulated, defleshed and partially destroyed by exposure to weather and animal scavengers) prevent or severely hinder analyses of cause of death. The exceptions indicate that warfare was often virulent during these periods, and this is supported by the prevalence of fortifications and specialized war weapons (see below).

The famous Tirolean "Iceman" mummy, an individual of the Late Neolithic (c. 4000 B.C.), was a casualty of war. Embedded in his back, just below the shoulder joint, was a stone projectile point. This lethal projectile was of a large, shouldered design that was very different from the small, triangular arrowheads the man carried. The design of the embedded projectile would have been difficult to remove after penetration, possibly a specialized war point. Evidence of similar deaths have been found at other sites dating to the Late Neolithic. At a mass grave at Roaix, France (c. 2500 B.C.), more than one hundred persons of all ages and both sexes, often with arrow points embedded in their bones, were simultaneously buried.

Bronze Age. Although cremation and secondary burial remained common in many areas, examples of traumatic injuries and mutilation are known from several Bronze Age sites. At the site of Hernádkak, Hungary, a male skeleton was found with a bronze spearhead embedded in his pelvis. A massacre is evidenced at the site of Velim, Czech Republic (c. 2000–1700 B.C.), where the fragmentary skeletal remains of dozens of individuals who died from traumatic injuries were found. All sexes and ages were represented, and some of the their bodies appear to have been cannibalized. A number of Bronze Age burials in Hungary are missing hands and feet, possibly taken as war trophies. Some prehistorians believe that trepanation holes found on some Bronze Age skulls were attempts to treat battlefield head injuries.

In the Late Bronze Age (1700–1400 B.C.) cremation becomes the almost universal burial custom in Europe. Thus, if human physical remains provided the sole line of evidence, the Late Bronze Age would seem quite peaceful compared with earlier periods. Nonetheless, female skeletons bearing weapons traumas were found at Wicnica, Poland, and there is evidence for cannibalism from the cemetery at Velatice in the Czech Republic, where the fragmentary remains of 205 individuals were found in association with one (cremation) urn burial. Despite the dearth of remains, other archaeological evidence (see below) has convinced archaeologists that this was a period of frequent warfare and destruction, especially in eastern and central Europe.

Iron Age. Well-preserved Iron Age skeletons are rare in many areas of Europe. Most of the tumulus burials of the Early Iron Age were looted before they could be investigated. Less vulnerable "flat burials" from later in the Iron Age have been excavated and analyzed, but most seem to involve only exceptional elites. In any case, burial customs were quite varied, with cremation and exposure common in many periods and regions. At a number of burial sites in east Yorkshire, of 107 male skeletons analyzed, three had died of sword cuts. One of those buried at the great hillfort of Maiden Castle in England had been killed by a Roman ballista bolt during the Roman conquest.

In the middle of the Iron Age, the warriors of prehistoric Europe came into open conflict with their "civilized" neighbors to the south. As a result, the Celts were among the first Europeans north of the Alps mentioned by classical authors (after 550 B.C.). These accounts recorded their prowess in war, the weapons they employed, and the tactics they preferred. Especially horrifying to Romans was their taking and displaying of heads from enemy dead. Diodorus Siculus states that warriors would "embalm in cedar oil the heads of the most distinguished enemies and preserve them carefully in a chest to display them with pride" (in Ellis 1990). In addition, these were often nailed above the door of the victorious warrior's hut. At Entremont, France, a third century B.C. fortification, a stone shrine with niches for displaying trophy skulls was found along with fifteen such skulls with nail holes for attachment. Similar trophy skulls and one other shrine with skull niches (from Roquepertuse) have been found at other Iron Age sites in the region.

FORTIFICATIONS

Fortifications are one of the most readily identifiable archaeological indicators of the possible presence of warfare during any period. Fortifications—often euphemistically called "enclosures"—are large-scale constructions that allow a relatively small number of defenders to repel forces that greatly outnumber them. The most common features of early fortifications include curtains (wooden palisades or walls of stone or earth enclosing a settlement or blocking its most vulnerable access routes), ditches in front of the curtains, bastions (projections of the curtain from which flanking fire can be directed along the curtain), and defensible gates designed to obstruct attackers and put them under fire from several directions.

Neolithic. Because of the smaller size of coresident groups and a more nomadic way of life, no fortifications attributable to Mesolithic or earlier foragers have been discovered. On the other hand, Neolithic and later fortifications are very common throughout Europe. They are first seen in the southeast at Early Neolithic sites such as Sesklo, Dimini, and Danilo. The earliest fortifications in central and western Europe appeared when early farmers of the LBK culture colonized these regions. There are now almost one hundred known LBK fortifications, and more are found each year. They date to all phases of the culture, although they are more prevalent in the later phases in the west. While many LBK fortifications appear to have been built to counter short-term threats, some sites, such as Schletz, Eisleben, and Köln-Lindenthal, evidence multiple phases of use. LBK villages were usually not located in locations with natural defenses. As a result, man-made features were needed for protection. These included one or two ditches backed by a fireproofed (daubed) palisade, baffled or screened entrances, and (rarely) gate houses or towers. These elements are surprisingly sophisticated, as they can all be found in fortifications up until the age of gunpowder. Their sudden appearance implies that LBK farmers had inherited an older tradition of building and refining defensive works.

The defensive works at Darion and Waremme-Longchamps, both in Belgium, are typical LBK fortifications. Ditches backed by palisades enclosed both villages. The entries into the palisades were protected by two methods. At Darion's north gate, a gate tower projects out from one side of the entrance. At Longchamps, a small "guardhouse" flanked the south gate but projected inward. Also at the south gate, both the ditches and palisades overlap forming a "baffle" (known to Roman military engineers as a *clavicum*). A similar design was employed at Darion's south gate, but only the palisades were "baffled." Attackers entering such gates had to expose themselves to fire from their unshielded (i.e., usually right) side and/or rear. The ditches fronting LBK palisades may have simply been large "borrow pits" from which mud was extracted to fireproof the palisade. However, their cross-section was often V shaped—particularly near the vulnerable gate areas—and they were two meters deep and three meters wide in some places, so they would have offered protection even without the palisade. Indeed, the Romans defended their forts with exactly similar

V-sectioned ditches of 1.2 to 3.5 meters deep that they called *fossae fastigata*. Another form of defended gate used during the LBK was the screened gate (as is seen at Köln-Lindenthal), known to Roman military engineers as the *titulum,* where a section of the palisade sat out or in from the main palisade to form a double baffle entry. Cardial farmers in south and southwest Europe, contemporaries of the LBK, also surrounded some of their settlements (such as Masseria Candelero, Italy) with ditches, sometimes with baffled ("crab-claw") gates.

In some cases, Early Neolithic fortifications were so large that it seems unlikely that the number of people living within them could have constructed them. For example, English Early Neolithic fortifications were estimated to have required over 100,000 man-hours to construct. The smaller fortifications at Darion, with only about twenty adults, would have needed about 1,700 man-days to build. Several cooperating villages must have constructed these, either as a central refuge for several nearby communities or as frontier protection for villages to the interior.

By the end of the Neolithic, in the Copper Age, regularly spaced bastions were a feature of several stone-walled fortifications, such as Chalandriani (Greece), Boussagues (France), Los Millares (Spain), and Zambujal (Portugal).

Bronze Age. Although nearly all of the fundamental features of subsequent fortifications were in use by the end of the Neolithic, fortifications continued to increase in size and number during the Bronze Age. After 4200 B.C., there was a general growth of fortifications across Europe as groups competed for resources and control of trade routes. Hillforts protected by a ditch and earthen rampart begin to make their earliest appearance in this period, as at Hradisko, Slovakia. There seem to have been few fortifications in northwest Europe during the Early Bronze Age.

During the Middle Bronze Age, much of the European continent was unfortified. Sites that had been fortified during earlier periods were still inhabited, but their defenses were either absent or in disrepair. Refuge fortifications are known from Italy, and the site of Prítluky, Slovakia, was enclosed in a double ditch and rampart. The greatest fortifications, however, appeared late in the Middle Bronze Age, with the rise of the Mycenaeans. The defenses of the Aegean palaces at Mycenae, Tiryns, and Pylos, had "Cyclopean" walls, so called because the stones used to construct them were so large that the mythological Cyclops would be needed to move them.

In the Late Bronze Age, there was an increase in the number of fortifications across Europe. The first Europeans to routinely construct hillforts were the Urnfield cultures. Some Urnfield sites were simply palisaded while others were enclosed in multiple walls and ramparts. The majority of Urnfield fortifications are in Germany, but they can also be found in southern and central Europe.

Fortifications with wall-and-fill (or "box") ramparts appear in Europe in the earliest Hallstatt phases of the Late Bronze Age. The method of construction involved building a facing wall of durable material—wood pilings, stone, or sod—and another wall two to three meters behind it. In some cases, the rear wall is tied to the face with transverse timbers, as at Poundbury in Dorset. The area between these walls was then filled with either spoil from the ditches fronting the wall or from quarries elsewhere. Box ramparts were relatively high yet resistant to slumping. They continued to be built until the ninth century B.C. and even later in some places in Britain. The rampart at Biskupin, Poland, also incorporated posts anchored into the outer slope at a 45° angle forming a kind of *chevaux-de-frise*. Gate areas were sometimes baffled, as at Seftenburg and the Wasserburg in Baden-Württemberg and the Mycenaean palace at Tiryns, but major advances in gate defenses came later in the Iron Age.

Around 1250 B.C. the defenses of the Mycenaean strongholds were strengthened, implying imminent conflict, but these improvements were apparently insufficient. By 1200 B.C. many sites bordering the Mediterranean were attacked, destroyed, and abandoned. Unfortified sites in Sicily were destroyed and subsequently rebuilt as fortified settlements by culturally different inhabitants. On the island of Sardinia, large stone refuge fortifications with massive walls and bastions, called *nuraghi,* first made their appearance at about this time. The wave of site destruction swept through the eastern Mediterranean as far as the mouth of the Nile. Its cause is still being debated.

At the same time, hillforts appeared in Italy, Ireland, and Romania. The people of the Swiss lakes region continued to utilize terrain to the best effect, locating their villages on islands or promontories and often enclosing them with substantial walls. In Ireland, artificial island strongholds, crannogs, were constructed.

Iron Age. Throughout the Iron Age, hillforts gradually increased in size, number, and complexity, particularly with regard to their entrances. Many hillforts—both on the Continent and in Britain—fell into disrepair around the middle of the first millennium B.C., suggesting some type of social collapse, only to be reoccupied by different peoples during later periods. By the sixth century B.C., hillforts on the Continent began to show the influence of classical Greece and Greek colonies, which resulted in square-bastioned fortifications such as Heuneberg, Germany, and Entremont, France, which are imitations of Greek fortifications.

The seventh century B.C. seems to have been a period of great unrest in northern Britain. Great hillforts were constructed, and farmsteads were fortified with stockades, suggesting that raiding was prevalent. In Scotland and Ireland, circular drystone towers called *brochs* began to appear, over fifty of which still survive. One of the earliest, Clickhimin, developed from a fortified farm. Two of the highest are Dun Troddan (7.6 meters) and Mousa (13.7 meters). Staigue Fort, in Ireland, was 3.9 meters high and over 24 meters in diameter and had rooms built within the thickness of the walls.

Fortifications with "dump" ramparts first appeared around the fifth century B.C. Although the term "dump" implies haphazard construction, these ramparts were carefully laid. Generally, these curtains were unfaced, but their thickness and the shallow angle of the ramparts prevented slumping.

The gates of hillforts evolved throughout the first millennium B.C. The earlier examples had simple bent outset gates that formed a small courtyard, within which was the gate proper. Over time, entrance passages became longer and more complex. Whereas earlier entrances at sites like Ivinghoe Beacon were only 3.4 meters deep, later passages were lengthened to over 40 meters—the then-effective range of bowshot. Later, flanking guard chambers were added to the passageway. In some hillforts, gated barriers at the beginning and middle of the passageway reinforced this position. In the latest examples of Iron Age fortifications, entrance passages were lengthened to 45 meters and were curved at the interior end so that the gate was not visible from the exterior of the fort (as is seen at Painswick Beacon, England). Curving the entrance passage inhibited the use of fire arrows against the wooden gate or the use of battering rams. Bridges over the guard chambers, implied by the footings at Rainsborough and Titterstone Clee, subjected gate attackers to fire from above as well as both flanks. Gate screens or barbicans also came into use.

The zenith of prehistoric fortifications were the large Celtic hillforts, or *oppida,* which even Roman generals described with respect. By the middle of the first century B.C., some fortifications had developed into massive hilltop edifices like Alesia, which took Caesar's legions weeks to reduce. Against attackers armed with only short-range weapons such as the bow, sling, and spear, lacking siege engines and artillery, such *oppida* must have been nearly impregnable. This explains the relative absence of evidence that they were attacked until the Roman conquest. Many *oppida* enclosed so many inhabitants and such diverse activities that they have been described as "protourban centers"—that is, more like walled towns than just refuges or forts. For example, cities such as Paris, Toulouse, and Colchester began as *oppida.*

WEAPONS AND ARMOR

The earliest known weapons of war were made of stone, wood, and bone. While used for more prosaic purposes, axes, adzes, mallets, knives (of stone or bone), and hunting weapons such as bows, throwing or thrusting spears, and slings were all employed to kill humans. As noted above, embedded arrow points and weapon traumas from knives, axes, and clubs have been found on the skeletons of Upper Palaeolithic and Mesolithic foragers.

Neolithic. During the Neolithic, the evidence for "purpose-built" weapons of war is at best circumstantial. Weapon traumas on victims indicate that the primary weapons of Early Neolithic warriors were the bow and arrow and the groundstone axe/adze. LBK arrowheads were large triangular points that would have been difficult to withdraw, while their lack of a stem made them likely to slip off the shaft when the arrow was extracted and remain to infect the wound. Food remains indicate that LBK farmers almost never hunted, so these points, as their design suggests, may have been purpose-built for warfare. Indeed, skeletons from this period bear embedded LBK arrowheads. These points are most prevalent in western LBK distribution, where other evidence for warfare is also common. The ubiquitous groundstone adzes of the Early Neolithic are often assumed to have been used solely for woodworking. As mentioned above, the perforated skulls of many war victims indicate that these tools were also used as weapons. Further proof is found in the fact that axes are found as grave goods in LBK adult male burials. Historically, prowess in war and the wielding of weapons was a much more common source of male status than skill at carpentry.

Bronze Age. How metallurgy appeared in Europe is still a matter of debate. Whatever its origin, Europeans immediately and most commonly used these new materials to make weapons.

Purpose-built weapons of war are among the earliest of metal artifacts. The first of these were triangular-bladed daggers with round pommels produced during the Chalcolithic by the makers of beakers. This form continued to be used for weapons and ornaments up until the Iron Age. Improvements in metal technology were signaled by the appearance of the Bronze sword in about 2300 B.C. Initially, these were short leaf-bladed weapons, heavily weighted toward the point and used to slash, but as knowledge of metalworking improved they became longer and slimmer. By the middle of the Bronze Age, true cut-and-thrust swords had been developed in central and eastern Europe, while rapier-like slashing swords were developed in the Aegean. The cut-and-thrust sword did not reach the Aegean (where early weapons show ties to Anatolia) until the Late Bronze Age. The first metal lance heads also appeared around 2300 B.C. They consisted of a dagger-like head with a long tang for attaching it to the shaft. The socketed spear tip followed shortly thereafter. These spears outnumber swords ten-to-one, suggesting that they were the primary weapon of common soldiers. It was not until the Late Bronze Age that bronze was used to create heads for arrows and javelins.

A major change in the way that war was waged arrived in central Europe with the Battle-Axe culture: the war chariot. By the Early Bronze Age, war chariots are known from Moravia, Slovakia, Hungary, and Transylvania. Early chariots were typically heavy carts, more like wagons than the graceful two-wheeled vehicles depicted in later art. Nevertheless, they enhanced the mobility of an army, allowing it to flank less-mobile opponents. They also increased the firepower of charioteers because they allowed more projectile weapons (arrows, javelins, etc.) to be brought rapidly to the front lines.

As weapon technology progressed, so did the need for more advanced personal defense, meaning metal body armor. The existence of baffled gates that force a warrior to expose his unshielded side implies that shields had been in use from the Early Neolithic. Early shields were undoubtedly made from perishable materials such as wood, bone, and treated leather. Early body armor made from such materials is known from the second millennium B.C. in the form of a boar tusk corselet from Aegina, Greece. Armor continued to be made from such perishable materials even in the metal ages because they were relatively inexpensive. No helmets are known before the Late Bronze Age, although they surely existed prior to that time.

Bronze armor was developed first in the Aegean and was unknown in Europe until about 1200 B.C. Armor dating from this time was discovered in a chieftain's grave in Caka, Slovakia. An early example from Dendra, Greece, consisted of bronze greaves (leg armor) and arm guards, and boar's tusk helmets, similar to those of Anatolia. By the Late Bronze Age, Aegean military equipment, such as the round shield, shows more of a central European character. By around 1000 B.C., European armor had assumed the basic forms it would keep with only minor variations for the next 2,000 years. For example, Urnfield warriors wore a bronze breastplate, greaves, and conical helmet with top knob and cheek guards, and they carried a round wooden shield sheathed in leather and sometimes bronze.

Iron Age. Iron was first worked in western Anatolia around 2000 B.C. By 1500 B.C., it was displacing bronze in that region for tools and, especially, weapons. Ironworking reached the Aegean around 1250 B.C., taking another 550 years to spread to the Britain.

In the eighth century B.C. there was an increase in iron usage in eastern and central Europe. In central Europe, it was associated with the early Celtic cultures of Hallstatt C and D. They were skilled ironworkers, producing a variety of iron weapons and tools, from socketed axes to billhooks. Their iron swords and spears were superior to the weapons of all but their southern neighbors. Not surprisingly, the well-armed warrior elite of the Late Hallstatt controlled riverine trade routes of central Europe and established trade ties with the Greeks to the south.

Later La Tène Celts developed a number of specialized modes of combat. They continued the development of chariot and mounted warfare, becoming the most formidable cavalry Europe had yet seen. Their armies were highly mobile, and their two and four wheeled chariots (*essenda*) gave them the advantage over all but the most disciplined and well-armed infantry. Elite chariot burials have been found across Europe. By the time of Caesar's conquest, chariots had gone out of fashion in combat on the Continent, but they were still so used in Britain.

Celtic warriors employed a wide array of weapons: arrows, javelins, short- and long-bladed swords, and—in Iberia—the *falcata,* a heavy cleaver-like weapon that the Roman historian Livy claimed could sever a head or a limb in a single stroke. Slings were almost certainly used much earlier but the "ammo dumps" of sling stones found beside Late Bronze and Iron Age fortifications, such as Maiden Castle, are the first clear evidence of their use in Europe. Both mounted and chariot-borne troops utilized javelins. They would rapidly advance, release their missiles, then retire to safety. The Celtiberians of Spain used a short stabbing sword, the *gladius,* so effectively against the Romans that the latter adopted it as their legions' principal weapon. Celtic warriors used long shields of an oblong or rectangular shape and wore horned or plumed metal helmets. A few of these have survived, although some were so fragile they were more theatrical than protective. Ornate "jockey cap" helmets with gold plating and coral inlays, such as the splendid fourth century B.C. examples from Amfreville and Agris, France, are known from the La Tène period.

The Celts' best warriors, called *gaesatae,* wore torcs, thick-braided circlets of metal, around their necks. *Gaesatae* usually fought naked, sometimes with their bodies painted blue with dye made from woad (a type of herb), in the front ranks of Celtic armies. Because of their reputation for ferocity, they were hired as mercenaries into many Mediterranean armies. According to classical authors, the Celts preferred to settle conflicts in single combat between opposing leaders or champions. The long blunt-ended swords, useful only for slashing, that equipped most Celtic warriors reflected this predilection for single combat. Because of their longer reach, these were best in open, uncrowded combat, but unwieldy in crowded close quarters, as the closed ranks of Roman Legions with their stabbing swords would demonstrate in many battles.

ART

Although rare, representations of homicide exist from the Palaeolithic onward, and depictions of warfare date from the Neolithic. They were created in every medium—paintings on cave walls and ceramics, sculpture, and engravings in stone, bone, ivory, and metalwork. Artistic representations are not photographs and do not always represent actual events, nor is their incidence directly related to the frequency or severity of actual conflict. Nonetheless, they do indicate that artists and audiences of the time were familiar with warriors, weapons, and combat.

One of the earliest depictions of warfare is from the Early Neolithic site of Morella la Villa–Cueva del Roure in Spain (c. 4900 B.C.). It shows combat between two groups of archers, one of four, the other of three. The larger group is both advancing in the center while flanking the smaller group on its more vulnerable right side. This painting indicates that even Neolithic warriors had knowledge of rudimentary tactics. There are other Neolithic conflicts depicted in Spain—eleven archers confronting nine at Les Dogues, fifteen archers opposing twenty at El Molino de las Fuentes. Several Bronze Age Scandinavian rock art scenes show groups of warriors with spears fighting on land and from ships. With the arrival of the Battle-Axe culture, images of chariot warfare appear in European art.

Beginning with the Hallstatt cultures, the number of objects decorated with martial scenes dramatically increased. In part, this is due to the more durable media on which they were recorded. Copper, bronze, gold, and iron were all used to depict Celtic warriors, their equipment and tactics. Early Celtic bronze drinking bowls typically depict scenes of warfare. The Hallstatt D (c. 530 B.C.) burial couch from Hochdorf, Germany, is decorated with warriors riding on wagons and three warriors brandishing swords and shields. Similar bowls from Steiermark, Austria, and Certosa, Italy, depict Celtic warriors with axes, spears, oblong shields, and rounded helmets. The Vix krater (wine mixing bowl), a Greek import found in a tomb in France, shows infantry and charioteers. In addition to its skull shrine, the site of Entremont provides further evidence for the Celtic obsession with trophy heads in the form of a sculpted pile of severed human heads.

Classical authors testify to the accuracy of the depictions on Celtic objects. Diodorus Siculus described Celtic warriors as carrying man-sized shields with projecting bosses of bronze and wielding long swords or lances. According to the author, their apparel included bronze helmets with horns or projecting figures, chain mail, and iron breastplates. They were said to be accompanied by musicians playing harsh-sounding war trumpets. All of these are depicted on the Gundestrup Cauldron, a second century B.C. La Tène artifact found in Denmark.

See also **Hochdorf** (*vol. 1, part 1*); **Maiden Castle** (*vol. 1, part 1*); **First Farmers of Central Europe** (*vol. 1, part 3*); **The Iceman** (*vol. 1, part 4*); **Late Neolithic/Copper Age Iberia** (*vol. 1, part 4*); **Sardinia's Bronze Age Towers** (*vol. 2, part 5*); **Late Bronze Age Urnfields of Central Europe** (*vol. 2, part 5*); **Mycenaean Greece** (*vol. 2, part 5*); **Oppida** (*vol. 2, part 6*); **Hillforts** (*vol. 2, part 6*); **Ironworking** (*vol. 2, part 6*); **The Heuneburg** (*vol. 2, part 6*).

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MAIDEN CASTLE

Maiden Castle is one of the largest and most impressive of the British hillforts. The site has considerable importance in the history of British archaeology, as it was originally excavated in the 1930s by Sir Mortimer Wheeler, one of the key figures in the development of British archaeology. His excavations were among the most extensive of the period and were crucial in developing the important concept of archaeological stratigraphy. They also established a diffusionist chronology for the Iron Age of southern Britain, which explained key changes in material culture as the result of invasions. Recent small-scale excavations by the author have reviewed aspects of the picture given by Wheeler but, more important, have provided a database of environmental evidence, which can be used to reconstruct the economy of the inhabitants. The hillfort is located close to the south coast of England, in the county of Dorset, and is situated on a low chalk ridge in the valley of the River Frome. The Roman town of Dorchester lies one mile to the north and appears to have been the natural successor to the hillfort.

Hillforts in this region were established in the first half of the first millennium B.C., and their appearance coincides with the dramatic changes that characterize the end of the Bronze Age and the beginning of the Iron Age. Maiden Castle had a much older history, however, and the Early Iron Age hillfort was constructed directly on top of an earlier Neolithic enclosure. This monument was an important community focus, and the large quantities of material recovered indicate that the enclosure was the focus for productive activities (flint ax manufacture) and had widespread contacts, particularly with communities in southwestern England. The hilltop appears to have lost its position as a center for the local community in the Bronze Age, and it is possible that it became a peripheral area located close to the boundaries of several distinct polities. The neutral character of the boundary location might have been a crucial reason for the establishment of the hillfort. Many of the southern British hillforts were established in similar positions, and some actually incorporated earlier linear earthworks. The size of the enclosing boundary and the area enclosed by this boundary indicate that hillforts were large community enterprises and imply the coming together of several communities.

The original hillfort of Maiden Castle was built c. 500 B.C. An area of 6.4 hectares was enclosed by a single bank and a ditch more than 8.4 meters from top to bottom, which was penetrated by two entrances, one an unusual double gateway. This hillfort is comparable to many other hillforts built at this time, and there are similar examples within a mile. Maiden Castle, however, soon became the center for the locality and then the region. For the next three hundred years the enclosure was subject to an almost continuous program of construction that focused on the enclosing boundary. After an initial refurbishment of the original enclosure, it was decided to expand the area enclosed to the west to create a hillfort 19 hectares in area. At first, this area was enclosed by a simple dump rampart and had two impressive double entrances, facing east and west, respectively. Soon, further external ramparts were added, and the original inner rampart was heightened. By the second century B.C. the hilltop was enclosed by three to four lines of banks and ditches, and the inner rampart stood more than 5.5 meters high. The entrances also had been transformed. Initially, these entrances had been fairly simple, but the addition of extra ramparts was used to create a complex interweaving of banks and ditches, which confuse the unwary visitor and conceal the entrance.

Little is known about the first occupation of the hillfort, but by the middle of the third century B.C. the interior was densely occupied and well organized. The occupation was characterized by small roundhouses, large pit silos used for the storage of cereals, and distinctive above-ground storage facilities in square timber buildings. These structures are characteristic of all Iron Age settlements in southern England, and the circular houses are a feature that distinguish Britain from the adjacent areas of the continent. The interior of the settlement was divided by roads, which were clearly visible in the geophysical survey. The economy of the hillfort was dominated by agricultural activities, and large quantities of barley and wheat indicate the importance of cereal production. Sheep were the most common animal, but cattle and, to a lesser extent, pigs were important also. Large quantities of ceramics and bone tools have been recovered, but metal tools and decorative objects are relatively rare in the Middle Iron Age contexts.

The normal explanation for the construction of these massive banks and ditches is that they reflect an increase in warfare caused by the breakdown of relationships at the end of the Bronze Age. This seems an inadequate explanation, because it does not explain the relative rarity of weapons such as swords and spears, which were common in the Bronze Age. The boundaries clearly served more complex uses than just simple defenses. It is possible that the creation of these enclosures symbolized the coming together of individual households and the foundation of a community separated and distinct from other local communities. The process of construction was an act that symbolically invoked a sense of belonging. It also provided an opportunity to compete with other communities, and the participation of communities that had been previously independent would suggest submission to the authority of the inhabitants of Maiden Castle. The massive investment in labor and resources that went into the construction of this "developed hillfort" testify to the involvement of a large number of people, and it is not surprising that Maiden Castle is the only hillfort in south Dorset of this size and complexity. By the third century B.C. the ramparts of Maiden Castle were an unambiguous indication of the status of the inhabitants and their authority over southern Dorset.

By the end of the first century B.C. the importance of the hillfort appeared to have declined. The rampart had not been enlarged for several hundred years, and the occupants seem to have abandoned the western extension. These changes coincide with the appearance of new settlements in the landscape surrounding the hillfort, and it is difficult not to conclude that people were moving out of the hillfort and that this represented a breakdown in the communal bonds that had been the strength of the community. These changes were associated with the increasing importance of material culture, and it appears that artifacts were being used to define individuals and to establish hierarchies that focused on individual identity.

The increasing importance of identity is reflected in the development of a distinctive regional burial tradition and the presence of a substantial cemetery in the eastern gateway of Maiden Castle. This cemetery is exceptionally large. Various other peculiarities, including paired burials, extended as opposed to crouched inhumations, an unusual range of grave goods, and bodies with signs of mortal injuries, make it unique. Wheeler used some of these features to present a dramatic historical reconstruction of the storming of the hillfort by the Romans, a very famous piece of historical conjecture. The story ignores many of the distinctive features of the cemetery, however, and although the Romans may have killed a few people, there was no evidence to support the dramatic storming of the east gate. The cemetery is really an indication of the continued importance of the hillfort community in a period when there were dramatic changes to the organization of society.

See also **Hillforts** (*vol. 2, part 6*).

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NIALL SHARPLES

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POSTGLACIAL FORAGERS, 8000–4000 B.C.

INTRODUCTION

By about ten thousand years ago, the Pleistocene glaciers in Scandinavia and the Alps had retreated more or less to their current locations. The warmer climate allowed forests to arise over much of Europe that previously had been covered by ice and tundra. Rivers, lakes, and seas teemed with fish, while forests were full of game and edible plants. Such an environment presented many new possibilities for the hunting and gathering peoples who inhabited it. They responded to these challenges and opportunities with technological, social, and symbolic innovations.

This period, which began over ten thousand years ago and ended with the establishment of agriculture, is called the "Mesolithic" to indicate that it falls between the Palaeolithic, the "old" Stone Age of the glacial epochs, and the Neolithic, the "new" Stone Age of agriculture. In southern Europe, where the changes were not quite so dramatic, the term "Epipalaeolithic" is often used by archaeologists for this period. Until about the early 1970s, the Mesolithic did not receive much attention from archaeologists. Many regarded this period as one of cultural stagnation and poverty relieved only by the eventual appearance of agriculture. In the decades since, however, experts have come to view the time following the establishment of a mild, modern climate in Europe as one in which great changes resulted in a reasonably comfortable way of life. In some areas, the adoption of agriculture may even have been delayed by the natural abundance and the human responses to it. The Mesolithic period throughout Europe sets the stage for the developments in the millennia that followed. We have therefore chosen to begin the coverage in this encyclopedia with the postglacial hunters of the European forests and coasts.

The migratory reindeer herds that had provided so much of the diet during the final millennia of the Ice Age retreated to northern Scandinavia by about 8000 B.C. or even earlier. Territorial game such as deer and wild pigs colonized the new forests, so hunters no longer had to follow reindeer herds over vast distances. Instead, they could confine their hunting to a smaller territory. The forests also contained many edible plants that could be gathered easily. This allowed children to contribute to the family's food supply by collecting nuts, berries, and mushrooms. Hazelnuts, which would have been harvested in large quantities and stored, provided an abundant and reliable supply of food. Tubers and rhizomes (the fleshy edible roots of plants) would have been another important source of nourishment. Evidence from pollen diagrams indicates that the postglacial foragers altered the forest by using axes and fire to create artificial clearings where hazel and other shrubs could flourish and where animals would gather. Runs of migratory fish, such as salmon, in the pristine European rivers would have provided seasonal abundances that needed to be preserved for later consumption by smoking and drying. Along the coasts, shellfish could be found in great quantities, and fish could be caught with spears, nets, and lines.

The coastline of Europe had not yet reached its modern shape, however. A hunter could walk across what is now the southern part of the North Sea and get his feet wet only when he had to ford the common estuary of the Thames and Rhine. The Baltic was initially a freshwater lake dammed by land bridges between Denmark and Sweden. Rising sea levels eventually inundated these land bridges. At the same time, the land previously compressed under billions of tons of ice began to spring back upward. The combination of rising seas and rising land had a large impact on the archaeological record. Many sites that were once on dry land are now submerged, as indicated by the finds of artifacts on the floor of the North Sea and in Danish coastal bays. Elsewhere, such as in central Sweden, sites that were once located on the coast or on islands are now far inland and high above modern sea level.

The Mesolithic foragers adapted their technology to the new climatic conditions. Tiny flint pieces called microliths were inserted in handles of wood and antler to form composite spearpoints and knives. Antler was used to make a wide variety of harpoons. A particularly clever and effective fishing tool called a leister had two curving serrated pieces of antler or wood attached to the end of a handle. It would have been thrust down over the back of a fish to seize it. Willow and hazel branches were used to make conical fish traps that were set into streams and estuaries such that the fish could swim into them but could not escape. In some places, many such traps were set across wide bodies of water, which permitted the capture of fish on an immense scale. Underwater investigations in Denmark have revealed the scale of such fish trapping. The development of such large facilities would not have been possible in the absence of some notion of property rights, since a community, or even a single household, would not invest its time in building such installations if their yield could be claimed by outsiders.

During the Mesolithic, dugout canoes begin to appear often in the archaeological record. Although they are usually found waterlogged in the bogs of northern Europe, we can infer that they were in general use throughout the continent at this time. The emergence of such watercraft had an important effect on Mesolithic society. It permitted foragers to exploit resources much farther from home, provided they could reach them by water, while maintaining their permanent settlement in one place for a large part of the year. A new concept of place and home replaced that of territory and home range held by the Ice Age hunting bands.

Archaeologists are only now beginning to consider such social aspects of the postglacial foragers. Evidence for their social lives can be gleaned from the many burials that have been discovered since the 1970s. Cemeteries at sites like Vedbæk in Denmark, Skateholm in Sweden, and Oleneostrovskii Mogilnik in Russia provide evidence of ritual behavior and perhaps social distinctions. Great care was taken in Mesolithic burial rituals. In many cases, red ochre (iron oxide) was sprinkled on the bodies. Objects such as red deer antlers and flint tools were often included in the grave with the body. At Skateholm, dogs were buried with the same care as people, reflecting their importance in Mesolithic life.

In central and southern Europe, Mesolithic foragers congregated around lake basins in the Alpine foothills and took advantage of the vertical distribution of resources in mountainous areas. Many new postglacial forager sites have been found in the Alps and in other upland regions in the 1990s and early 2000s. Caves near the Mediterranean coast and in the limestone areas at the head of the Adriatic were also attractive locations for settlement. In southern Greece, Franchthi Cave frequently was occupied by foragers throughout this period. By 8,500 years ago, following rises in the sea level, the coastline was only about a kilometer away from the cave. An increasing amount of fish and shellfish are found among the food remains in the area, along with many different plant species. Along the Atlantic coasts of Portugal and Spain foragers also took advantage of the rich marine life.

In the interior of the Balkans, an important and unusual series of Mesolithic sites has been found in the Iron Gates gorges of the Danube River, on the border between Yugoslavia and Romania. Here, at sites like Lepenski Vir, Padina, and Vlasac, people took advantage of the abundant fish in the river and game on the adjacent slopes. They lived in small huts, each with a stone-lined hearth, and buried their dead among the houses. A distinctive trait of the Iron Gates settlements is a style of sculpture that features human-like heads carved from the local limestone.

The postglacial foragers of Europe were remarkably creative in the ways in which they adjusted to new environmental conditions. Recognition of this creativity has earned them greater respect from archaeologists, who now see this period as one of immense transformation rather than impoverishment. As a result of their successful adaptation to postglacial conditions, the Mesolithic foragers were generally not anxious to adopt agriculture when it appeared nearly nine thousand years ago in southeastern Europe, but after some delay they integrated crops and livestock into their diet and blended into the farming population.

PETER BOGUCKI

POSTGLACIAL ENVIRONMENTAL TRANSFORMATION

The Holocene interglacial epoch began around 9500 B.C. with an abrupt warming of the climate across most of Europe. Although interglacial conditions were established rather quickly, it would be wrong to imagine that the natural environments of the Early Holocene were identical to those of the present day or that they have remained static since that time. For example, most regions experienced a climatic thermal optimum between 8000 and 4000 B.C., as indicated by the extension of species, such as the water chestnut and the pond tortoise, north of their present European climatic limits. In addition, several key features of the natural European landscape were not formed until some time after the start of the Holocene. In most coastal regions, for example, recognizably modern shoreline configurations were only achieved around 5000 B.C.

COASTAL ENVIRONMENTS

The repeated build up and decay of ice sheets during the Pleistocene had locked up and then released water from the hydrological cycle, causing sea levels to rise and fall. Global sea levels were lowered on average by more than 100 meters when the ice sheets and glaciers were at their peak, creating land bridges that made it possible to walk from the European mainland across to the British Isles. The configuration of the glacial coastline differed most strongly from that of the early twenty-first century in areas with shallow offshore gradients, such as the North Sea. In these areas, land was drowned by rising sea levels between the tenth and sixth millennia B.C. at a rate that must have been noticeable from one year to the next. Human populations had to relocate themselves and their economic activities landward, as is shown by the changing locations of shell middens and other Mesolithic sites related to human habitation of the coastal areas.

In Southeast Europe, the lowered sea level caused the Black Sea to be isolated from the world oceans during glacial times because the Bosphorus Straits that connect them are only about 50 meters deep in the early twenty-first century. By the Early Holocene, world sea levels rose so that they may have become higher than those in the Black Sea, and around 5500 B.C. the two became reconnected. In *Noah's Flood,* William B. F. Ryan and Walter Pitman have proposed that seawater poured through the Bosphorus in a flood several hundred times greater than the world's largest modern waterfall. If true, human populations around the former Black Sea coast would have found the sea advancing toward them at about a kilometer and a half every day. Their memory of this possibly catastrophic event may provide the basis for the flood legend of the Sumerian Epic of Gilgamesh, which later came to be incorporated in the story of Noah in the Old Testament of the Bible.

Rising Early Holocene sea levels led to river valleys being drowned throughout Europe's coastal zones, with the end of the Early Holocene representing the time of maximum marine incursion inland. Since then, stabilized sea levels and river-derived siltation have led to a reversal in this trend, with the land pushing seaward at the mouths of major rivers, such as the Rhône. This process has left many ancient harbor cities, particularly around the

Mediterranean, stranded several miles inland from the coast during modern times. It should be noted that a different trend was experienced during the Holocene in some high-latitude regions, such as the northern part of the Baltic Sea. There the land lifted after the ice sheets melted, which forced land formations farther above the water than they had been previously.

PLANT AND ANIMAL RESOURCES

Prior to 9500 B.C., Europe north of the Mediterranean had been largely covered by tundra-steppe and boreal forest, and it had supported large herds of reindeer, wild horses, and other herbivores. However, in the subsequent two millennia, new tree species moved in, so by 7000 B.C., the dominant vegetation type had become mixed deciduous forest. With it came new woodland animals, such as red deer, aurochs (wild ox), and wild boar. As targets of human exploitation, these animals were more dispersed and less visible in the forests than had been the concentrated and easily culled fauna of the lateglacial tundra. Yet the mixed deciduous woodland contained hundreds of potentially edible plant species, ranging from hazelnuts through berries and fruit to fungi and bracken rhizomes.

Although the distribution of vegetation types had become essentially modern by 7000 B.C., their species composition continued to change. This can be seen from many pollen diagrams in which the characteristic feature is the continued arrival and rise to dominance of new woodland plant classifications. After the pioneer woods of birch and pine, the first deciduous trees to arrive in Northwest Europe were hazel and elm. Later arrivals included oak, lime, alder, and ash. Yet other trees—for example, beech—did not achieve their maximum extents until the declining stage of the Holocene, and some trees, such as spruce, may still be expanding their ranges. The Early Holocene forests formed an almost continuous blanket across most of the central and northern European lowlands during Mesolithic times. The hunter-forager communities in those areas preferred to locate their settlements in places where there were fewer trees. These included sites in forest clearings, along the seacoast, next to rivers and wetlands, and at higher elevations close to the upper limit for tree growth. A good example is the site of Star Carr in northern England, which was the scene of pioneering archaeological investigations between 1949 and 1951 by Grahame Clark. His were among the first excavations to move beyond the study of stone tools to also include an examination of site economy and environment, which are revealed by bones, seeds, and pollen grains. Star Carr comprised a platform made of birch at the swampy edge of a lake, now filled. The waterlogged conditions are responsible for the excellent preservation of organic remains at the site. Wetlands such as this were rich in natural resources, including waterfowl, fish, and edible water plants, such as cress and water lily.

The seasonal rhythm of plant growth and animal movement in temperate woodland ecosystems strongly influenced the food schedules and lifestyles of Mesolithic hunter-forager groups. But people were already capable of modifying natural environments to suit their needs. For example, selective burning of vegetation is a traditional technique of environmental management that has been practiced by hunters and pastoralists for many millennia. The new vegetation growth after a fire increases grazing and browsing potential, and the number of deer or wild cattle that can be supported responds accordingly. Charcoal provides one of the best palaeoecological indications of past fire frequencies. Charcoal fragments in soil and peat profiles suggest that recurrent burning of upland vegetation took place during the Late Mesolithic in Europe. Hazel, which sprouts new growth in response to burning, is much more abundant in the early part of the Holocene than in any previous interglacial period—possibly an indirect result of Mesolithic use of fire.

THE IMPACT OF THE FIRST FARMERS

The advent of Neolithic agriculture brought greater potential for modifying natural environments and put humans into sharper conflict with nondomesticated species. In the long run, this has meant that predators, such as the wolf and the bear, are now rare across western and central Europe, whereas wild competitors, such as the aurochs, are now extinct. Decline in some nondomesticated animal populations is partly the result of hunting but more importantly due to habitat loss, given that farming requires at least partial clearance of the existing vegetation cover. Early agriculture is also associated with the first substantial human impact upon the soil, an impact all the more permanent because of agriculture's association with a settled, or sedentary, way of life.

Between 7000 and 3500 B.C., Neolithic farming spread across Europe from the Near East, primarily northwestward along the Danube-Rhine axis. Neolithic farmers appear to have initially exploited only a small portion of the total landscape, selecting those particular habitats—notably alluvial and loess soils—best suited to their needs. Sites in the western Mediterranean and parts of northern Europe (e.g., those of the Ertebølle culture in Denmark) have shown evidence of transitional economies, indicating that, in those locations, agriculture may have been gradually adopted by preexisting Mesolithic populations. Evidence for the impact of Neolithic farmers upon European wildwoods was first recognized by Johannes Iversen in the form of clearance, or *landnám,* phases in pollen diagrams. There are three principal *landnám* phases:

1. an initial clearance stage, in which tree pollen declined relative to herb and grass pollen;
2. a farming stage, in which grasses, including cereal-type and weedy species, reached a maximum;
3. a regeneration stage, in which shrubs, such as hazel, increased before declining as more substantial trees replace them.

Clearance phases are also sometimes associated with a rise in the frequency of charcoal, suggesting that fire was employed in a "slash and burn" manner.

The effect of Neolithic clearance on the overall woodland cover was initially rather small, although more significant changes did take place in the composition of the natural vegetation. One of the species affected was the elm tree, and a sharp and usually permanent decline in the number of elm trees occurred during Neolithic times. Although the direct cause of this decline was most likely a catastrophic disease outbreak similar to the modern Dutch elm disease, the lack of subsequent recovery of the tree population is likely to have been linked to increasing human disturbance of forest ecosystems. Another group that responded to Neolithic agriculture was weeds. Species such as ribwort plantain, stinging nettle, docks, sorrels, and grasses appear with increasing regularity in post-Mesolithic pollen diagrams. These plants thrive on disturbed ground, and they exploited humans for their dispersal and have remained a familiar part of European agricultural landscapes ever since.

CULTURAL LANDSCAPE CHANGE IN BARBARIAN EUROPE

Neolithic peasant farming societies started the long process of clearing Europe's forests to make way for farms, fields, and pastures. From Julius Caesar's description in his *De bello Gallico* that "the population is exceedingly large, the ground thickly studded with homesteads," it certainly appears that, in France and lowland Britain, the landscapes were already largely agricultural at the time of the Roman conquest in the first century B.C. By medieval times, around A.D. 1000, the removal of the forests was almost complete. At the time of the Domesday survey of A.D. 1086, only 15 percent of England was still wooded, and more than twice that amount of land was devoted to growing crops. It is clear that the vast majority of primary forest clearance in lowland England had taken place before the Norman conquest of the eleventh century A.D.

The so-called barbarian cultures were therefore largely responsible for the transformation of Europe from a natural to a cultural landscape, although the pace and timing of this transformation varied among different regions. In some cases, significant opening of the primeval forest took place during Neolithic times; for example, land snails and pollen from buried soils and ditch fills at Avebury, Silbury Hill, and Stonehenge show that the chalk landscape of southern England had, by the second millennium B.C., already been changed from woodland to open pasture or scrub. In general, however, organized agricultural landscapes were more often created in the Bronze Age or Early Iron Age, particularly during the second and early first millennia B.C. In part of Spain, this was associated with the development of the *dehesa* system, which uses and conserves oak trees in an open parkland interspersed with cereal cultivation and grazing land, whereas farther north, landscape change is linked to the emergence of proto-Celtic and Celtic societies. These societies became hierarchical and tribal, with a mode of production progressively less dependent on domestic subsistence agriculture. Change was manifest in the landscape in the creation of organized arable field systems and other forms of land allotment as well as in the creation of defensive hillfort settlements. Animals were no longer raised solely for meat but also were used for plowing, transport, and wool and milk production and to provide manure to fertilize the fields.

The Bronze Age saw an important extension of settlement into many upland regions, such as the Alps. A good example of this process is provided by Dartmoor in Southwest England, where large parts of the Bronze Age landscape have been preserved. Archaeological remains include low stone walls—or *reaves*—that are linked to the wider system of prehistoric land boundaries that cover the whole of Dartmoor. The Bronze Age economy was based on pastoralism, and the round stone farm dwellings in this area may have only been occupied seasonally as part of a transhumant pattern of land occupation, where livestock was moved between different areas. Pollen diagrams from peat deposits and buried soils record prehistoric woodland clearance and the inadvertent creation of acid moorland with podzolic and gley soils.

Late Holocene woodland clearance often had permanent consequences for soil resources. In some regions the fertile but superficial cover of loess—a wind-blown silt that had been deposited during glacial times—was eroded to leave skeletal, calcareous soils, the eroded soil having "sludged" downhill to form extensive colluvial deposits at the bases of slopes. Some of this eroded soil material was moved into river systems, which led to the widespread accretion of fine-grained floodplain alluvium in lowland rivers of northern Europe after 1000 B.C. At Braeroddach Loch in Scotland, soil erosion and consequent influx of sediment increased in a series of steps through time, starting with the arrival of Neolithic agriculture. In this lake catchment, soil losses under agricultural land use represent a thirtyfold increase compared with that under Early Holocene forest cover. Without doubt, land degradation in Northwest Europe has been related to increasing population growth and agrarian pressure. An extreme example of irreversible environmental change is provided by the limestone plateau of the Burren in western Ireland. The Burren's thin soil cover, which had been able to support pine, yew, and birch forests during much of the Holocene, was almost totally eroded down karstic fissures during the Late Holocene. All that is left is bare limestone pavement incongruously criss-crossed by Celtic fields with no soil inside them (fig. 1).

In many areas, such as the North European plain of Germany and Poland, the post-Roman period witnessed a decline in population, and pollen diagrams show that woodland regeneration took place. Yet the basic pattern of land occupation established in the pre-Roman Iron Age was often not greatly altered. And toward the margins of permanent settlement in northern Europe, as in Scandinavia, the first millennium A.D. was a formative period of landscape change. This is well illustrated in the Ystad Project, in which archaeologists, historical geographers, and palaeoecologists worked together to establish an integrated regional history of Holocene landscape change in an area of southern Sweden. The post-Roman period also saw the introduction of some new crops, such as rye and hemp-hop.

CLIMATIC CHANGES DURING LATER PREHISTORY

Although much less marked than during the Early Holocene, the period between 4000 B.C. and A.D. 1000 nonetheless experienced some significant shifts in climate. Notable among these was a progressive cooling following the Holocene thermal optimum. A range of biotic temperature indicators, including diatom algae, cladocera (microcrustaceans), pollen, and midge larvae, have been analyzed from lake sediment cores taken in various parts of boreal and mid-latitude Europe. Some of these records show cooling to 2–3°C (4–6°F) below modern values during the later third millennium and second millennium B.C., after which the climate recovered to modern values. Another climatic deterioration from warmer and drier to cooler and wetter conditions took place at the Subboreal-Subatlantic transition, a change dated in European peat bogs to around 600 B.C. At this humification feature, known as the Grenzhorizont (boundary horizon), dark, oxidized peat, typical of slow-growing mires and often including buried tree stumps, was replaced by relatively undecomposed sphagnum peat typical of wetter, fast-growing mires. The water balance of oceanic bogs in northwestern Europe reflects both temperature and precipitation effects, but the evidence favors temperature as the main forcing factor. Periods of wetter

Fig. 1. Limestone pavement at the Burren, Ireland. © TOM BEAN/CORBIS. REPRODUCED BY PERMISSION.

bog surfaces most probably reflect declining summer temperatures that, in turn, impacted evapotranspiration.

High-latitude Europe has been intensely studied in terms of Holocene climate variability. This is because it possesses many natural climate archives with high temporal resolution, such as tree rings and varved lake sediments, and also because these northern regions were relatively little affected by human landscape disturbance. Tree-ring analysis (dendroclimatology) from regions such as Scandinavia and Ireland shows several periods of narrow growth rings that are inferred to have resulted from years of unusually severe climatic conditions. One such series of years occurred in the seventeenth century B.C. and may be linked to climatic cooling following the explosive eruption of the volcanic island of Thera in the Aegean Sea, whereas another took place in the sixth century A.D. Across much of mid-latitude Europe, however, the effect of Late Holocene cooling and warming fluctuations was often disguised by increasing human disturbance of the vegetation cover.

CONCLUSION

Pollen diagrams from many areas of Barbarian Europe typically record three phases of human land-use activity between 8000 B.C. and A.D. 1000. The first was Mesolithic hunting and gathering under wildwood; the second was small-scale Neolithic-Chalcolithic "peasant" farming within secondary woodland; and the third phase was dominated by agricultural landscapes of fields and farms created under complex, stratified, Bronze Age, Iron Age, and later societies. Because clearance of the original woodland and consequent land degradation have a long antiquity in this corner of the world, European landscapes can only be understood by considering changes in prehistoric and early historic times as well as those in more recent centuries.

See also **Star Carr** (*vol. 1, part 1*).

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NEIL ROBERTS

THE MESOLITHIC OF NORTHERN EUROPE

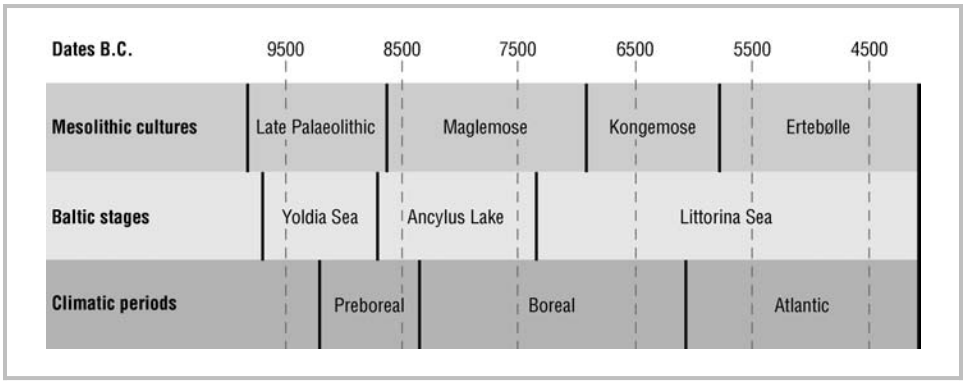
FOLLOWED BY FEATURE ESSAYS ON:

After the glaciers retreated from northern Europe at the end of the Ice Age, forests were soon established across northern Germany and Poland, southern Sweden and Norway, and all of Denmark. These forests were inhabited by hunter-gatherers who exploited the abundant game animals and the rich plant life found in these woodlands and the aquatic life in adjacent rivers, lakes, and seas. The postglacial foraging societies of northern Europe are often considered to be the classic manifestation of the Mesolithic way of life. Whether they were coastal communities accumulating immense shell middens or interior bands repeatedly visiting seasonal hunting camps, the Mesolithic groups of northern Europe left behind one of the richest archaeological records of hunter-gatherer societies anywhere in the world. Waterlogged sites in bogs and estuaries have yielded remarkable collections of wood, bone, and antler artifacts in addition to stone tools and early attempts at pottery. Seeds and animal bones are abundant, and new isotopic techniques have allowed archaeologists to study the diet of these foragers in great detail. Burials have provided information about social practices as well as evidence of an increasingly sedentary way of life.

THE BALTIC BASIN

In order to understand the Mesolithic of northern Europe, it is important to know the history of the Baltic Sea, and, in turn, it is necessary to know about two major geomorphological processes: eustasy and isostasy. Eustasy is the change in coastlines caused by rising sea levels that drown low-lying coastal areas, while the upward rebound of land previously burdened by millions of tons of ice is termed isostasy. The combined result of eustasy and isostasy is that many sites that were once on dry land are now under water, as indicated by the finds of artifacts on the floors of coastal bays, while sites elsewhere that were once located on the coast are now far inland or at a higher altitude.

The basin of the Baltic Sea first filled with fresh water from the remnants of the glacial ice to form the Baltic Ice Lake. Eventually (by about 12,200 years ago), so much water had accumulated that it had broken through to the North Sea across central Sweden. The resultant brackish gulf is known as the Yoldia Sea. About 10,800 years ago, the isostatic rebound of central Sweden blocked off the ocean access, leaving a body of fresh water known as the Ancylus Lake. It was dammed at its southern end until



Mesolithic chronology for southern Scandinavia. ADAPTED FROM LARSSON 1990.

some time just after 7000 B.C. The further tilting of the Baltic basin caused by continued isostatic rebound in the north and the total global melting of land ice then caused salt water to flow in through the Øresund, the strait between Denmark and Sweden, to form the Littorina Sea, the precursor of the modern Baltic. Continued eustasy and isostasy has resulted in significant changes in shorelines throughout the Baltic basin during the last several millennia.

Until the 1980s, the archaeological record of the Baltic basin was known almost exclusively from sites on dry land or in bogs, but submerged coastal sites have received greater attention in the years since. Near Kalundborg, along the west coast of the Danish island of Zealand, a swimmer can stand on the remnants of Mesolithic fish-trapping apparatus, for example. The recognition of isostasy as an important process has resulted in the discovery of sites much farther inland and at significantly higher altitudes than they had previously been expected, providing new information about Mesolithic settlement distributions.

MESOLITHIC CULTURES

Archaeologists have applied the traditional approach to defining "cultures" to the Mesolithic of northern Europe, based largely on changes in stone tool assemblages and the eventual appearance of distinctive artifacts such as pottery. This practice is most developed in northern continental Europe and southern Scandinavia, whereas elsewhere in Scandinavia, the Mesolithic is commonly just divided into periods such as "Early," "Middle," and "Late."

The Maglemose-Kongemose-Ertebølle sequence from Denmark and southern Sweden is perhaps the best known Mesolithic sequence in Europe (see table). The Maglemosian culture (not named for any particular site, just derived from the Danish for "big bog"), was the first major Mesolithic culture of southern Scandinavia, characterized by stone axes, microlithic tools, stone picks, and bone and antler barbed points. It was succeeded in Denmark and southern Sweden by the Kongemose culture (after the lake settlement of Kongemosen in Zealand), which continues Maglemosian traditions with stone axes and antler tools but also adds large blades to the stone-tool inventory. During the Atlantic period, Kongemose in turn is succeeded in Denmark and the western Baltic by the Ertebølle culture, about which much will be said below. In northern Germany, Ertebølle remains are known locally as the Ellerbek culture.

In northern Poland and Germany, the Mesolithic cultural sequence is less sharply defined. The Komornica culture of northern Poland is roughly contemporaneous with the Maglemosian and shares broad similarities with it, and it is succeeded by the Chojnice-Pieńki culture. In northern Germany, a variety of local Mesolithic groups tracked the developments in southern Scandinavia.

EARLY MESOLITHIC MOBILE FORAGERS

The foraging societies of northern Europe at the beginning of the Holocene are known primarily from sites along the shores of lakes and bogs. At Friesack, about 150 kilometers northwest of Berlin, hunter-gatherers repeatedly visited the side of a lake between 8700 and 7800 B.C. They left few traces of their presence, but careful excavation has revealed over thirty visits separated by intervals ranging from a decade to a century. Waterlogged refuse layers at Friesack have preserved a remarkable array of finds. The Preboreal and early Boreal inhabitants of Friesack hunted red deer, roe deer, aurochs, beaver, rabbits, small carnivores, and birds; they also caught pike, catfish, and turtles. Many wooden artifacts, including arrows and a bow, along with nets and baskets, were found. Earlier occupations occurred primarily in the spring, while the later ones took place in the fall. This pattern of repeated seasonal visits to the shores of lakes and bogs was repeated countless times across northern Europe during the early Holocene.

The breakthrough around 7000 B.C. that connected the Littorina Sea to the North Sea inundated many coastal lowlands and the Mesolithic sites at the mouths of rivers and bays. Since the early 1980s, it has been possible to explore a number of submerged Mesolithic settlements, including several from the Preboreal period. The bottoms of the Øresund strait between Denmark and Sweden and of the Store Bælt strait between the Danish islands of Zealand and Fyn are now accessible to archaeologists wearing scuba apparatus. They have found several early Mesolithic sites on the Swedish side of the Øresund between 6 and 20 meters below the surface. At Pilhaken 4, trenches were dug with water nozzles and suction, resulting in the recovery of flint tools and bones from roe deer, red deer, and aurochs. Other sites were found during the construction of the bridge and tunnel between Denmark and Sweden during the 1990s. The new submerged finds indicate that early Mesolithic coastal settlement was probably as intensive as it was later in the Mesolithic.

While the coasts of southern Scandinavia were being inundated by early Holocene eustasy, central Sweden was experiencing dramatic coastline changes due to isostatic rebound. These changes had the most significant impact in the vicinity of the modern city of Stockholm. The rebound began as soon as the area was free of ice and is still continuing today. Soon after the ice retreated, the higher points of land began to poke through the surface of the Yoldia Sea as rocky islands. Since the ice front was not far to the north, icebergs must have floated among them. By about 8000 B.C., a thin belt of islands extended to the east of the Swedish mainland for about 130 kilometers through this cold, watery world. Around this time, the first humans reached these islands either by boat or by walking across winter ice.

Until the latter part of the twentieth century, the Mesolithic sites of the Stockholm Archipelago were almost completely unknown. Several factors account for this. First, the continual upward movement of the land meant that these sites were far from the sea and on very high terrain. Archaeologists expected to find Mesolithic sites near the coast and in lowlands. The sites had indeed been on the coast, but what was the coast in 8000 B.C. is now 75 meters high and well inland. Second, most tools left by the inhabitants of these sites were made primarily from local white quartz, not flint. Quartz does not fracture like flint to make artifacts that look like the blades and flakes found farther south. Since quartz pieces lie everywhere across the landscape, tools made from quartz blend in with the nondescript pebbles and gravel strewn across the surface.

Once archaeologists learned where and how to find early Mesolithic sites in eastern Sweden, many were found, primarily in forested areas between 70 and 85 meters above modern sea level. The Södertörn Peninsula south of Stockholm was just a small cluster of rocky islets at the outer edge of the archipelago in 8000 B.C., and several hundred Mesolithic sites have been found there since the early 1980s. Also around 8000 B.C., pioneering foragers began to settle the islands of the Stockholm Archipelago, locating their shoreline camps on sheltered bays and along narrow straits between islands. Seal hunting probably drew Mesolithic pioneers to the outer archipelago, while sites on the larger islands closer to the mainland contain a greater variety of hunted animals. Agneta Åkerlund has argued that the inhabitants of the outer islands of the Stockholm archipelago persisted in a distinctive lifestyle that focused on fishing and sealing for several millennia.

Farther out in the Baltic, hunters arrived at Stora Förvar cave on the island of Stora Karlsö, off the coast of Gotland, around 7200 B.C., having crossed Ancylus Lake by boat. The coast of Gotland, as in the Stockholm Archipelago, was the location of gray-seal rookeries. Ashy Mesolithic layers at Stora Förvar contained the remains of more than a thousand seals. Sea birds and fish were also caught. Human bones in the Stora Förvar deposits indicate the presence of children and adolescents along with male and female adults, so it appears that the site had been inhabited by entire families who came to stay for an extended period rather than by seasonal seal-hunting parties.

LATE MESOLITHIC SEDENTARY FORAGERS

After about 6500 B.C., the Mesolithic cultures of northern Europe became increasingly complex and varied. People became increasingly tied to smaller territories and specific locations. Some Kongemose and Ertebølle sites, such as Tågerup in southern Sweden, have habitation traces that suggest year-round occupation, while elsewhere, seasonal movements became constrained. The use of bulky items like large flint axes and pottery, fixed features such as fish weirs and traps, and the burial of the dead in cemeteries are important evidence for such sedentism. Yet the increased evidence for the use of dugout canoes indicates that people living in permanent or semipermanent locations were also able to exploit much larger territories along the coasts and among the islands of the Littorina Sea and the North Sea and to move inland along rivers. Mesolithic settlement was also pushed farther north into Sweden and Norway.

The most famous Late Mesolithic sites of northern Europe are the Ertebølle shell middens. These are large deposits of seashells created by millions of individual actions of opening oysters, limpets, and scallops, extracting the meat, and tossing away the shell. The result is a dense, stratified concentration of shell that also includes flint tools and animal bones, yielding important information about diet and tool use. Such "kitchen middens" (in Danish, *køkkenmøddinger*) have long formed the core of our knowledge about the Late Mesolithic of northern Europe and dominate the general archaeological literature.

As important as the coastal shell midden sites are, it is important to recognize that they provide only a partial glimpse of life in the Late Mesolithic. It seems unreasonable to expect that people actually lived on these mounds of discarded shells, so it is necessary to look away from these coastal middens to find more substantial places of habitation. Other important sites consist of the places where non-shell rubbish was discarded, especially the "discard zones" adjacent to shoreline settlements. A major development in the last decades of the twentieth century was the discovery of several Ertebølle cemeteries in Denmark and southern Sweden, as well as substantial facilities for catching fish on a large scale with traps and weirs. Finally, it is clear that Late Mesolithic people throughout this region did not abandon the interior lakes and bogs around which their activities had revolved during the preceding millennia, and archaeologists have begun to recognize the relationship between the interior and the coastal sites.

Late Mesolithic Interior Settlements. Ringkloster in eastern Jutland (Denmark) is a Late Mesolithic interior site located on the shore of Lake Skanderborg, about 20 kilometers inland from the coast. It consists of a shoreline habitation area and the "dump zone" in the adjacent lake. Ringkloster was occupied intermittently between about 5400 and 3550 B.C. Animal bones reflect both the hunting of terrestrial animals, especially wild boar, and the trapping of small fur-bearing mammals such as pine marten and otter. Seasonal indicators from the animal bones suggest a cold-weather occupation between the autumn and early spring. Bones of dolphin and marine fish point toward contact with the coast. Ringkloster may have been occupied either by Ertebølle foragers, who spent the rest of the year at the coast, or by members of an interior settlement system that was in contact with, but distinct from, the coastal dwellers.

Small islands in interior lakes of southern Scandinavia were favorite late Kongemose and Ertebølle settlement locations. Ageröd V, in the Ageröd bog in southern Sweden, was located on a small island in an immense marshy lake, about 400 meters from the nearest dry land. Fish traps in the surrounding lake provided a supply of perch, bream, and tench. The inhabitants of Ageröd V also went to the mainland to hunt red deer, roe deer, moose, and wild pig, although two of the hunters forgot their bows on the island.

A short distance inland from the modern Baltic coast in northern Poland, the site of Dąbki provides another example of a Late Mesolithic interior site. During several occupations between 5400 and

4600 B.C., the inhabitants of this site hunted beavers, deer, and ducks and caught several species of freshwater fish, especially pike and perch. Two seal bones are the only evidence of contact with the coast, however. The settlement layers at Dąbki contained pointed-base pottery much like that of the Ertebølle sites of southern Scandinavia, suggesting that the distribution of this ware was more widespread along the south Baltic littoral than previously thought.

Late Mesolithic Coastal Settlement. The famous Late Mesolithic settlements and shell middens of the Ertebølle culture of Denmark and southern Sweden were occupied between about 5800 and 3800 B.C. It is important to understand that coastal Ertebølle sites show considerable variability, and they must also be considered together with the interior Ertebølle settlements like Ringkloster for a full picture of Late Mesolithic life in southern Scandinavia.

The name "Ertebølle" comes from a large shell midden at the northern end of Jutland excavated in the mid-nineteenth century by a special commission set up to determine whether the shell mounds were natural or manmade. Since then many other Ertebølle sites have been excavated in eastern Jutland, the Danish islands, and southern Sweden, and related sites of the Ellerbek culture are found in northern Germany and Poland. The classic shell middens are generally found only in the western part of the Ertebølle area, where the high salt content of North Sea water produced large shellfish. Middens are either small or absent in eastern Denmark and southern Sweden because the lower salt content of the Baltic hampered mollusk growth.

Ertebølle itself, located on the Limfjord in northern Jutland, is a long, narrow midden about 140 meters long, 20 meters wide, and 2 meters thick, while the nearby site of Bjørnsholm is about 325 meters long and between 10 and 50 meters wide. Such an elongated shape running parallel to the shoreline is typical of Ertebølle shell middens, which are composed primarily of oyster shells, with some scallops, mussels, and periwinkles. Mixed among the shells are mammal, bird, and fish bones, flint tools, and hearths containing ash and charcoal. Careful excavation has revealed that these middens are not continuous accumulations but rather were the product of many short occupations that produced piles of shell and refuse between 2 and 7 meters long and between 30 and 50 centimeters thick. Over several centuries, such repeated smaller accumulations built up to form the large middens. Near Ertebølle and Bjørnsholm, several smaller sites on headlands and small islands were special locations for seasonal activities. The general absence of evidence for structures suggests that the surfaces of the Ertebølle middens were primarily the location of food preparation and consumption. Other habitation areas are presumably nearby, perhaps behind the midden on the landward side, but the archaeological focus on the middens themselves has hampered their discovery. The middens may appear to be more important than they actually were in the Ertebølle settlement system, since even a small group eating shellfish can produce an enormous pile of discarded shells in a short time.

On the Danish island of Zealand and along the southern coast of Sweden, many inlets and fjords have yielded extensive traces of Ertebølle settlement without shell middens. In southern Zealand, ninety-seven Ertebølle sites have been found around Karrebæk-Dybsø Fjord, leading to the estimate that this estuarine ecosystem and its hinterland supported about two hundred and fifty people. Similar concentrations of population around fjords and estuaries are coming to light on both sides of the Øresund. Tågerup, for example, lies at the head of a narrow fjord on the Swedish side of the Øresund. Two large circular huts about 7.5 meters in diameter and a longhouse about 15 meters long indicate a substantial permanent Ertebølle settlement, much larger than the previous Kongemose occupation on the site.

A distinctive feature of Ertebølle settlements in Denmark and southern Sweden is the occurrence of pottery (fig. 1). It is unclear whether it was an indigenous development or was adopted from pottery-using farming communities to the south, although at the moment, it seems more likely to have been indigenous. Ertebølle pottery appears in two basic forms: thick-walled, pointed-base, sack-shaped vessels of various sizes and small oval bowls termed "lamps." Whether or not the latter actually served as oil lamps is unknown. Although the pointed bases on the pots made it impossible to rest them

Fig. 1. Classic Ertebølle pointed-base pot and a smaller vessel interpreted as an oil lamp. THE NATIONAL MUSEUM OF DENMARK. REPRODUCED BY PERMISSION.

upright on a hard surface, they were ideally suited for being set on the ground along a sandy shoreline.

Another important development of the Ertebølle culture was the development of large-scale installations to capture fish using either traps or weirs. Mesolithic fish traps are usually conical wicker baskets with a narrow funnel-like opening in one end. Fish could swim in with the current but could not find their way out again. A trap left in the water long enough would fill with fish by itself. A fish weir is a low, thickly woven fence in a tidal zone. When the tide comes in, fish swim along with it over the fence, but when the water recedes, they are trapped on the beach behind it. The existence of such stationary features reveals that: (1) local populations were large enough to make such construction worthwhile; (2) people controlled the rights to the fish that they caught and were not compelled to share the catch with others who had not participated in the construction (which might have diminished their motivation to make the effort); and (3) there was some means of preserving or storing the fish that could not be immediately consumed. Underwater investigations in Denmark, especially in conjunction with the building of the Store Bælt Bridge from Zealand to Fyn, have revealed the extent of passive fish trapping. Multiple belts of traps have been found preserved underwater in bays of the Danish islands, and stakes of fish weirs have been found at a number of submerged sites, such as at Tybrind Vig.

The discovery of submerged sites has added a new dimension to the study of the Ertebølle culture since the early 1980s. Most of these areas are covered by about 5 meters of water, but divers have been able to find evidence for activities that, during the Mesolithic era, took place in the intertidal zone as well as artifacts that were lost, discarded, or abandoned immediately offshore. Tybrind Vig, for example, has yielded a remarkable array of wooden finds in addition to the usual artifacts from flint, bone, and pottery. Some of the most intriguing submerged Ertebølle/Ellerbek sites have been found recently on the northern coast of Germany on the floor of Wismar Bay, around the island of Poel. At Timmendorf-Nordmole, submerged refuse layers have yielded numerous well-preserved artifacts, including many wooden fish prongs called "leisters" (fig. 2), wooden stakes from fish weirs, and the remains of a dugout canoe. Most of the bones come from fish, especially eel and cod, as well as from sea mammals and birds. Radiocarbon dating of food residues on pottery indicate that the site was occupied between about 4400 and 4100 B.C., toward the end of the Ertebølle culture, just before the transition to agriculture in this region.

Ertebølle Cemeteries. In 1975 earth moving for a new school in the town of Vedbæk, north of Copenhagen in Denmark, revealed an Ertebølle cemetery. The cemetery was near the shoreline of what had been an inlet of the sea six thousand years ago. Although some graves had been destroyed by the construction, archaeologists found eighteen burials containing at least twenty-two individuals of various ages. In many of the graves, red ochre (iron oxide) had been sprinkled over the corpses. The graves of older individuals often contained antlers of red deer. Many females had necklaces and belts of beads made from shell and animal teeth, while males were buried with flint tools.

Almost all of the Vedbæk burials were in an extended position, lying on their backs. One contained the skeletons of a young woman and a newborn infant. Beneath the mother's head had been a cushion of some perishable material ornamented with snail shells and deer teeth. The baby's body had been placed on a swan's wing. More disturbing was the triple burial of a man, a woman, and a child. The man had a bone point in his neck, suggesting either a violent death or an arrow shot into the corpse.

When they were found, the Vedbæk burials caused quite a sensation because, aside from a few isolated single burials, no Ertebølle cemeteries were then known. In years since 1975, more Ertebølle cemeteries have been found, and now more than one hundred graves are known from this period. In the early 1980s, the Swedish archaeologist Lars Larsson of the University of Lund began excavations at sites at Skateholm in southern Sweden, along the shore of a prehistoric lagoon near the Baltic coast. Skateholm I and II are both cemeteries. Skateholm I yielded sixty-five burials, while twenty-two graves were found at Skateholm II. Several of the burials contained the skeletons of dogs, and some had grave goods as elaborate as those of people, including antlers and flint tools.

In 1990–1991 a submerged hunter-gatherer settlement site was found in southern Denmark at Møllegabet. During the excavation, the remains of a dugout canoe were found. The Møllegabet dugout was made from the trunk of a linden tree more than 60 centimeters in diameter. Some human bones were found around the boat, and after it had been taken to a laboratory, additional human bones were found in the soil inside. A return to the site revealed additional human bones that are believed to have washed out of the canoe.

The Møllegabet canoe contained the remains of a male about twenty-five years old. A skull fragment shows traces of a healed wound, probably inflicted by an axe. The body appears to have been covered in sheets of bark. In the boat, an arrowhead was found. As at Vedbæk, it could have caused the death of this individual or may have been shot into the corpse after the person had died by other means. Antlers found nearby also may have belonged to the burial. The Møllegabet canoe burial suggests that the Nordic tradition of boat burials may have deep prehistoric roots.

The Ertebølle burials from southern Scandinavia reflect a society with complex rituals associated with death. Individuals (even sometimes dogs!) had distinct social identities and were carefully treated after they died. Certain locations were formally associated with the dead, thus marking important places in the landscape.

THE MESOLITHIC OF NORTHERN SCANDINAVIA

Once northern Scandinavia was free from ice, the land was available for human settlement. This region has seen considerable isostatic uplift, such that in some parts of northern Sweden, coastal Mesolithic sites may now lie more than 100 kilometers from the coast. Coastal Norway had already been the scene of hunter-gatherer settlement since early in the Holocene, and valleys in the mountainous interior of Norway and Sweden were settled almost as soon as they were clear of ice.

Alträsket is a Mesolithic coastal site at the northern end of the Gulf of Bothnia that is 25 kilometers inland and 100 meters above the present sea level. Excavations revealed several depressions along an ancient beach-terrace that were the locations of pit-houses with hearths. Other features with stones have been interpreted as "boiling pits." Mammal bones include ringed seal and moose. As in the area near Stockholm, the northern part of the Baltic basin was an archipelago of rocky islets in the Littorina Sea. Alträsket was located on one such island.

At the far northern end of Norway, on the island of Sørøya, the site of Slettnes has also yielded traces of Mesolithic house depressions. Among these depressions were five large rocks covered with carvings of forest animals such as moose. Slettnes is far above the Arctic Circle, indicating that Mesolithic people were capable of adapting to cold conditions if the rich resources of the sea and the coastal forests made it attractive to do so.

CONCLUSION

The Mesolithic societies of northern Europe provide an important example of how rich natural resources, particularly those of lakes, streams, and seacoasts, can sustain substantial populations. Although agriculture became available in nearby parts of central Europe when communities of the Linear Pottery culture arrived around 5500 B.C. in northern Poland and Germany, there was little incentive to abandon the foraging way of life. Yet when the transition to agriculture did occur in southern Scandinavia about 3900 B.C., it was surprisingly rapid over the entire area between the southern Baltic coast and the Dalarna River in central Sweden. In northern Sweden and Norway, however, an essentially Mesolithic way of life persisted for many more centuries.

See also. **Saltbæk Vig** (*vol. 1, part 1*); **Archaeology and Environment** (*vol. 1, part 1*); **Postglacial Environmental Transformation** (*vol. 1, part 2*); **Skateholm** (*vol. 1, part 2*); **Tybrind Vig** (*vol. 1, part 2*); **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Transition to Farming along the Lower Rhine and Meuse** (*vol. 1, part 3*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*); **Consequences of Farming in Southern Scandinavia** (*vol. 1, part 4*).

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SKATEHOLM

Skateholm is a small coastal village located in the southernmost part of Sweden. A major part of the area close to the coastline comprises a wetland about 4 kilometers in length, running more or less parallel to the present coastline. During the Late Atlantic chronozone (c. 6800–4000 B.C.), which included several transgressions, an inlet was formed in stages. The freshwater from a couple of small rivers was mixed with inflowing saltwater, transforming the inlet into a basin with high levels of nutrition and diverse salinity levels advantageous to a wide variety of fish, birds, and mammals. Such an environment was quite attractive to humans in the Late Mesolithic with a base in fishing, hunting, and gathering. They settled on capes and islands close to the available resources. As a result of the transgressions, favorable sites for settlement subsequently were submerged, and the settlers had to move to suitable new camps. At least four such major settlement sites and several seasonal camps have been identified within the inlet, covering the time sequence 5200–4500 B.C.

Research has been adapted with a view to obtaining an overall picture of the infrastructure of the settlements in an attempt to identify activity areas of various types. This research applies, in particular, to the highest-lying sections with a partially disturbed, find-impoverished layer—in the majority of cases sites situated on slopes. Interest has concentrated on the upper sections of the settlement areas as the result of research conducted at the Bøgebakken site on the Danish Øresund coast. In 1975 construction work was carried out on the upper reaches of this site, where several graves of Late Mesolithic age came to light. The question was raised whether the Bøgebakken phenomenon was anything other than unique.

At Skateholm the main area of interest, toward which the majority of fieldwork has been directed, has been the investigation of nearly ninety burials on two main sites, Skateholm I and Skateholm II, located just a couple of hundred meters apart. Investigations have shown that Skateholm II is somewhat older than Skateholm I. Both sites contain numerous graves, which also were related to a contemporaneous settlement. Within the compass of a small area it is possible to study similarities and differences in the pattern of settlement and burial customs over the space of several hundred years. The size, location, and great age of the two cemeteries are naturally of considerable interest to the researcher, although there is another, equally fascinating aspect that concerns insight into the symbolic world provided by the cemeteries and burials.

The processing of the Skateholm material has produced indications that point to a complicated burial ritual. These rituals concern not only the interment itself but also the whole range of activities from the moment it was realized that a person was dying up to the act of refilling the grave. The dying person appears to have eaten a "last supper" with a particular content, evidence of which is provided by the fish bones in the stomach. The positioning of the deceased in the grave and the composition of the grave goods followed a particular pattern. The ritual included the deposition not only of objects such as tools and ornaments, which are classified as grave goods, but also of the skeletal parts of animals. Food, including fish, also was placed in the grave.

Various activities took place in connection with the filling in of the grave. Food was eaten, and the leftovers were deposited in the filling material. Traces of wooden structures raised over the grave pit have been found. These structures had been burned down before the refilling of the grave. The Mesolithic mortuary practice also included a small number of cremations, three out of eighty-seven. Three main categories of body positions can be identified: supine, seated, and crouching. The composition of the grave goods follows a more distinctive gender pattern than do the body positions. Tools, such as knives and axes, typically are found with men, whereas women have ornaments, such as belt decorations made of animal teeth. In addition various combinations of animal bones were sewn onto the clothes. Antlers also are found buried in a few graves. Red ochre was used frequently, more often than not covering only limited parts of the deceased person's body.

Certain differences in mortuary practice can be detected between the cemeteries. The crouching position, for example, is virtually unknown in the older cemetery at Skateholm II, whereas almost two of every five people interred at Skateholm I were placed in this position. The custom of depositing red deer antlers in graves is, on the contrary, quite unknown at Skateholm I, whereas it is a common feature at Skateholm II. At Skateholm the first evidence of dog graves was found. Dogs were provided with grave goods and were strewn with red ochre, reflecting a symbolism that appears to have applied to humans and dogs alike.

Investigations of grave fields such as those at Skateholm have radically influenced the approach to Late Mesolithic societies in northern Europe. The evidence of large grave fields with complex burial practices has added to the fund of information about the society. The Skateholm cemeteries thus can be placed in an interesting context with regard to both western and eastern Europe. Similarities exist between the cemeteries at Skateholm and those at Bøgebakken in eastern Denmark, for example. Several sites from the Late Mesolithic of southern Scandinavia have provided both cemeteries and single graves. Cemeteries in conjunction with large settlements seem to be a common feature.

Mesolithic cemeteries occur in western Europe in conjunction with shell middens, such as those at Téviec and Hoëdic in Brittany. New studies and radiometric dating of previously investigated cemeteries have provided a fresh and valuable perspective on Mesolithic cemeteries along the eastern Baltic coast and neighboring areas. The large cemetery at Oleneostrovskii Mogilnik in Karelia has been shown to be of Mesolithic age, and the cemeteries at Oleneostrovskii Mogilnik and at Zvejnieki in western Latvia are contemporary with the oldest known burials in Scandinavia.

See also **Oleneostrovskii Mogilnik** (*vol. 1, part 3*).

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LARS LARSSON

TYBRIND VIG

The Late Mesolithic Stone Age settlement of Tybrind Vig, which today is submerged, is located on the west coast of the Danish island Fyn (central Denmark) facing a sea called Lillebælt. Originally, it was a coastal settlement, but because of a geological tilting of the southwestern part of Denmark that has taken place since the Mesolithic, the prehistoric coastlines of this part of the country today are submerged. The site therefore now lies on the seafloor, c. 250 meters from the present-day coast and 2–3 meters below modern sea level. Because of the gradual rise in sea level, the habitation area proper (on dry land) was heavily eroded, while the lower and more protected parts of the site, mainly the waste or dump areas in the adjacent marine deposits, were and still are well preserved. There, the prehistoric remains have always been situated in wet, oxygen-free, and calcareous sediments, the best preservation conditions for "soft" organic materials, such as wood, bark, fibers, and bast, so far seen at northern European settlement sites.

The area around Tybrind Vig is hilly and was formed during the end of the Late Glacial of Denmark, c. 16,000 B.C. During the Mesolithic the site was located on a protected bay with shallow waters and connected to the more open sea (Lillebælt) by a narrow canal. The subsoil consists of a mixture of morainic clay and sand combined with gravel. The surrounding area was covered by primeval forest of lime, oak, and elm with thickets of hazel. Along the seashore there was a belt of seaweed.

The settlement was occupied during a gradual rise (transgression) in sea level, so the lower sedi-

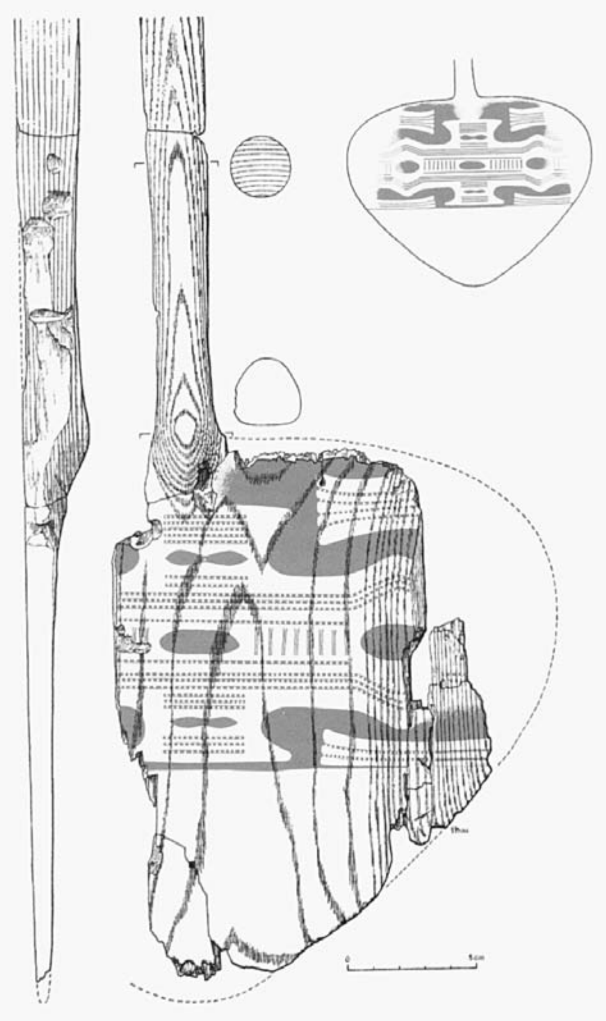

Fig. 1. Ornamented paddle from Tybrind Vig. COURTESY OF SØREN H. ANDERSEN, NATIONAL MUSEUM OF DENMARK. REPRODUCED BY PERMISSION.

ments are more coarse and sandy, while the top horizons consist of fine-grained mud (*gyttja*). During the transgression the surrounding coastal areas were eroded, and a large number of forest trees died and fell into the water and later became embedded in the marine sediments. Today these tree trunks allow for exact dating by dendrochronology and also give an indication of the duration of habitation. Carbon-14 dates inform us that the occupation period spanned some 1,500 years, from about 5500 to 4000 B.C., that is, the entire duration of the Ertebølle culture in southwestern Scandinavia.

The Tybrind site is the first and still the most extensive underwater excavation of a Stone Age settlement in Nordic waters. It was there that the great scientific potential of such sites became evident for the first time—mainly owing to the excellent preservation conditions for organic materials. This also was the site where Danish archaeologists learned how to excavate settlements on the seafloor and developed the necessary expertise and technical equipment for such investigations.

As mentioned, the habitation area proper eroded away during the transgression, and only the grave of a young girl and a newborn baby was still in place in this part of the settlement. All other finds of material culture and waste from the site were excavated in the adjacent marine deposits, where they had ended up during occupation. Besides the huge amount of waste, the area in front of the settlement also functioned as a "fishing ground," evidenced by the presence of hundreds of stakes from destroyed fish fences, fishhooks (of bone), nets, net floats, fish weirs, and leister prongs. This area probably was the access to richly stocked waters that were the main reason for selecting this particular spot for habitation.

The hundreds of animal bones—mainly from fish (small cod, flatfish, and dogfish); sea mammals, such as gray seals and porpoises (but also one killer whale); and red and roe deer and wild boar—give evidence of the economy of the site. In the forest fur-bearing animals, such as pine marten, otter, fox, and badger, were trapped. The only domesticated animal was the dog. Hazelnuts and acorns were collected and roasted at the site. The types of animal bones and chemical analysis of human bones, combined with the wide array of fishing equipment and the location of the settlement, supports a clear dominance of a marine diet.

The excavation has shed light on many aspects of material culture and art. All the ordinary artifacts of the Ertebølle culture, such as flint, other types of stone, bone, antler, and pottery—as known from sites on dry land—have been recovered. Because of the long duration of occupation, some changes in the inventory also were seen, most notably, the oldest ceramics in southern Scandinavia, dating to c. 4700 B.C.

A large array of wooden implements has been found at the site. Among them are axe handles of different sizes, lances, spears, bows and arrows, and a variety of paddles. There also were several dugout canoes, made of hollowed-out trunks of lime trees, one that measures 9.5 meters in length with a capacity of up to 700 kilograms. In addition, there are a variety of tool types that have never been encountered earlier from the northern European Late Mesolithic, and whose uses are obscure. The number and diversity of items of wooden equipment clearly show how essential this material was—it is estimated that only about 10 percent of the all the equipment consisted of flint.

The most extraordinary finds were textiles made of twisted strings of lime and willow knitted together in a technique called "needle netting"; these are the oldest European textiles found to date. There also are several ornamented paddles exemplifying a completely new type of Mesolithic craft working in "soft materials" (wood). The motifs are very different from those of earlier finds on ornamented bone, antler, and amber; these new designs consist of rounded curves, ovals, circles, and similar geometric shapes carved into the surface of the paddles and filled with a brown substance (possibly paint). For the first time we also have been able to analyze the remains of charred food crust from the inside of the pointed-bottom Ertebølle pots, telling us that they were used for cooking soup made of cod with a mixture of herbs of the grass family.

Excavation of this type of Mesolithic site opens up completely new avenues for Stone Age research in northern Europe. On dry land, agriculture or drainage has destroyed nearly all wetlands. On the seafloor we still can obtain a wide range of information, not only on material culture but also on subsistence and the environment, information that was lost long ago in now dried wetlands.

See also **Saltbæk Vig** (*vol. 1, part 1*).

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SØREN H. ANDERSEN

THE MESOLITHIC OF NORTHWEST EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

The Mesolithic of northwest Europe is the period between the end of the last Ice Age and the widespread adoption of agriculture. During the Mesolithic the region was occupied by hunter-gatherers, but the term itself refers specifically to a technological stage. Translated literally, it means "Middle Stone Age" and was adopted in the 1920s, when this period was viewed as a not particularly interesting interlude between the old and new Stone Ages—the Palaeolithic and the Neolithic. This view is no longer accepted, and the Mesolithic is now seen as the period in northwest Europe when anatomically modern humans adapted to the challenges and opportunities of the Postglacial environment. Conventionally, it spans six millennia beginning about 10,000 B.C.

TECHNOLOGY

The diagnostic artifacts of the Mesolithic in northwest Europe are retouched blades of chert, flint, or similar stone, referred to as "microliths," because of their often very small size; examples less than 10 millimeters long are common. These microliths were components in composite hunting weapons, usually arrows. One microlith provided the piercing tip, while others mounted in series down the shaft acted as barbs, not to secure the arrow in the wound but to increase its size and stimulate bleeding. Examples have been found in Sweden, still mounted in their shafts. The adoption of the bow and arrow as the principal hunting weapon is a characteristic of the Mesolithic, although the origins of the practice lie among the Late Upper Palaeolithic communities at the end of the Ice Age.

Microliths underwent development over time, and the various stages that have been identified have been used by archaeologists to subdivide the period. This practice has been superseded by the widespread application of radiocarbon dating. Three broad typological categories, however, are still referred to widely in the literature (fig. 1). The earliest types of microlith found in the northern part of the region were made on relatively broad blades that had been obliquely snapped, or truncated, to produce a robust tip. The origins of this type are found in Late Upper Palaeolithic assemblages referred to as Ahrensburgian. One lateral margin was abruptly retouched to facilitate insertion into the arrow shaft, and additional retouching sometimes extended around the tip and the base. These broad-blade, obliquely blunted points are widespread in southern Scandinavia, but they also are the characteristic find of the period down to about 8000 B.C. in the British Isles, the Low Countries, and northeastern France.

Assemblages in which this type predominates are referred to as Maglemosian in southern Scandinavia, but outside this region they are simply termed Early Mesolithic.

Farther south, obliquely truncated blades also dominate early assemblages, but the blades themselves tend to be narrower than those used in the north and the resulting microliths more geometric in form. They seem to have been influenced by the small, simple backed blades of the Late Upper Palaeolithic Azilian assemblages. In the literature these assemblages are termed Sauveterrian, named after the type site of Sauveterre-la-Lémance in France. During the period between 10,000 and 7000 B.C., microliths of this type spread from central and southern France throughout the region, replacing the broad-blade forms as the predominant type in the north in the eighth millennium B.C. During this period microliths also became smaller, narrower, and more geometric in form.

The third major technological stage was confined to mainland northwest Europe and saw the introduction from about 7000 B.C. of trapeze-shaped microliths. This stage is called the Tardenoisian, after the type site of Fère-en-Tardenois in France. The introduction of trapezoidal microliths suggests a change in hunting tactics, the trapezes being mounted singly at the end of the arrow shaft. Trapezes did not spread to the British Isles, where Late Mesolithic assemblages are characterized by the continued development of narrow-blade geometric microliths.

The Mesolithic hunter-gatherers of northwest Europe used a wide range of materials in addition to chert and flint, but because many were perishable, few examples survive. Bone and antler provide something of an exception, and two categories of implements made from these materials have been recovered in significant numbers: barbed projectile points and heavy-duty digging tools known as mattocks. Barbed points, which functioned as arrowheads, spearheads, and harpoon heads, also are known from Late Upper Palaeolithic assemblages; during the Mesolithic many different types were made to suit specific needs. The main change over time was in the production blanks, with long splinters of bone or antler being replaced about 8000 B.C. by blanks made from split sections of long bone or antler beam. The mattocks show fewer signs of

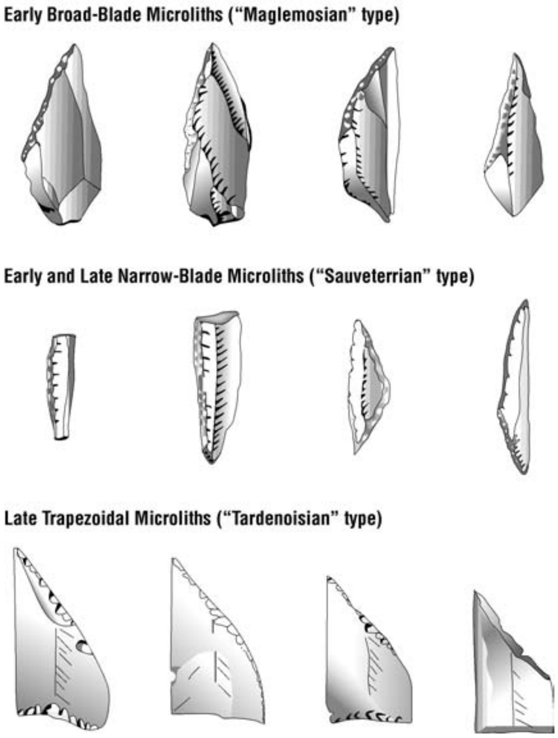

Fig. 1. Artifact types of the Earlier (Maglemosian) and Later (Sauveterrian and Tardenoisian) Mesolithic from northwest Europe. Widths of the microliths depicted here range from about 0.5 centimeters (narrow-blade) to 1.5 centimeters (trapezoidal).

development through time. Early Mesolithic examples are made from the basal sections of the antler, whereas antler beams were favored in the Late Mesolithic. Other, spectacular finds made from organic materials include several dugout canoes and basketwork fish traps.

SUBSISTENCE

The Mesolithic people of northwest Europe were hunter-gatherers, and their subsistence activities were governed by what was available. There are indications, however, that toward the end of the period, some groups were beginning to manage aspects of their environment through the controlled use of forest fires to enhance its productivity. Over the six millennia of the Mesolithic period, the environment of northwest Europe underwent a series of significant changes. In terms of plants and animals, species that had been driven out of the region or into its more southerly latitudes by the harsh conditions of the Ice Age migrated northward as the climate ameliorated. Throughout most of the Mesolithic the region was cloaked in a dense mantle of deciduous woodland, although the mosaic of species varied with latitude. For example, oak was predominant everywhere; in the south, warmth-loving species, such as pistachio, formed a significant component, whereas in the north, birch was often a major component.

These woodlands provided a home for a range of animals, many of which experienced human predation. The most favored animals appear to have been red and roe deer, wild cattle, and wild boar. Moose were important early in the period, but their absence after about 9000 B.C. suggests that habitat loss and predation had led to their extinction within the region. Small animals, such as hare, beavers, and pine martens, were trapped mainly for their pelts, and birds, especially waterfowl, also were taken. Evidence from a number of sites indicates that dogs had been domesticated by this time, and their status in society is reflected by the fact that they occasionally are found to have been given formal burial in cemeteries otherwise occupied by humans. Little is known about the use of plant resources, owing to the rarity with which such material survives, although hazelnuts are almost ubiquitous.

Aquatic resources, both freshwater and marine, made a significant contribution to subsistence, but their role needs to be evaluated in light of the major changes in sea level that occurred during this period. At the height of the Ice Age much of the Earth's water was locked up in continental ice sheets and, as a consequence, sea level was greatly reduced. Estimates vary, but eighteen thousand years ago the sea level around northwest Europe may have been as much as 130 meters lower than it is today. With the melting of the ice sheets, the sea level began to rise, but by the beginning of the Mesolithic it was still around 35 meters below the present level. Britain did not become an island until the middle of the eighth millennium B.C. The effect of these changes in sea level was profound. During the Early Mesolithic the area of the North Sea was dry land, and bands of hunters could walk dry-shod from the Low Countries to southeast England. As sea levels rose, the loss of land led to population displacement. It also produced lengthening of the coastline and flooding of estuaries. These processes greatly increased the availability of aquatic resources and fish; marine mammals and shellfish became important components in later Mesolithic subsistence strategies. Substance patterns in Mesolithic northwest Europe can be illustrated by considering the faunal inventories recovered from numerous key sites.

The site of Star Carr in Yorkshire, England, provides a good example of subsistence during the Early Mesolithic. This site, which is one of several lying along the shores of a Late Glacial/Early Postglacial lake, experienced two periods of occupation during the middle of the ninth millennium B.C. As well has large numbers of Early Mesolithic microliths and barbed antler points, the excavators recovered bones of moose, wild cattle, red and roe deer, pine marten, fox, and beavers. Surprisingly, no fish remains were recovered, but birds included red-breasted merganser, red-throated diver, and great crested grebe. Edible plant remains reported from Star Carr were water chestnuts, bog bean, fat hen, and nettle, in addition to hazelnuts.

The site at Mount Sandel in the valley of the River Bann in Northern Ireland was occupied during the later part of the ninth millennium B.C., and the flint assemblage was dominated by narrow-blade, geometric microliths, although a few broad-blade forms also were present. Of the mammal bones recovered, 98 percent were of wild boar. Ireland was cut off from mainland Britain by rising sea level at an early stage in the Postglacial, and this specialization on a single species may have been due to the impoverished nature of the available fauna, few species having successfully established themselves before access was cut off. Among the birds recorded were mallard, teal, wigeon, grouse, capercaillie, and snipe or woodcock. Fish were well represented, and 80 percent of the identified bones came from salmon or sea trout. Eel and bass also were present, and plant remains included hazelnut shells, pear or apple pips, and water-lily seeds, all of which probably contributed to the diet.

The faunal assemblage from the small rock shelter of L'Abri du Pape in the Meuse Valley of Belgium provides good insight into the species preyed upon by the Mesolithic hunters of this part of northwest Europe during the eighth and early seventh millennia B.C. Mammals comprised red and roe deer, wild boar, wild cattle, otter, fox, and wild cat, although the quantities of each are small. Predation appears to have been focused on river fish and birds, of which more than thirty different species have been identified. The fish species include carp, pike, catfish, eel, salmon, perch, and shad.

The sites of Téviec and Hoëdic now lie on small islands off the coast of Brittany, but during the Mesolithic lower sea levels may have meant that they were on promontories joined to the mainland. These sites were excavated in the early years of the twentieth century, and the available details are not as extensive as for Star Carr and Mount Sandel. Nonetheless, the presence of trapezoidal microliths allows them to be placed in the later Mesolithic. Both sites consisted mainly of accumulations of food debris, called middens, into which had been inserted numerous human burials. Among the food species identified were shellfish, such as limpet, periwinkle, mussel, oyster, and scallop, and numerous fish bones, mainly of wrasse. Bird remains included waterfowl and auks; mammals consisted of red and roe deer, wild boar, fox and wildcat, and plants exploited included wild pear.

Finally, the excavated sites at Hardinxveld-Giessendam near Rotterdam in the Netherlands have provided abundant data on subsistence resources at the end of the Mesolithic and the beginning of the Neolithic. The site at Polderweg was situated on a riverbank and witnessed three phases of occupation during the latter part of the sixth millennium B.C. Throughout this period the main activity appears to have been pike fishing, probably undertaken during the second half of the winter. Roach, bream, tench, eels, catfish, and salmon also were caught, probably through the use of sophisticated traps. Beaver and otter were the most important mammals, probably trapped for their pelts, as were pine marten, wild cat, and polecat. The remains of wild boar and red and roe deer also were present in the assemblage. Fowling concentrated on ducks, and plant resources comprised acorns, hazelnut, water nut, wild apple, and various berries. The flint assemblage at Polderweg is dominated by simple blades but includes three arrowheads of a type normally found on Early Neolithic *Linearbandkeramik* sites in the region. The presence of simple bag-shaped pottery vessels also testifies to contacts between these Late Mesolithic hunter-gatherers and their Early Neolithic neighbors; unlike the nearby and slightly later site of De Bruin, however, domestic animals and cultivated grains are absent.

SETTLEMENT PATTERNS

It is thought that the Polderweg site was occupied mainly during January and February, and the issue of the seasonal availability of resources needs to be kept in mind when considering settlement patterns in the Mesolithic. In general, hunter-gatherers needed to live a mobile, seminomadic existence, moving from one area to another as resources became available at different times of the year. The deciduous woods of northwest Europe offered a fairly homogeneous environment, but seasonal movements would have been undertaken by most groups, migrating between the coasts and the interior and between the lowlands and uplands. Movement also would have been necessitated when resources in one region became exhausted or disturbance of prey species led to diminishing returns.

Two patterns of mobility can be identified. In one, the whole group moved on a fairly frequent basis, at least each season or more often, and hunting and gathering took place within a day's march of the residential location. The American anthropologist Lewis Binford coined the term "residential foraging" for this pattern of behavior. In the alternative pattern, moves were made less frequently, and part of the group might have remained in one location over several seasons while specialist task groups were sent out to hunt and gather farther afield. Binford calls this "logistic collecting." These two patterns each represent either end of a continuum, and it is unlikely that any Mesolithic population adhered to one extreme or the other. Rather, the emphasis probably shifted on a tactical basis from season to season and from year to year. Groups may have been residential foragers in spring and early summer, when resources were generally scarce, but shifted to a more logistic strategy in autumn, which was the season of plenty. Storage of the autumn abundance may have limited the need for frequent moves in the winter.

Settlement mobility is difficult to demonstrate, but it sometimes is possible to show that a site was occupied only at certain times of the year, with the implication that at other times the people were living elsewhere. Star Carr was visited mainly in the spring and summer, Mount Sandel in the autumn, and Polderweg during the winter. Another way of monitoring mobility is through the distribution of raw materials. For example, flint found on Mesolithic sites in the Pennine uplands in northern England originated up to 80 kilometers away in Yorkshire, whereas material found at Polderweg came from the Meuse gravels 50 to 100 kilometers away. It may reasonably be assumed that these materials give an indication of the distances covered by the groups in the course of an annual cycle. Caution must be exercised in interpretation, however, as in the case of Wommersom quartzite, items of which also were found at Polderweg. This material outcrops naturally in a very restricted area of central Belgium, but artifacts made from it are found over an area of about 45,000 square kilometers, extending from the North Sea to the valleys of the Rhine and Meuse. Within this area the distribution can be subdivided into a core lying between the Meuse and Schelde in which Wommersom quartzite can form up to 77 percent of assemblages and a wider zone in which its contribution to assemblages is usually less than 5 percent. Whereas the distribution within the core area probably reflects the movements of individual groups to and from the source or the deployment of logistic task groups, the marked falloff indicated by the wider distribution is more reminiscent of the patterns generated by down-the-line trade or exchange.

These patterns of mobility have meant that archaeologists can encounter a range of site types. From the finds made, some appear to have been home bases where the whole group resided for at least part of the time, while others seem to have been the locations of more specialized activities. Among the latter are hunting camps used by logistic task groups when away from the home base and extraction sites, such as the locations where raw materials were collected and animals were killed. Home bases are the most common type of site identified in northwest Europe during the Mesolithic, which suggests that the most frequently followed pattern was one of residential foraging. Star Carr, Mount Sandel, and Polderweg probably are examples of home bases, although the latter two sites appear to have become hunting camps during a later phase of activity. The shell-midden sites along the Atlantic seaboard, such as Téviec and Hoëdic and those on the island of Oronsay in the Hebrides, may reflect specialist activities.

Population numbers are notoriously difficult to estimate, but comparison with recent hunter-gatherer populations suggests that northwest Europe at the height of the Mesolithic is unlikely to have supported more than 100,000 people and possibly far fewer. Published estimates for the British Isles at the end of the Mesolithic suggest a range of between 2,750 and 5,500. Residential foragers usually lived in small groups, or bands, made up of just a few families. Archaeology can tell little about the social relations within and between these bands. In common with recent hunter-gatherer societies, bands probably were fairly egalitarian, with leadership provided on a tactical basis by skilled individuals. Older members would have had a valued role as repositories of knowledge and experience. Relations with other bands are likely to have ranged between amity and enmity, depending on the degree of competition over resources, and probably were managed by a complex system of alliances. Toward the end of the period, as population levels increased, more complex, hierarchical social structures may have emerged. During periods of abundance it would have been possible for several bands to come together, perhaps at regular intervals. Such gatherings would have been highly necessary both socially, for the exchange of information and the maintenance of alliances, and genetically, for the maintenance of a healthy gene pool through the exchange of marriage partners.

SETTLEMENT STRUCTURES

Very little is known about the kind of structures erected on Mesolithic settlements. This is hardly surprising, given the transitory nature of most settlements. Many temporary campsites may not have had any structures other than a windbreak and a fireplace. In areas where the geology was suitable, such as the Meuse Valley in Belgium, southwest France, and the limestone regions of England and Wales, caves were used on an occasional basis. Nowhere does this seem to have been a popular or widespread practice, however, and caves were used almost as frequently as burial grounds. Some early sources make reference to "pit dwellings," holes in the ground thought to have been roofed over and occupied as shelters. This view is no longer accepted, and these features now are interpreted as tree-fall hollows, the presence of Mesolithic finds in and around them being regarded as accidental. The identification of a few substantial Mesolithic structures nonetheless indicates that this absence of evidence is in part due to the exigencies of survival.

The best examples of Mesolithic houses excavated in northwest Europe are the structures uncovered at Mount Sandel in Northern Ireland. There, three D-shaped huts were identified that could have been occupied at the same time. Each structure was 5.5 meters in diameter and had a central hearth. Walls were indicated by stake holes, which inclined inward, suggesting a superstructure of bent and tied saplings. The whole structure presumably was covered with vegetation or hides. These huts provided 30 square meters of floor space, and each could have accommodated a single family, suggesting a three-family co-residential group. Traces of similar structures have been reported from elsewhere in the region.

SYMBOLISM, RITUAL, AND BURIAL

Compared with the preceding Upper Palaeolithic, which saw the flourishing of cave art, the Mesolithic in northwest Europe is an impoverished period, with little more to offer than a few bone and antler implements with rudimentary abstract engravings and some putative anthropomorphic figurines. By far the best example is the 125-millimeter-high statuette from Willemstad, in North Brabant, the Netherlands, dated to the mid-sixth millennium B.C. This is carved on a plank of oak and consists of the head and part of the upper body; the gender is unspecified. It was found in a peat bog and probably was a ritual deposit rather than a casual loss.

Other evidence for ritual behavior, apart from burial, is virtually nonexistent. At the site of Star Carr in Yorkshire, England, twenty-one red deer antler frontlets were recovered. They had been adapted for wearing as headdresses; rather than simply regarding them as deer-stalking disguises, it has been claimed that they are evidence for a hunting ritual. This distinction between secular and ritual behavior probably did not apply in the ninth millennium B.C., and hunting may have been a highly ritualized activity. Similar modified frontlets are known from elsewhere in northwest Europe but not in such large numbers.

Burial is the one form of ritual behavior for which there is evidence throughout the region, but even so this area stands in poor comparison with southern Scandinavia and the Baltic, from which most of the evidence about Mesolithic funeral practices has been derived. The fact that northwest Europe has produced a few hundred Mesolithic burials at most means that the great majority of people were not afforded the right of formal burial but had their mortal remains disposed of in some other way. A hint as to what happened to them is provided by the Mesolithic shell middens on the island of Oronsay in the Hebrides, Scotland. Excavation of a group of these sites failed to identify any formal burials but did recover a number of isolated bones, mostly of fingers and toes. The explanation that has been offered is that the dead were laid out on exposed platforms while they decomposed. When this process was complete, the bones were collected for disposal elsewhere; inevitably a few small bones would occasionally get lost. There is evidence for this practice from recent hunter-gatherers, and it represents a parsimonious explanation for the absence of numerous burials and the occurrence of isolated bones.

Some segments of the population were buried formally. In certain cases these were single individuals buried within or close to settlements. A good example is the burial of an adult woman of about fifty years of age during an early phase at the Polderweg settlement. She was laid on her back in an extended position (fig. 2). A greatly disturbed second burial was found nearby, along with those of three dogs. Caves featured prominently in Mesolithic burial rituals, both for individuals, as in the case of Cheddar Man, a burial of the late ninth millennium B.C. found in Goughs Cave, Cheddar Gorge, England, and for groups. Examples of the latter come from the Meuse Valley in Belgium, where ten to eleven female burials are reported from the Margaux Cave and five adults and six children from the Autours rock shelter. These cave burials all date to the ninth millennium B.C., as is also the case with the seventy or more burials reported from Avelines Hole, near Cheddar, England (most of them were found more than a century ago, however, and few details are available).

In northwest Europe the best examples of Mesolithic cemeteries outside caves are the Breton shell-midden sites of Téviec and Hoëdic. In Téviec ten graves contained the remains of twenty-three individuals, whereas at Hoëdic nine graves contained thirteen people. That many graves at these Late

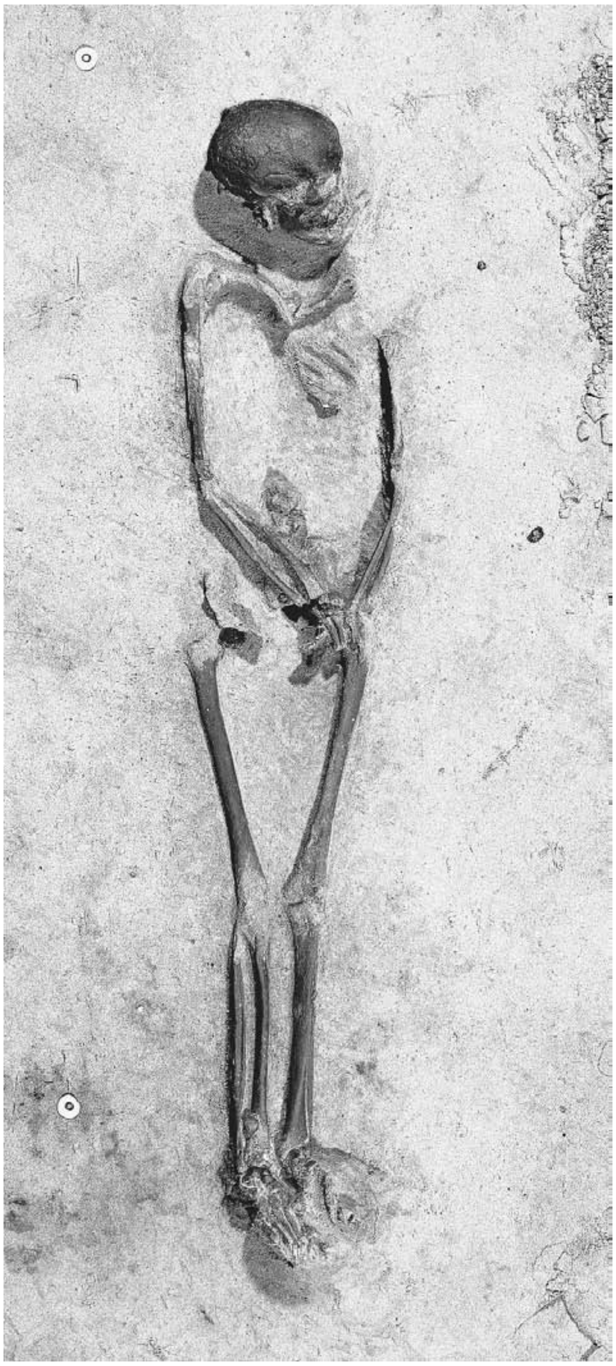

Fig. 2. Late Mesolithic grave of an adult woman at Hardinxveld-Polderweg, The Netherlands. COURTESY OF DR. L. P. LOUWE KOOIJMANS, LEIDEN UNVIERSITY. REPRODUCED BY PERMISSION.

Mesolithic sites contain more than one inhumation is particularly interesting, as collective burial was to become a major feature of funerary rites in the subsequent Early Neolithic period. One burial at Téviec, that of a young adult man, provides further insight into life in the Late Mesolithic, in that he was found to have a transverse arrowhead embedded in his spine. Other cases of violent death are known from elsewhere in Europe, particularly southern Scandinavia and southeast Europe, and it has been suggested that the Late Mesolithic period witnessed the origins of formal warfare. The evidence is insufficient to support such a sweeping conclusion, but these cases do suggest a degree of interpersonal violence not witnessed earlier.

The end of the Mesolithic in the region is marked by a shift to the adoption of farming during the Neolithic. The reasons for this change are the subject of debate; environmental, economic, and social pressures have been proposed as the driving forces, and a single explanation is unlikely to apply throughout the region. What is not in question is that farming makes it possible to support a larger population, and population pressure must have played a part in convincing people of the advantages of adopting agriculture. The origins of farming are to be sought outside northwest Europe, in the Near East, Anatolia, and southeast Europe, and the process of adoption in northwest Europe was gradual, spanning at least a millennium. Domesticated sheep and goats are reported from the French Mediterranean site of Chateauneuf-les-Martiques in the sixth millennium B.C., whereas domestic animals are not recorded in the north of the region before the mid-fifth millennium. At one time it was believed that farming was spread by Neolithic immigrants, but it is now considered more likely that it was adopted selectively by the indigenous Mesolithic population. Nevertheless, it remains the case that the species involved and the ideas about their management had to be introduced from outside.

Two sources of this influence can be detected in northwest Europe. On the one hand, on the Mediterranean coasts, elements of Neolithic culture, such as pottery and grinding stones, begin to appear in Mesolithic assemblages in the seventh millennium B.C. On the other hand, in the northeast, pottery and specialized types of arrowhead, derived from the Early Neolithic farmers of the *Linearbandkeramik* culture, appeared in late Mesolithic assemblages by the beginning of the fifth millennium. In both cases elements of material culture were adopted before the first signs of domestic crops or farm animals. Given the several million years of the span of human history, the period of time over which farming was adopted in northwest Europe was brief, and by 4000 B.C. it had spread throughout the region. Hunting and gathering continued to be part of the way of life, however, for many communities for more than a millennium.

See also **Mount Sandel** (*vol. 1, part 2*); **Star Carr** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Transition to Farming along the Lower Rhine and Meuse** (*vol. 1, part 3*).

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CHRISTOPHER TOLAN-SMITH

MOUNT SANDEL

Mount Sandel is best known as the name of a Mesolithic settlement site that generally is regarded as producing the earliest securely dated evidence of human settlement in Ireland. The name of the site derives from a nearby prominent earthen fortification, which was used from the early medieval period to the seventeenth century. The fortification and the Mesolithic settlement lie on the edge of an escarpment 30 meters high and overlook the upper reaches of the estuary of the River Bann as it flows northward into the Atlantic Ocean. The River Bann is the second-largest river system in the island of Ireland and drains two-thirds of the state of Northern Ireland.

The potential of Mount Sandel first became apparent in the 1880s, with the recovery of a large number of chipped flint axes. The recovery of these "kitchen midden axes" at Mount Sandel and several other nearby localities and along the River Bann soon led several antiquarians (in particular William Knowles) to speculate that they were associated with what was thought of as the earliest Neolithic recolonization of northern Europe—what is referred to today as the Mesolithic period. During the 1930s, with the work of Hallam Movius, attention was focused more on the assemblages on the nearby Holocene raised beaches, and so interest in Mount Sandel waned. It was only with the work of Pat Collins in the 1960s and Peter Woodman in the 1970s that the full significance of Mount Sandel became apparent. The 1960s excavation concentrated on a series of deposits, at least partially slumped, on the slope below Mount Sandel Fort, while the excavations in the 1970s concentrated on an area that lay behind the fort, especially in fields where a major housing development was planned.

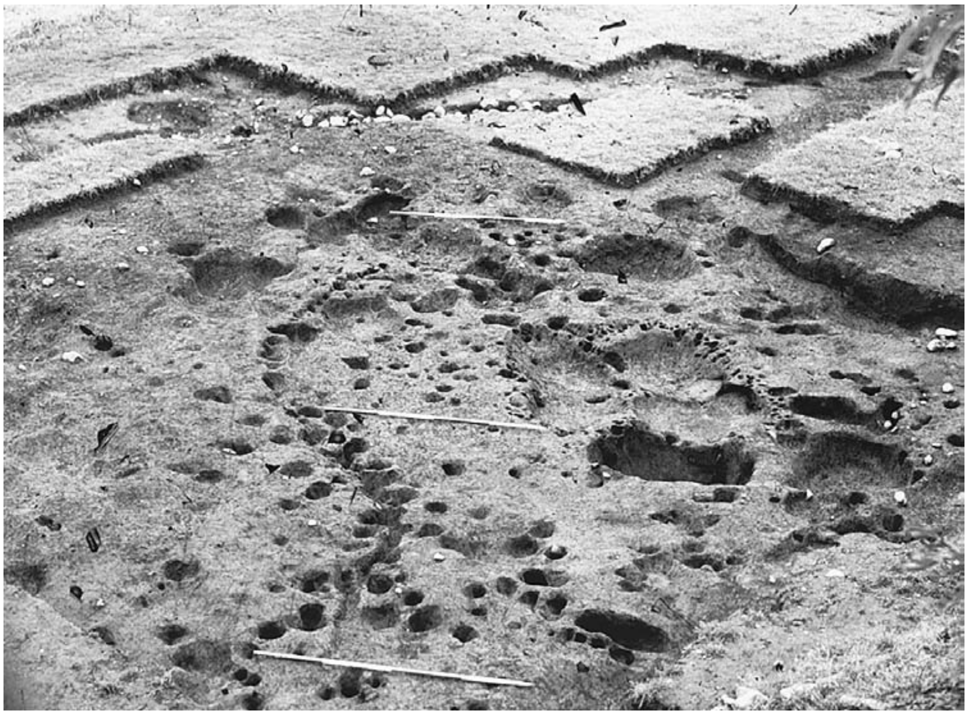

Fig. 1. View of the excavation of the hut foundations at Mount Sandel. COURTESY OF PETER WOODMAN. REPRODUCED BY PERMISSION.

It had become conventional wisdom that the human occupation of Ireland began at 6000 B.C., but the excavations at the upper site in the fields have shown that the occupation at Mount Sandel began at a much earlier date. The radiocarbon dates from the site range from 8990±80 B.P. to 7885±80 B.P. Most of the dates from the main phase of occupation seem to be earlier than 7700 B.P. If the earliest dates are calibrated, it suggests that occupation at Mount Sandel could have begun by 8000 B.C. It should be noted, of course, that this date is approximately one thousand years after the beginning of the European Mesolithic. A few older dates from other sites also are known, but they either are from unreliable contexts or have such large standard deviations that the age spans of the dates renders them virtually useless.

The excavation of the upper site concentrated mainly in fields adjacent to Mount Sandel. Owing to extensive cultivation of the area, little evidence other than that in the topsoil was expected to survive. The actual excavation, however, uncovered extensive traces of structures, which represented the partially preserved remnants of numerous reoccupations of the site. A series of stake holes, hearths, pits, and patches of dark charcoal-stained soil was uncovered. In one area a small, shallow depression had been enlarged and flattened, and in it a series of four almost circular huts had been built in sequence on roughly the same spot. These huts were built with stakes to form either an inverted bowl or wigwam-shaped hut, each of which would have been between 5 and 6 meters in diameter. Toward the center of each hut a shallow depression about 20 centimeters deep and up to a meter across had contained fires. Other pits were dug in the vicinity of each hut. A few were quite large, up to 1 meter in depth. Larger and more irregular hollows probably were created by tree falls. (In some parts of Europe these tree falls may have been misinterpreted as pit dwellings.)

As Ireland may have been an island for more than the past ten thousand years, it has a distinct ecology. During the Early Holocene, probably no more than ten indigenous mammals and a few freshwater fish species inhabited Ireland. In fact most of the large mammals as well as such fish as pike that normally would have been hunted or caught in the rest of northwestern Europe were not present in Ireland. Therefore one question of interest is how early hunter-gatherers adapted to living in Ireland. Unfortunately, in many parts of Ireland the soils can be quite acidic, and so the faunal remains do not survive on many prehistoric settlement sites. At Mount Sandel, however, considerable quantities of bone, hazelnut shells, and other plant remains were thrown onto fires; as a result, the burned or carbonized organic remains survived. These remains often were recovered from layers where they had been left in hearths or dumped into other empty pits. Although limited in quantity, the organic material from Mount Sandel still provides one of the best pictures of the lifestyle of Mesolithic communities living in Ireland. The faunal remains from the excavation were dominated by the bones of migratory fish species, particularly salmonids, with lesser numbers of eels. Other fish species, including some sea bass, were rare. While a scatter of bird bones was recovered, the mammalian remains were made up of wild pig, three bones of hare, and a dog bone. The plant remains consisted of many thousands of fragments of hazelnut shells as well as a few water-lily and apple seeds.

The substantial nature of the dwellings and the careful positioning of the settlement to take advantage of a range of different environments suggest that the Mount Sandel site was used by a group of hunter-gatherers who remained at this one locality for a significant part of the year. Salmon could have been fished as they moved upstream during the spring and summer, and eels would have been caught as they came downstream in the autumn and early winter. Some of the fish and other resources, such as the hazelnuts, may have been stored throughout the winter. The bones of young piglets born in the early spring were found mixed in with the shells of hazelnuts, which presumably had been collected at the end of the previous autumn.

The stone tools from the site usually were made from flint and were, to some extent, similar to those found in adjacent parts of Europe. The most common artifacts were the small geometric microliths that would have been used in composite tools as knife-edges, barbs, and so forth. The most usual forms of microliths were elongated triangles and backed rods. The axe forms recovered from the site included broad-edged adzes (flake axes), small chopping tools (core axes), and numerous polished stone axes. Polished stone axes are well-established features of the Irish Mesolithic.

Somewhat similar assemblages have been found throughout Ireland, from Lough Boora in the Irish Midlands to sites in the south of the island, such as Kilcummer, which overlooks the Cork Blackwater River. There is still no evidence of an earlier human presence in Ireland, either during the first thousand years of the Holocene or in the preceding three thousand years of the Late Glacial, when intermittent human presence is known in southern Britain. At the same time, there is no doubt that some of the implement types found at Mount Sandel are local forms, which would suggest the existence of an earlier phase of human settlement in Ireland.

See also **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **Star Carr** (*vol. 1, part 2*).

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STAR CARR

The Early Mesolithic site of Star Carr lies in North Yorkshire, England, 7 kilometers to the south of Scarborough, on the northern margins of an area of flat, peat-covered ground that in the early stages of the postglacial era (c. 8000–9000 B.C.) was occupied by a large lake, approximately 5 kilometers by 2 kilometers in extent. At the time of occupation (during a period of rising sea levels as the last glacial ice sheets melted) the site would have been approximately 10 to 12 kilometers from the coast, flanked by the limestone and gritstone hills of the North York Moors to the north and the chalk hills of the

Yorkshire Wolds to the south. Owing to the reduced sea levels, the whole of the southern North Sea basin at this time was dry land, allowing easy access to the Early Mesolithic groups from the adjacent areas of Denmark, northern Germany, and southern Sweden. Calibrated radiocarbon dates point to occupation of the site spanning a period of around three hundred years, from c. 8700 to 8400 B.C.

The classic excavations of the late Sir Grahame Clark at Star Carr between 1949 and 1951 revealed remarkable finds of both stone and bone or antler artifacts concentrated mainly within an area of 200 square meters in the heavily waterlogged deposits that occupied the shoreline area at the edge of the former lake. Clark interpreted the finds in terms of a closely spaced succession of occupations by small groups of hunters, which he estimated from the overall extent of the occupied zone to be in the region of at most twenty to twenty-five people, possibly equivalent to four or five families. The working of red-deer antlers was clearly a major activity at the site, employing the "groove-and-splinter" technique to detach long splinters of antler that were subsequently shaped into multiple-barbed spear points, of which no less than 191 were found on the site (see fig. 1). Other bone and antler artifacts included hafted "mattock heads" of moose (European elk) antler, bone pins, scrapers made from the split metapodial bones of wild oxen, antler-tine wedges, and parts of twenty-one "headdresses" consisting of thinned pairs of red-deer antlers, still attached to parts of the skull, and perforated for attachment either as hunting disguises or (more probably) ritual headgear employed in ceremonial activities. Associated stone artifacts included large numbers of flint microliths (of triangular, trapezoidal, and obliquely blunted forms), apparently employed as barbs and tips of wooden arrows, flint skin scrapers, burins (for working antler), rotary awls, and transversely sharpened flint axes or adzes, together with at least thirty perforated beads made from thin shale pebbles and a perforated pendant of North Sea amber. The only wooden artifact recovered was a fragment of (apparently) a wooden paddle (fig. 1).

The rich assemblage of animal bones recovered from the site included remains of at least twenty-six red deer (not counting antlers), seventeen roe deer, sixteen aurochs (wild oxen), twelve elk (moose), and four wild pigs, as well as a few bones of wild birds and the remains of a domesticated dog. Surprisingly (for a lakeside site) no remains of fish were recovered. Although initial analyses of these remains suggested occupation mainly in the winter months of November to April (a conclusion based principally on the abundance of unshed red-deer antlers still attached to the skull), subsequent analyses of the faunal remains as a whole by Anthony Legge and Peter Rowley-Conwy (1988) point to occupation of the site mainly in the summer season, with the large quantities of red-deer antlers probably being imported into the site as a source of raw materials for tool manufacture from animals killed elsewhere. On the basis of the relative frequencies of different parts of the red-deer carcasses—and by analogy with similar patterns recorded on Inuit caribou-hunting sites—Legge and Rowley-Conwy suggested that the site most probably represented a repeatedly visited "hunting stand" probably occupied by small groups of male hunters who had their main base camps elsewhere. Winter sites, they suggested, could have been located on the adjacent North Sea coast while (as Clark had suggested in 1972) other summer-season camps could have been located on the uplands of the adjacent North York Moors, directly to the north. Other workers (including Clark himself) have preferred to see the site as a more general base-camp locality, with a strong component of both industrial and ceremonial activities represented on the site.

Fieldwork at Star Carr in the late 1980s amplified this pattern in several ways. An excavation 20 meters to the east of Clark's original excavations revealed a short (6 meter) segment of wooden trackway, consisting of carefully split planks of aspen, up to 30 centimeters across and 3 meters in length, extending from the edges of the dry-land occupation zone toward the open waters of the lake—seemingly the earliest evidence for systematic carpentry so far recorded from Europe. Associated analyses of the lake-edge sediments by Petra Dark revealed successive levels of charcoal fragments, which suggested repeated and almost certainly deliberate burning of the lake-edge reed-swamp vegetation extending over a total time span of around three hundred years (from c. 8700 to 8400 B.C. in calibrated radiocarbon years). The burning could have been carried

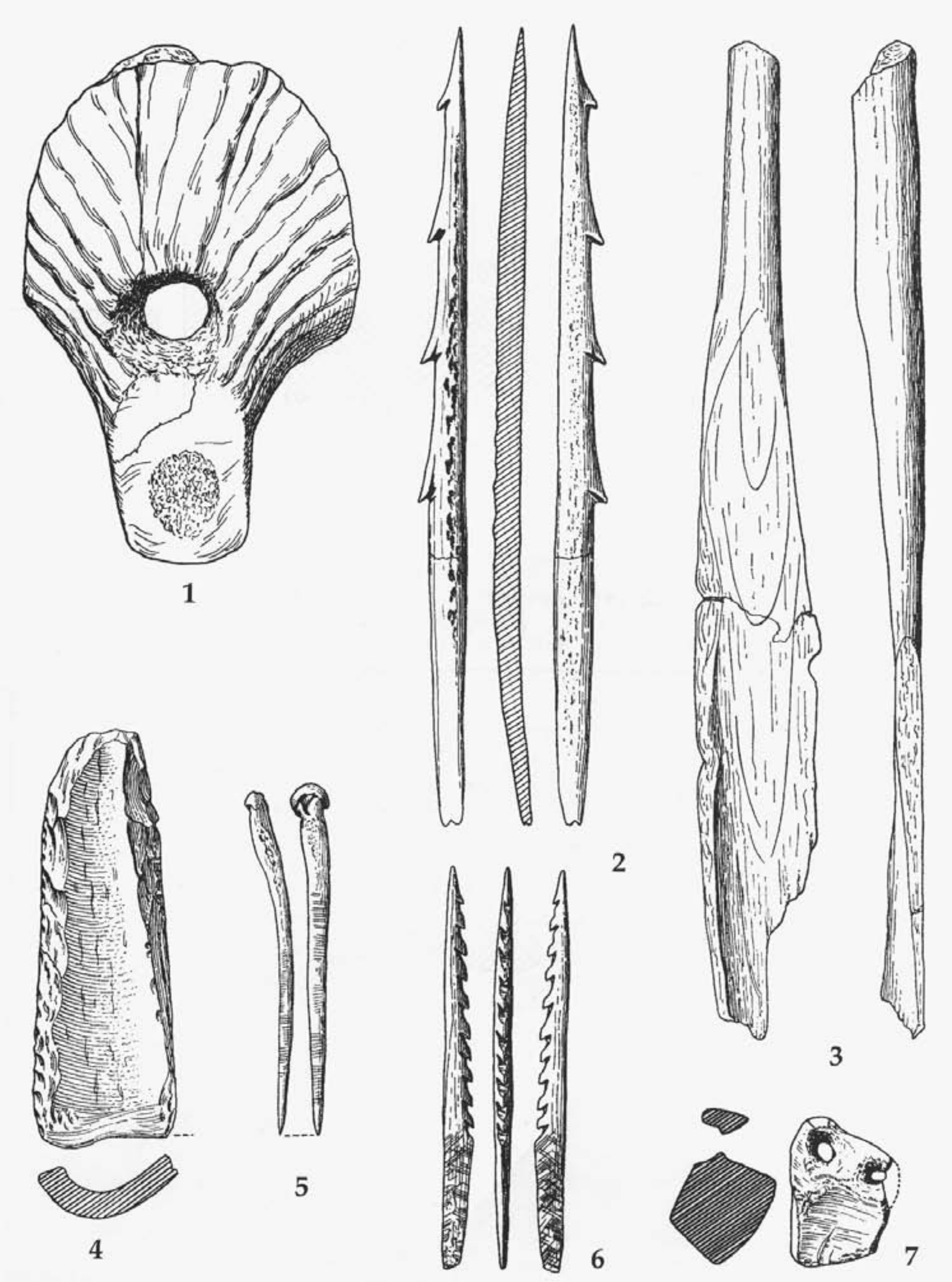

Fig. 1. Bone and antler artifacts and wooden "paddle" from J. G. D. Clark's excavations at Star Carr. FROM *EXCAVATIONS AT STAR CARR* BY J. G. D. CLARK. REPRINTED WITH THE PERMISSION OF CAMBRIDGE UNIVERSITY PRESS.

out either to attract animals to the new growths of reeds on the burned-over areas or (more prosaically) simply to clear away the dense growth of reeds between the occupation zone and the lake itself. Ongoing fieldwork as of 2003 in other parts of the lake basin by Tim Schadla-Hall and the Vale of Pickering Research Trust has shown that at least a dozen other sites of the same period are located at various points around the shores and islands of the same lake, though as yet none of these have produced rich finds of bone and antler remains comparable to those from Star Carr itself.

The evidence from Star Carr and the adjacent sites forms part of a broader pattern of rapid human colonization of northern Europe as the ice sheets of the last glaciation rapidly retreated and the preceding open, tundra-like landscapes were replaced by the pioneering birch and pine forests of the early postglacial (Preboreal) period. Sites of similar age and with similar archaeological material have been recorded in Denmark (Klosterlund), southern Sweden (Henninge Boställe), and northern Germany (Duvensee, Friesack, Bedburg-Königshoven) and are generally grouped together under the term "proto-Maglemosian." While these sites provide confirmation that similar patterns of adaptation and culture existed over a large part of the northern European Plain at this time (including, no doubt, large areas of land now submerged below the North Sea) the site of Star Carr remains unique in the extraordinarily rich and varied collection of bone and antler artifacts, and associated food refuse, recovered. It is generally seen not only as the "classic" site for this earliest Mesolithic occupation of northern Europe, but as one of the most important Mesolithic sites so far investigated in Europe.

See also **Archaeology and Environment** (*vol. 1, part 1*); **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **Mount Sandel** (*vol. 1, part 2*).

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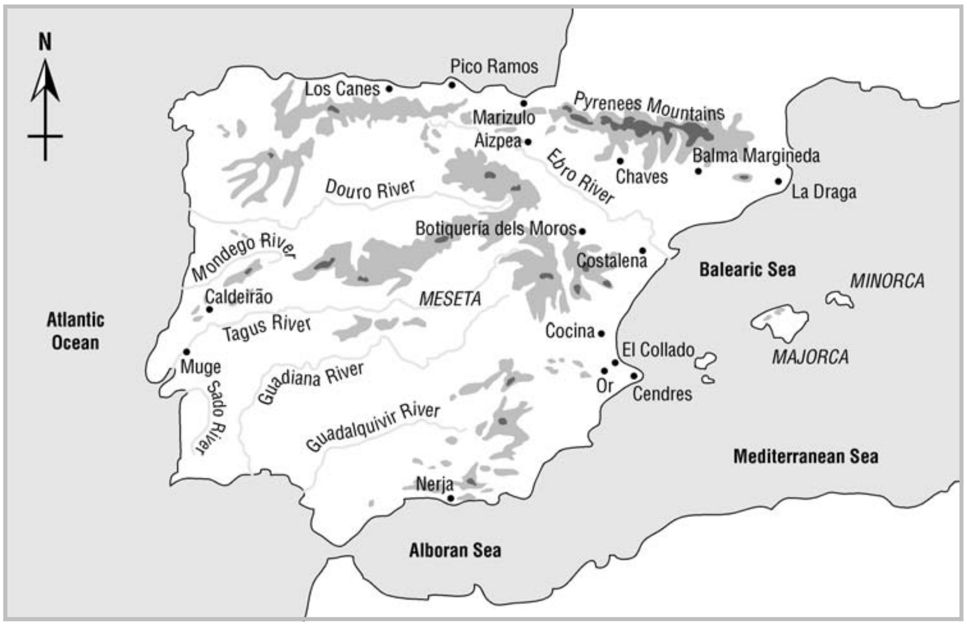
THE MESOLITHIC OF IBERIA

Until the end of the Ice Age hunter-gatherer settlement in the interior of Iberia must have been as important and permanent as that of the coastal regions of Asturias, Cantabria, the Basque country, Portuguese Estremadura, and the Mediterranean arch (from Gibraltar to the eastern flank of the Pyrenees). This is best exemplified by the open-air art and habitation sites of the Douro basin, particularly those found in the Côa River valley. After that, however, the interior *mesetas* show few signs of human occupation until almost 4000 B.C., when they were resettled extensively by farmers. No taphonomic biases that could explain this pattern have been identified, which suggests that it is indeed a genuine reflection of regional settlement histories.

The reasons behind this major reorganization of human settlement from the interior to the coasts probably are related to the abrupt climatic change that occurred at the transition from the Dryas III to the Preboreal periods (c. 9500 B.C.), when average temperatures rose by several degrees in a single generation. Another consequence of this process was the rapid flooding of the vast littoral platforms that extended beyond present-day coastlines, especially along the Atlantic. As a result an economic shift toward increased reliance on aquatic resources is evident in all coastal areas of the peninsula. It must be noted, however, that the inception of this trend can be traced back to Magdalenian times (between c. 17,000 and c. 12,000 B.C.) in such areas as the Cantabrian coast and the bay of Málaga. In these areas, because of the abrupt submarine relief, today's coastal sites are quite close to the later Palaeolithic and Early Mesolithic seaside, permitting the preservation of an archaeological record of adaptations that elsewhere was destroyed by the rise in sea levels.

The effects of such a shift are most visible in the marked contrast that exists between the Portuguese sites located on each side of the Dryas III–Preboreal divide. Earlier, sites that were located no more than 10 kilometers away from the sea do not contain shell middens. Afterward, most sites are shell middens or else contain a significant shell-midden component, even if they are located at distances from the sea in excess of 40 kilometers. Given the distances involved, the accumulation of coastal and estuarine resources at such inland sites cannot have been related to procurement within the site's immediate environs. More likely it suggests the accumulation over time of the residues of small amounts of food transported and consumed upon arrival at or during the first days of the occupation of recurrently used seasonal or functionally specialized sites. Movement by water inside such territories must have been fairly easy and fast. Fed by precipitation well above that of the region's present-day Mediter-



Selected sites in Mesolithic Iberia.

ranean climate, the rivers and streams of the Early Mesolithic flowed through freshly incised valley bottoms and therefore must have been larger and deeper, making for quite practical communication routes if canoes were used. In such a scenario the size of economic territories would have increased threefold, from about 500 square kilometers, hypothesized for the Upper Palaeolithic, to the some 1,500 square kilometers implied by the interpretation of the Early Mesolithic inland cave sites with shell middens as complementary to residential camps placed along the coast.

The critical role of aquatic foods in Preboreal times probably explains the apparent Mesolithic abandonment of the interior Iberian *mesetas.* Unlike European areas north of the Pyrenees, where contemporary occupation of the Continental hinterland is documented, the interior of Iberia lacks important lakes, and the rivers, even the largest, often dry out in the summer over extensive stretches. In any case the absence of human settlement from vast regions with a very dense temperate forest cover is documented in other parts of the world. A similar pattern, for instance, has been observed in southwest Tasmania, where at the time of contact the inland valleys had been devoid of humans from the beginning of the Holocene, despite the abundant archaeological evidence of occupation throughout the Ice Age.

A further implication of the Portuguese evidence is that, by comparison with late Palaeolithic times, not only population densities but also the overall population size must have decreased significantly in the Early Mesolithic. In fact the area available for settlement became significantly reduced by the rise in sea level. Nevertheless the size of economic territories seems to have increased. This is the opposite of what would have happened if the same number of people settled the now smaller area available for occupation. Along the northwestern and southwestern coasts of seventeenth-century aboriginal Tasmania, individual bands of up to 50 people wintered at residential camps situated at intervals of about 50 to 100 kilometers and placed in the major estuaries of this 1,000-kilometer-long coastline. This seems to be a reasonable settlement analogy for the Iberian Mesolithic, at least along the Atlantic, where human adaptations operated under similar environmental constraints and with a similar economic basis.

THE CANTABRIAN COAST

In Cantabrian Spain the cultural transition from Azilian to Asturian stone tools takes place throughout the Preboreal, accompanying the transition from glacial to fully temperate climatic conditions. The Azilian is a continuation of the Magdalenian with the same blade/bladelet stone technology rich in microliths but with different types of bone harpoons. The Asturian features macrolithic cobble (rock) tools. Most Asturian sites are shell middens accumulated in rock shelters and cave porches and are located in the region's narrow strip of plains and lowlands between the sea to the north and the Cantabrian Mountains to the south. The characteristic stone tool is the Asturian pick, a flat cobble (in this case a rock rolled by the sea or a river), 8–10 centimeters long, featuring a cortical (the outer, weathered, rolled "skin" of the cobble) base and a unifacially shaped point (shaped on one side only), triangular in cross section, which may have been used in the collection of plants. Food residues—mollusk shells, fish remains, and mammal bones—document the exploitation of the resources provided by the rich coastal waters, combined with the exploitation of the forests covering the adjacent hills and mountain slopes. *Patella* and *Monodonta* species (limpets) dominated among the mollusks and red deer among the land mammals, but aurochs, horses, wild boar, roe deer, chamois, and ibex also contributed to the menu. The little seasonality information that is available does not record summer occupations, suggesting that intensive shellfish gathering played a supplementary role, mostly during the cold season, when other resources (especially plant foods) were scarce or unavailable. Specialized sites high on mountains are known, as are a few occupations in intermediate territory. It is as yet unclear whether the latter sites represent logistical or seasonal establishments integrated in the settlement-subsistence system of the coastal lowlands or separate interior adaptations. The areas rich in raw materials for stone tools indicate rather small territories, which is more consistent with the second hypothesis.

No art objects are associated with the Asturian, but burial is documented, notably that of an elderly female from the Molino de Gasparín shell midden. Excavated in 1926, this woman was found in an extended position, with three picks laid on stones by her head. A mound, on top of which a fire had been lit, covered the body. Between 1985 and 1990 seven people, buried in three features, were excavated in the Los Canes cave (Asturias). The human bones from this burial were dated by radiocarbon to the period between about 6000 and 5000 B.C. The cave contained no traces of habitation from this time period, suggesting that it was used only for funerary purposes. The bodies were placed in *decubito supino* (lying on the back) or in *decubito lateralis sinistro* (lying on the left side) in association with body ornaments—pierced red deer canines and perforated shells of *Callista chione, Trivia europaea,* and *Littorina obtusata*—bone tools, cobbles, and animal bones, conceivably representing meat offerings. One of the bodies a very gracile female, offered an extensive picture of dental problems, with caries, abscesses, and alveolar resorption (receding gums) affecting the upper jaw. No such pathological conditions are known in the other human remains from the regional Mesolithic, suggesting that toward the end of the period diets became richer in carbohydrates, specifically plant foods.

Pottery is present in this region from c. 4900 B.C., as evidenced by Accelerator Mass Spectrometry (AMS) radiocarbon dating of charcoal collected from the fabric of a sherd taken from Los Canes level C, above the stratigraphic horizon corresponding to the burials. Because no evidence for domesticates exists in this area before c. 4200 B.C., it would seem that such early pottery represents a technological introduction into a hunter-gatherer context, documenting the existence of exchanges with the groups of farmers that had become established in the upper Ebro basin. The survival of hunter-gatherer economies until well after 4900 B.C. is documented by Mesolithic levels in the cave sites of Pico Ramos and la Trecha, which date to as late as 4300 B.C. and contain no domesticates, animals or plants. Although the evidence at present is ambiguous and the existence of a pre-Megalithic Neolithic is suggested by different lines of evidence, it seems that in Cantabria, as well as in Galicia and northwestern Portugal, the appearance of peasant-shepherd groups roughly coincides with the beginnings of megalith building during the second half of the fifth millennium B.C. It seems clear that this is a local process, with little demographic input from the outside and high levels of cultural continuity, representing the adoption by local hunter-gatherers of economic and technological innovations acquired through trade and exchange.

Beyond the eastern border of the distribution of Asturian sites, stone tool assemblages in the coastal areas of the Basque country, labeled post-Azilian, are characterized by different kinds of flint microliths, with geometric types dominating toward the end of the sequence. Adaptations and the timing of economic changes, however, follow along the same lines documented for the Asturian, as exemplified by the stratigraphic sequence in the Santimamiñe cave from post-Azilian to Neolithic and by the beach site of Herriko Barra. The burial of a twenty-five-year-old man of average height, accompanied by a headless dog and a lamb, in level I of the Marizulo cave represents the earliest secure evidence of farming in the region; the human skeleton has been dated by radiocarbon to about 4150 B.C.

THE WESTERN FACADE

Asturian-like picks associated with other large core-and-flake stone tool assemblages made on beach cobbles and believed to date to the Early Holocene on geological or typological grounds are common finds along the shores of Galicia and northwestern Portugal. No in situ contexts with organic remains have been found; thus our knowledge of the period's human adaptations in these regions is scant. The continuity with the Asturian seaside in landscape and ecology, however, suggests that the Mesolithic settlement of these regions must have been organized along similar lines.

Many Preboreal and Boreal sites are known to the south of the Mondego River. Their geographic distribution is in apparent continuity with that of the latest Upper Palaeolithic, even if their other characteristics differ significantly, given the emphasis on aquatic resources and the apparent changes in mobility patterns and population sizes reviewed earlier. These changes are related to the major impact upon animal populations of the alterations in climate and vegetation: the biomass of large mammals was reduced drastically, open-space species (chamois and ibex) retreated to high mountain areas outside the region, and horses saw their habitat limited to the fluvial plains. As a result, from the end of the Dryas III (the Pleistocene or Ice Age) onward, the composition of hunted mammal faunas is dominated by red deer, along with aurochs, roe deer, wild boar, and lagomorphs (hares and rabbits).

Consideration of site size and assemblage composition indicates that sites from these periods can be divided into three groups. Extensive open-air sites containing a diversified stone tool component with several types of armatures (stone tools that can be used as arrow or spear points) are found in interior areas. Most lack organic preservation, which is an indirect indicator that subsistence activities relied on the exploitation of terrestrial resources alone. (The abandonment of mollusk remains would have created a carbonated environment favorable to the preservation of both shell and bone.) Small open-air sites containing scarce and less-diversified stone tool remains but featuring abundant remains of mollusks exist along the present-day coastline in locations that correspond to the bottoms of the estuaries of the time, when sea level was still lower than it is in the twenty-first century. A few caves and rock shelters feature organic remains related to the exploitation of food resources of terrestrial and coastal origin and tool assemblages that include several types of armatures, but the small overall size of the cultural accumulations suggests very short or rare stays. The most reasonable explanation for these differences is functional complementarity between recurrently occupied residential sites and smaller specialized or seasonal sites used or created in the framework of a highly mobile settlement system. In southern Portugal extensive sites covering many thousands of square meters and having hearth features associated with a core-and-flake macrolithic tool kit (such as Palheirões do Alegra in coastal Alentejo or Barca do Xarês in the Guadiana River region) have been dated to the Boreal. These sites correspond to palimpsests resulting from the accumulation of many different, repeated, and probably specialized occupations.

The onset of the Atlantic climatic optimum, c. 6500 B.C., brought about a major reorganization of settlement, which at that point focused on the inner parts of the estuaries of the rivers Mondego, Tagus, Sado, and Mira. Stone tool kits of the period are dominated by geometric microliths made in the framework of a sophisticated blade-bladelet production system featuring pressure flaking and indirect percussion, and they contrast markedly with those of the preceding phase, when armatures tended to be very small retouched bladelets extracted from small carinated cores. The exploitation of these resource-rich ecotones led to the formation of large heaps of bivalve mollusks, the extension of which (both in area and in height) significantly transformed the original topography of the terrain.

The Muge middens, in the Tagus, are the best example of this new kind of site, which is suggestive of sedentary or near sedentary residence, an inference that agrees with available seasonality evidence. The fact that these sites also functioned as cemeteries, indicating the existence of a proprietary relationship of the different bands with their territories that was transmitted across generations, points in the same direction. It is estimated that three hundred skeletons have been excavated from the different Muge sites and one hundred from those in the Sado Valley. The importance of aquatic foods is confirmed by stable isotope analysis of these skeletons, according to which such resources contributed with some 50 percent of the diet.

Occupation of these estuary habitats seems to have peaked in about 6000 B.C. and lasted until 4750–5000 B.C. From roughly 5500 B.C. these hunter-gatherers coexisted with farmers settled in the limestone massifs of the region between the Tagus and Mondego. Such earliest Neolithic groups possessed domestic sheep (whose bones were dated by radiocarbon at the cave site of Caldeirão) and are defined by a material culture that is totally lacking in contemporary Mesolithic shell middens. It includes such items as cardial-decorated pottery (Cardial Ware culture), polished stone axes, and flint tools obtained with a technology involving heat pretreatment of the rock. Among body ornaments, tear-shaped *Glycymeris* beads as well as pierced red deer canines and bone beads imitating their shape feature prominently. Caves are used as cemeteries, and stable isotope analysis of these remains indicates a fully terrestrial diet, in marked contrast to that of the people buried in the Muge and Sado middens. These two cultural packages with mutually exclusive geographical distributions must represent separate adaptive systems, not different functional or seasonal aspects of a single, highly diversified system. The similarities in culture and adaptation between the earliest Neolithic of Portugal and that of the Mediterranean regions to the east, combined with the enclave nature of its initial settlement pattern (the areas occupied are devoid of Mesolithic sites postdating the onset of the climatic optimum), suggests that it represents a cultural intrusion not an in situ development.

The temporal, geographical, and archaeological features of the process indicate maritime pioneer colonization by small groups of farmers, their subsequent expansion leading, through intermarriage, to the absorption of the local Mesolithic groups, whose economy implied a significantly lower demographic potential. An alternative hypothesis is that of precocious adoption of the Neolithic package by hunter-gatherers living in the limestone massifs of Estremadura, while those living off the river estuaries would have retained the traditional way of life for several hundred more years. Studies of human skeletons provide results that can be construed as indicating significant continuity in populations across the Mesolithic-Neolithic boundary, in accordance with such an alternative model. No signs of the putative Late Mesolithic adopters, however, have been found in the limestone massifs (which seem to have been abandoned by humans after c. 6000 B.C., except for fleeting occupations at caves near the springs that dot its periphery).

Likewise there is no readily apparent explanation for why adaptations in the two areas followed such different strategies after the Neolithic package became available to both groups through the long-distance exchange networks in which all human groups living in coastal Portugal must have participated. Moreover significant continuity in skeletal morphological characteristics is to be expected if the external Neolithic input was small or if no significant genetically based differences in such features existed in the original Late Upper Palaeolithic Mediterranean stock from which the different groups involved in the process must have derived.

THE MEDITERRANEAN ARCH

Along the Mediterranean coast between Gibraltar and Valencia cultural continuity across the Pleistocene-Holocene boundary (c. 9500 B.C.) is clear and unambiguous. As in the better known Magdalenian-Azilian transition of the Cantabrian coast, regional late Magdalenian industries gradually evolved into what is called the Mediterranean Microlaminar Epipalaeolithic. The latter period is characterized by a decrease in the size and variety of bladelet armatures, which become restricted to a few types of backed elements, and by the scarcity, if not altogether disappearance, of bone tools. The earliest such assemblages have been dated invariably to the period immediately before the Dryas III–Preboreal divide. They seem to have lasted until the middle of the eighth millennium B.C. By that time modest amounts of small-sized geometric microlithic armatures (crescents, trapezoids, triangles), reminiscent of the Sauveterrian phase of the Mesolithic of regions farther to the north, had been introduced in stone tool kits.

As in Portugal, the economic impact of the global climatic change is apparent in the dramatic increase in the consumption of aquatic resources. The trend was in place by later Magdalenian times, as shown by the Nerja cave sequence, which contains abundant fish remains. Their number is five times greater than that of rabbits in the Magdalenian, but, in the Preboreal levels, fish outnumber rabbits 10 to 1. The collection of sea and land mollusks as well as pine nuts and acorns also is attested to in the Early Mesolithic levels, even if the bulk of food supplies continued to be represented by the meat of red deer and ibex, as in the preceding later Magdalenian. The significant broadening of the menu also is exemplified by the remains of seals and of different species of birds, such as ducks and partridges. Available seasonality indicators suggest that Nerja was occupied in autumn and winter, which means that the exploitation of aquatic resources may have been most important during the cold season, as also may have been the case in Asturias and Cantabria. Summer camps and summer activities probably are recorded in open-air sites that remain to be identified; this exclusive representation of caves and rock shelters in the regional sample of sites significantly hinders understanding of its Early Mesolithic settlement.

After about 7000 B.C. regional stone tool assemblages change into what is called the Mediterranean Geometric Epipalaeolithic, featuring a blade/bladelet technology geared toward the extraction of blanks for the production of geometric armatures manufactured through the microburin technique. At the stratified cave site of Cocina, an earlier phase, dominated by trapezoids, can be distinguished from a later phase, dominated by triangles, mirroring the similar development apparent in the Portuguese shell middens of Muge. Ibex was the prime game animal, but this finding may be due to sample biases because most sites of the period providing data on subsistence are located in mountainous environments. The exploitation of coastal marshes, estuaries, and lagoons, along the lines better exemplified by the Portuguese evidence, is documented by the shell midden of El Collado (Valencia), which also contained numerous burials. Fifteen individuals are reported, lying extended on their backs or their right sides. As in Los Canes, their legs were tightly flexed, and their feet were crossed or tucked together, a forced position that suggests that the corpses were somehow banded or bagged.

In all known deeply stratified cave sequences (such as Chaves, Or, and Cendres), the earliest Neolithic of the region dates to c. 5500 B.C., as proved by the direct dating of cereal remains from the sites of Mas d'Is (an open-air settlement) and La Falguera (a rock shelter). A wide variety of new types of bone tools and a new stone tool production system accompany the introduction of pottery, polished stone axes, wheat, barley, and sheep. Blade debitage probably resulted from pressure flaking, and there is evidence of heat pretreatment of the flint. Microliths are geometrics (almost exclusively trapezoid) used for the most part as sickle blades, but use of the microburin technique is not documented; instead, laminary products (stone tools with blade proportions, that is, elongated with roughly parallel edges) were systematically shortened through flexure-breaking techniques. Borers with thick, long points make their first appearance in the regional sequences. The marked discontinuity in settlement, economy, and basic technology suggests that this earliest Neolithic evidence represents a cultural intrusion, which is in agreement with its similarities to the Cardial cultural package of regions farther to the northeast. The presence of some Cardial pottery sherds in the uppermost levels of the long stratigraphic sequences of such inland sites as Cocina has been interpreted as evidence of interaction between immigrant farmers and the local hunter-gatherers, eventually leading to the adoption of agropastoral economies by the latter group.

The so-called macroschematic style of rock paintings, replicated in the decoration of ceramic vessels from Or, is another cultural manifestation of the region's first farmers. At several sites, particularly in Alicante (notably La Sarga), such paintings are superimposed with animal motifs and hunting scenes of the Levantine art style, which for a long time was considered of Mesolithic age because of the nature of its themes. The stratigraphy of decorated panels now shows, however, that Levantine paintings date to the Late Neolithic and the Copper Age. The only positive manifestations of Mesolithic art in the region therefore are the limestone slabs decorated with linear or geometric patterns discovered at Cocina.

THE EBRO BASIN

At present the Mesolithic sites of the Ebro basin cluster in three geographically separate groups: the lower Aragon group, some 60 kilometers from the delta, including such well-known sites as Botiquería dels Moros and Costalena; the Pyrenean group, which dots the mountain range and its adjacent elevations from east (Navarra) to west (Andorra and northern Catalonia), featuring the major sites of La Balma de la Margineda and Aizpea; and the upper Ebro group, a continuation of the latter region into the province of Alava, where such sites as Kanpanoste Goikoa and Mendandia are located. The cultural-stratigraphical sequence, however, is largely uniform across this extensive area (some 85,000 square kilometers) and begins with a process of gradual transition from Magdalenian to Azilian-like small-blade assemblages akin to those of Mediterranean regions to the south. The Catalonian sites of Sant Gregori de Falset and Filador yielded two of the few portable art objects securely dated to this transitional period in Spain: a slab with the engraving of a female deer and a pebble painted with parallel lines. The appearance of notch-and-denticulate assemblages with Sauveterrian-like, very small geometrics after 8000 B.C. marks the end of the transition. Blade and trapezoid assemblages similar to those of the Mediterranean Microlaminar Epipalaeolithic arise after c. 7000 B.C. In its last stage new geometric types appear alongside the trapezoid: Cocina-type triangles in the lower Aragon sites and Sonchamps points (triangular points with inverse [inferior, ventral side] or bifacial [both sides] retouch) in the west Pyrenean sites.

Throughout the sequence the bones of land mammals (red and roe deer, ibex, chamois, wild boar, aurochs, horses, and rabbits) represent the bulk of food residues abandoned at habitation sites. Favorable preservation conditions at the rock shelter of Aizpea allowed for the recovery of extremely abundant fish remains; contrary to the situation elsewhere in the Iberian Mesolithic, bone tools, particularly fishhooks, were numerous, suggesting that this component of the tool kit may be associated closely with the exploitation of riverine resources. Aizpea is a good example of the critical role that the use of freshwater foods must have played in the successful settlement of the region's inland areas. This area also relied on the economic exploitation of forest plants, which is indicated at the site by hazelnut shells and the remains of wild apples and other fruits recovered throughout the whole Mesolithic sequence. The land snail *Cepaea nemoralis,* whose shells are present in large numbers at many of the period's sites, probably was introduced by humans as food. The skeleton of a female lying on her back against the wall of the shelter, with no associated artifacts and dated to the latest Geometric period of occupation of Aizpea, is the only Mesolithic burial so far found in the region.

The earliest Neolithic is documented by cave sites in the Pyrenees, notably La Balma de la Margineda and Chaves, featuring levels with Cardial pottery and domesticated sheep and goats. The radiocarbon evidence suggests broad contemporaneity with the Valencian sites, and the shared features of the process indicate that the introduction of farming took place along the same lines better documented in the regions farther to the south. The lakeside village of La Draga (Banyoles, northern Catalonia) shows that, at least since about 5000 B.C. and probably well before that, Early Neolithic settlement was organized in permanent aggregates of wood houses 3–4 meters high and built from oak planks and posts.

See also **Muge Shell Middens** (*vol. 1, part 2*); **Caldeirão Cave** (*vol. 1, part 3*).

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JOÃO ZILHÃO

MUGE SHELL MIDDENS

The existence of Mesolithic shell middens in the lower valley of the Tagus River, located some 50 kilometers northeast of Lisbon, was first reported in 1863 by Carlos Ribeiro, who immediately recognized them as counterparts of the recently discovered Danish "kitchen middens." The sites are located near the confluence with the Tagus of the Muge and Magos streams, a few meters above the extant water level; they occupy what, in the local palaeogeography of the Atlantic climatic period, was an ecotonal position: at the bottom of a very large estuary, close to extensive brackish-water mollusk banks and, at the same time, in a strategic location to secure access to other aquatic or wetland resources, such as fowl and fish, as well as to river-plain and forest game, such as aurochs, red deer, and wild boar.

Three sites in particular—Cabeço da Arruda, Cabeço da Amoreira, and Moita do Sebastião, located along the two banks of the Muge stream within a couple of kilometers of each other—have been the object of much research, focusing for the most part on the study of the numerous human remains recovered therein. In 1880, coinciding with the Lisbon meeting of the Ninth International Congress of Anthropology and Prehistoric Archeology, Ribeiro undertook systematic excavations at Cabeço da Arruda and Moita do Sebastião and invited congress participants to visit the sites. In his paper to the meeting, he informs that 120 skeletons were found; further work at the two sites carried out in 1884 and 1885 by Francisco Paula e Oliveira produced another 52 skeletons.

Paula e Oliveira's research was conducted under the auspices of the Geological Survey in Lisbon; research on the middens was continued in 1930–1931, 1933, and 1937 under the auspices of the Institute of Anthropology of the University of Oporto with further excavation of Cabeço da Arruda and new work at Cabeço da Amoreira. The principal investigator in the 1930s was António Augusto Mendes Correia, who earlier in the century had been the promoter of the *Homo afer,* var. *taganus,* designation for the dolichocephalic type—that is, the elongated head shape—predominating among the people buried in the Muge middens (see "Origins of the Portuguese," 1919). The concept of "Homo after taganus," which established a physical anthropological link with Africa, meant that the Muge people were an African race, or descended from African races. It was instrumental in substantiating the postulated corresponding cultural link with the idea that the flintworking Mesolithic culture known as the Tardenoisian (to which the French archaeologist Henri Breuil had ascribed the geometric industries found in the Tagus sites) derived from the Capsian. It also strengthened the then popular notion that, at the end of the Upper Palaeolithic, the Iberian Peninsula had been colonized by populations of North African origin. Mendes Correia assumed that "the miserable fisherman of the Muge were far from the standards of the Magdalenian [the last culture of the Ice Age, with its impressive cave art] civilization" and that "the Homo taganus should rather be included in a group of inferior races, Australoid or protoethiopian and probably of meridional origin." According to Mendes Correia, these people would have contributed little, if at all, to the ethnogenesis of the Portuguese nation, whose roots should be sought in the dolmen builders of the later Neolithic period.

Fig. 1. In situ human skeletons from the 1953 excavations at Moita do Sebastião. COURTESY OF JOÃO CARDOSO. REPRODUCED BY PERMISSION.

In the period 1952–1954, Octávio da Veiga Ferreira and Jean Roche carried out a salvage operation at Moita do Sebastião, the upper part of which, composed of mobile sediments, had been removed the year before for the construction of an agricultural facility. Of the original 2.5-meter-high mound, occupying an area of about 300 square meters, only the basal part remained, forming an east-west 32.5-by-12.5-meter elliptical area of hardened sediments with a maximum thickness of about 20 centimeters. The excavations revealed a series of features penetrating the bedrock of Pliocene sands, including an arrangement of postholes suggestive of a hut-like habitation with an area of about 37 square meters, as well as several burial pits containing thirty-four human skeletons, providing for the first time reliable information on funerary rituals. The bodies, always lying on their backs and with their heads raised, were emplaced in clusters of shallow pits, young children separate from adults. Perforated shells of the small fluvial gastropod *Theodoxus fluviatilis* are the main body ornaments, sometimes arranged in collars or belts, but traces of red ochre were also found. The fact that a few skeletons were clearly associated with accumulations of unopened clamshells of *Scrobicularia plana* and *Tapes decussata* suggests the practice of food offerings.

No other excavation work has been carried out since the 1950s. Substantial portions of the original midden mounds still remain at Cabeço da Arruda and Cabeço da Amoreira, whereas only some of the Moita do Sebastião basal features have been preserved in situ. From the different accounts provided by the excavators, the total number of skeletons recovered over the years at the three sites can be estimated at about three hundred. In her analysis of the collections preserved in both Lisbon and Oporto, however, Denise Ferembach (1974) could only inventory 136 "more or less complete" individuals from Cabeço da Arruda and Moita do Sebastião: 25 percent were under fifteen years of age (two-thirds of those were under five), and among the adults of all ages, from eighteen to over fifty, that could be sexed, men (sixteen) predominated over women (nine). Ferembach's study's main concern was still the establishment of a "racial diagnosis." It was concluded that the "protomediterranean" type predominated and that there were also small and gracile "cromagnoids," as well as a few "alpine" and "mixed protomediterranean-cromagnoid" people. Since this mix still exists in modern-day Portugal, a large degree of population continuity until the present was inferred.

Late-twentieth-century research on the collections has been able to establish the chronology of the sites and their sequence of occupation, based on radiocarbon dating and the composition of lithic assemblages. Moita do Sebastião, first occupied between 6100 and 5900 B.C., is the earliest, and features assymetrical trapezes of different types. The latest is Cabeço da Arruda, first occupied c. 5600 B.C. and containing more segments and triangles than trapezes. The occupation of Cabeço da Amoreira, featuring the characteristic "Muge triangle" type of geometric microlith, must have fallen in the intermediate period.

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João Zilhão

THE MESOLITHIC OF UPLAND CENTRAL AND SOUTHERN EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

There was a surge of active research into the Holocene hunter-gatherers of central and southern Europe during the late 1980s and 1990s. Among the many reasons for growth in the intensity of investigation has been the increasingly strong argument for the role of Mesolithic hunter-gatherers in the spread and adoption of agriculture in Europe. Furthermore, many scholars no longer view the Early Holocene as the backwater of Pleistocene big-game hunters but rather as a dynamic period of socioeconomic as well as environmental changes, separate yet related to both the preceding Epipalaeolithic and the following Early Neolithic.

In addition to the attempts at "rethinking" the Mesolithic, anthropological and ethnological studies have found their way into archaeological research designs in places where they had not been active previously. This fact, in the case of Italy, prompted at least one researcher, Amilcare Bietti, to argue that a "paradigmatic shift in current Mesolithic research" had occurred, especially in northeastern Italy. Understandably, these trends are regional and uneven across the archaeological landscape. Therefore, in this account, divided according to regions, some sections are more substantial than others in terms of data and research.

BACKGROUND

The time period referenced here is the Holocene, the latest epoch of the Quaternary system. The Holocene started approximately eleven thousand years ago and extends to the present day. It is also known as the post-Pleistocene, following the Pleistocene ice age. Archaeologists are dealing with the Early Holocene, since the present is what might be called the Middle or Late Holocene. The Early Holocene can be divided roughly as follows, based on the stone tool industries most common for the central and southern European Mesolithic hunter-gatherers:

Pleistocene

Late Glacial Epipalaeolithic industries 13,500–11,000 years ago

Holocene (climatic subdivision: Preboreal/Boreal)

Early Sauveterrian 11,000–10,300 years ago
Middle Sauveterrian 10,300–9,500 years ago
Recent Sauveterrian 9,500–8,500 years ago

Holocene (climatic subdivision: Atlantic)

Castelnovian 8,500–7,300 years ago

The Sauveterrian industry received its name from a site in southwestern France, Sauveterre-la-

Lémance. Stone tools were found there in stratified order following early Azilian and late Magdalenian palaeolithic assemblages. The Sauveterrian industry is characterized by microliths (very small tools) made on small blades in geometric shapes, mainly triangles. The Castelnovian industry also is named after a site in France and is distinguished by trapezes made on regular and somewhat larger blades. There are regional differences to this scheme, sometimes with alternative names (e.g., "Tardenoisian" for Castelnovian), but for simplicity's sake it is sufficient to think in terms of the two industries mentioned (fig. 1).

The main difference between the Preboreal/Boreal and the Atlantic is in the climate, the former being cooler and drier and the latter warmer and more humid. The underlying theme here is that the Holocene was a period of change in the hunting-gathering populations of Europe. The transformations are evident in the stone tool types, the fauna that were exploited, and the nature of landscape use. The reasons for such change were largely environmental, although concomitant social factors played a part as well. The major environmental developments of the Holocene were an increase in forestation and accompanying improvement in soil cover and plant resource variability and a rise in sea level, loss of coastlines, and fluctuations in inland water levels affecting both marine and riverine habitats and resources. Related to these environmental developments were alterations in the subsistence systems of the human populations as they adapted to and, in some cases, adopted strategies to manage the range of new resources.

Admittedly, the environmental shifts were slow in terms of human lifetimes and, as Michael Jochim put it in a chapter for *Europe's First Farmers,* "would have been perceived as gradual changes in relative proportions of habitats and resources, not abrupt replacements." The varied geographic, climatic, and environmental factors that have interplayed with cultural development among the various upland regions of central and southern Europe contribute to the difficulty of defining a homogenous process of post-Pleistocene adaptation. A regional approach incorporates the varying factors and allows the researcher to compare regions rather than archaeological cultures.

ALPINE AND PRE-ALPINE REGIONS

In northeastern Italy, especially in the Adige valley, researchers have shown that site distribution differs between the Preboreal/Boreal age (c. 10,300–7,500 years ago), affiliated with the Sauveterrian chipped stone industry, and the Atlantic age (approximately 7,500–6,000 years ago), associated with the Castelnovian industry. The break between these two industries is not especially sharp, and their usefulness in supporting a meaningful comparative framework is limited. In the earlier period the sites were distributed both on Alpine valley bottoms and in the mountains at altitudes from 1,900 to 2,300 meters. Over time, the sites on the Alpine valley bottoms remained while the mountain sites became rarer, and even those high-altitude sites interpreted as Castelnovian camps are dated to the beginning of the Atlantic period. In addition, an increasing number of later, rather than earlier, sites have been found in the pre-Alpine zone and on the plains.

The change in site distribution has been related to ecological changes through time, accompanying a progressive shift from a cold, dry environment to temperate and more humid woodland. These changes included the expansion of forests and a rise in sea level, among others. The rise in heat and humidity between the Boreal and Atlantic caused the disappearance of ibex and chamois at lower altitudes, whereas expansion and restocking of oaks and hazelnut advanced the populations of red deer, roe deer, and wild boar in the Alpine valleys and plains. The retreat of the caprine habitat thereby affected land use, site distribution, and hunting patterns. It also had an impact on butchering patterns. Faunal evidence from three Adige valley sites, Pradestel, Romagnano III, and the Soman rock shelter, shows that seasonal hunting of caprines continued between the Boreal and Atlantic subdivisions. Because of the greater distances necessary to climb to hunt these animals, however, transport became a problem. Butchering and skinning began to take place at the hunting stations to reduce transport costs. Other important stratified sites include Vatte di Zambana (Adige valley) and Riparo Gabon (east of Trento).

High-altitude sites from this region are worth mentioning because they reflect later research efforts. The site of Vaiale, which is found at 830 meters above sea level, is considered a Sauveterrian site

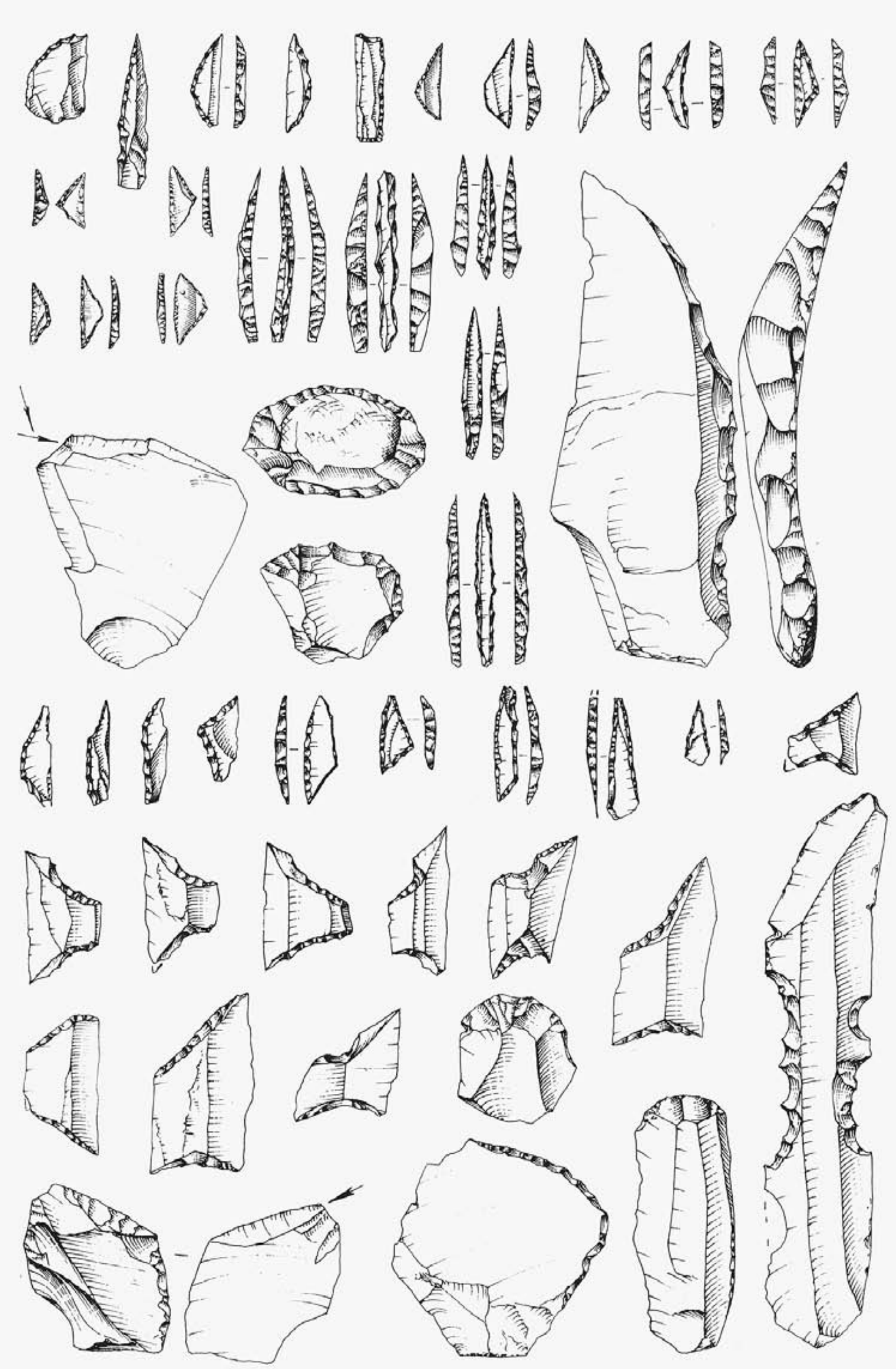

Fig. 1. Characteristic examples of Sauverterrian and Castelnovian industries from Riparo di Romagnano, Italy. Courtesy of Dr. Michele Lanzinger, Museo Tridentino di Scienze Naturali. Reproduced by permission.

owing to the stone tool assemblage, which consisted of scalene triangles, backed points, microburins (of a type that reflects a particular manufacturing technique), cores, and debitage (waste flakes). Another Sauveterrian site, Rondeneto, is located at 1,780 meters above sea level. The stone tool assemblage there included a very small core, scalene triangles, backed blades and points, side scrapers, and microburins. Both of the sites are regarded as hunting camps.

A later assemblage, dated to the end of Boreal or the beginning of the Atlantic, was found at Lago delle Buse sites 1 and 2 (8,220±110 B.P., or 7040–6813 B.C.) at 2,000 meters above sea level. The assemblages also are considered Sauveterrian and are made up of microliths and side scrapers. A final example of a high-altitude site is Laghetti del Crestoso, at 2,000 meters above sea level in the Brescian Alps, dated to the middle Atlantic (6,790±120 B.P., or 5930–5445 B.C., and 6,870±70 B.P., or 5849–5592 B.C.). The complex is thought to be late Castelnovian and is interpreted as a seasonal campsite for hunting, possibly ibex.

These sites have provided valuable data for an understanding of Holocene resource and land-use patterns. For example, Lago delle Buse presents evidence for the growing presence of fire in the archaeological record, although it is not known whether it is due to human influence. It may have been used purposefully to promote fruit and nut species. It is believed that during the Holocene, fire came to be a major element that formed the structure of woods in the mountain and sub-Alpine zones. Other Alpine sites for which evidence of fire has been cited are located on the high plain of the Sette Comuni in the Alpine region.

Apparently, no evidence has been found for such activities in the Apennines or in the Valcamonica region. Carbonized hazelnut shells, however, were recovered from Sopra Fienile Rossino, a site in the Brescian Alps at 925 meters, dated 6,810 ± 70 B.P. (5765–5528 B.C.). Elsewhere, the archaeological record has given evidence for exploitation of hazelnuts (*Corylus avellana*) during the Mesolithic. It has been pointed out that hazelnuts are a nutritious food, easily carried and stored.

Laghetti del Crestoso is a more complex site than the other hunting camps mentioned, and the presence of nonlocal lithic materials raises the issue of possible exchange networks during the Early Holocene. The overall evidence for such exchange networks is still meager, although the likelihood of such networks often is assumed, especially during the Castelnovian. Monteval de Sora (San Vito di Cadore in Belluno) is an important site in the Dolomites (a range in the eastern Alps), representing a rare example of a Mesolithic burial. The site, discovered in 1985, is located under the overhang of a large cliff on a terrace at 2,100 meters above sea level. The oldest occupation is Mesolithic in date, assigned to the Sauvetterian (c. 7,500 B.P., or 6500 B.C.) on the basis of tool typology. It also was occupied during the Castelnovian (c. 6,500 B.P., or 5500 B.C.) to which the burial belongs. The skeleton is of a robust man, 167 centimeters tall and about forty years of age. Accompanying the burial were stone tools and bone and antler artifacts, including pierced deer teeth.

NORTHERN APENNINE CHAIN

Eastern Liguria and the contiguous Tusco-Emilian Apennines are rather rich in surface finds dating to the Mesolithic. For example, the site of Gazzaro in the Emilian pre-Apennines produced the remains of a fireplace and animal bones. High-altitude Emilian sites include Passo della Comunella, at 1,619 meters (6,960±130 B.P., or 6020–5582 B.C.), and Lama Lite, at 1,764 meters (6,620±80 B.P., or 5622–5348 B.C.). In Tuscany the site of Piazzana lies at 820 meters and is slightly older (7,330±85 B.P. or 6366–5979 B.C.).

THE PLAINS

Research on the Po and Friuli plains has not been as intensive as in the Alpine areas, although it too has been gaining momentum since the last decade of the twentieth century. Published data from the Po plain for the Mesolithic are almost nonexistent, whereas the data from the Friuli plain have been gathered since the 1970s, most from survey. Only a few sites have been excavated, such as the Bierzo rock shelter. According to lithic typology, this site is Sauveterrian, as is the site of San Giorgio di Nogaro. Another site, Muzzana del Turgnano, is associated with the early Castelnovian, again on typological grounds.

In Friuli, as in many other areas, Mesolithic sites are found among the morainic hills, facing basins of glacial origin that probably were flooded into the Holocene. Examples include the sites of Molin Nuovo, Rive d'Arcano, Corno-Ripudio, Cassacco, Porpetto, and sites along the Torres. It has been suggested that there was an emphasis on water resources, such as fish, aquatic turtle, and waterfowl, in this area, although the record is poor. Given the limited data at hand, one can still say that the pattern of site distribution does not appear to differ dramatically over time between the Early Mesolithic Sauveterrian and the later Castelnovian in this region.

THE KARST

The Trieste karst is bordered to the northwest by the alluvial deposits of the Isonzo River, to the northeast by the syncline of the Vipacco, to the southeast by the Val Rosandra, and to the southwest by the Adriatic Sea. The karst at one time was covered with a mixed oak woodland, mainly composed of oak, hornbeam, and ash. Forest clearance started during the fourteenth century A.D. and almost completely destroyed the original tree cover in four centuries. Mesolithic occupation in the Trieste karst has been known and studied for at least the second half of the twentieth century onward, largely owing to the efforts of speleologists in the region.

There are no open sites known from the Italian karst, although there are a few Mesolithic open sites from Slovenia and Istria. Breg is an open-air site in the region of Ljubljana (Slovenia) that has been excavated and dated to 6,830±150 B.P. (5968–5440 B.C.). Faunal remains from Breg, as well as other sites in Slovenia, indicate that red deer, wild pig, and roe deer were hunted during the Early Holocene. In addition, remains of sea otter and fish have been found at this site as well as at the Mesolithic site of Pod Črmukljo, also near the Ljubljana marshes. Such finds, together with bone harpoons found at Breg and the site of Spehovka cave in the Slovenian karst, suggest that marine resources also were exploited by these hunter-gatherers.

In northeast Istria, Mesolithic deposits were found in the cave site of Pupićina, which dates to approximately 9,500–10,000 years ago. In addition to the stone assemblages, excavators found pierced seashells and pierced red deer canines. Several other sites are located in the region of Pupićina and are being studied as part of a larger project. These sites include the Šebrn rock shelter (8400–7610 B.C.) and the open-air site of Kotle (Castelnovian, no dates). The results of the project have shed light on changes in resource use by foraging populations through time.

Grotta dell'Edera is a karst cave in Italy near Trieste at which research also is ongoing. The work at Edera has revealed superimposed fireplaces, hearths, cooking floors, and fire pits that represent temporary Mesolithic and Neolithic episodes of habitation. A Castelnovian fireplace, dating to about 6500 B.C., was found below the Neolithic levels. Within it were stone tools and sherds from two coarse pottery vessels, undecorated and not revealing of time or culture—an unusual association of Mesolithic tools and Neolithic pottery. In addition, three perforated beads, made of nonlocal sandstone, each measuring approximately 1.5 millimeters in diameter, were identified with this feature. Small pieces of sandstone and ochre, which are exotic to the limestone cave, also were uncovered. Finally, specimens of marine shells dominate the faunal remains from this fireplace, a situation found in similar caves of the same age. For example, at the caves of Azzura and Tartaruga, land mollusks had been found in conjunction with earlier levels, whereas sea mollusks and fishing came to dominate the faunal remains in the later levels, associated with Castelnovian industries.

Not surprisingly, the dates correspond generally to changes in sea level due to melting ice sheets, c. 8,000–7,000 years ago. Before that time, indirect evidence indicates that the northern Adriatic plain had supported rich ungulate fauna during the Pleistocene, while the inland areas were used sporadically, possibly on a seasonal basis. With the rise in sea level, the plain was reduced to a small area around the Gulf of Trieste. Approximately 20–25 kilometers of coastal plain in the northern Adriatic was submerged. The progressive rise in sea level during the Early Holocene is known to geologists but poorly related to the archaeological record at this time. The reduction of the resource base of this region should be taken into account, as should its demographic effects. In brief, the impact of the gradual loss of the plain that had existed in the northern Adriatic, extending as far south as Ancona and Zadar, doubtless is operative in Holocene developments. In addition to the inundation of earlier sites, the rise of sea level would have had profound effects on inland waterways, estuaries, and lagoons.

CENTRAL AND SOUTHERN ITALY

Outside of the northern Adriatic zone are regions where the Mesolithic record still is not well known. It once was believed that hunter-gatherers of central and southern Italy continued to use Epipalaeolithic types of stone tools after the Pleistocene. A specific industry, known as the Romanellian, after the Grotta Romanelli in central Italy near Puglia, was dated between 9,000 and 10,000 years ago. These early assemblages contain small circular and irregular scrapers, burins, backed blades, microburins, and geometrics (segments and triangles). New research shows that following the Romanellian, there is a Sauveterrian-Castelnovian sequence, as elsewhere in the Mediterranean. Some sites of importance are the Grotta della Serratura in Campania, the Tuppo dei Sassi and Grotta Latronico 3 in Basilicata and the Grotta Marisa and Grotta delle Mura in Puglia. Studies of faunal remains have shown that through time, hunting was mainly for red deer and boar rather than ibex and chamois, as seen farther north. There are regional variations on the pattern, however. For example, horse and cattle were hunted in the less wooded karst environment of the Salento peninsula of Puglia.

EASTERN ADRIATIC COAST

Evidence for Mesolithic sites farther south along the Adriatic coast (Dalmatia, Montenegro, and Albania) is minimal, although so-called Epigravettian assemblages have been found. Epigravettian (c. 12,000 years ago), which is the final phase of the Palaeolithic stone tool tradition called Gravettian, is known throughout Europe and characterized by backed blades. These continuities in assemblages suggest that perhaps there was less environmental change in this region than, for example, in northern Italy. Two major sites with Mesolithic tools in Montenegro are Crvena Stijena and Odmut (about seven thousand years ago) with Castelnovian-type industries. Even farther south, layers of Early Neolithic with Impresso pottery and "industries of Castelnovian aspect" (as noted by Djuricic to suggest a loose cultural affiliation of stone tool assemblages) have been recorded in western Montenegro, suggesting that the final hunter-gatherers in the region encountered the earliest food producers.

Continuing south, in Albania, close to the Greek border, an excavation at Konispol Cave reportedly has yielded Mesolithic materials. The excavators compared the site to Franchthi, a famous site in Greece with Mesolithic deposits. A survey in Albania, conducted to relocate the caves uncovered by Luigi Cardini in the 1930s, has reported at least three caves with potential Mesolithic stone tools. These sites are the Kanalit rock shelter (along the coast on the western side of the Dukat plain in the Acroceraunian mountains), the Kamenica cave (near Delvina), and Ksamili hill and village (near Butrint).

BALKANS

The Iron Gates Gorge sites along the Danube (Lepenski Vir, Padina, Vlasac, and others) are dealt with separately in this volume; they represent an exceptional opportunity to study Mesolithic hunter-gatherers in an unusual context. Aside from those sites, the Mesolithic record for the Balkans is not extensive. As was the case for southern Europe, the change from Late Glacial to Postglacial and into the Holocene was marked by change in forestation from pine to mixed oak, although specific regions would have been affected differently.

Generally, the contrast in climate and vegetation after the Pleistocene was greater close to the Alps than it was in the central Balkans. During the Late Glacial, Epigravettian industries were common east of the Alps, with types similar to those found in Italy. After this time there appear to have been three different traditions based on stone tool types, one being the Castelnovian, with similarities to that of southern Europe (France and Italy). It also shows ties to the previous Sauveterrian industries. A second tradition continued basic Epigravettian traditions, with some trapezes (the hallmark of Castelnovian industries) and includes such sites in Romania as Ripiceni-Izvor. The third is that found within the Iron Gates Gorge sites.

The situation in Greece is similar to that in the balance of the Balkans, namely, that Mesolithic settlement appears to have been very thin. A survey of the Mesolithic in Greece found less than a dozen sites, of which only two have been excavated and the results published. In addition, the distribution of the sites seems to be uneven, with large parts of Greece apparently unpopulated during the early

Postglacial. The reason for this sparseness could have been a lack of population, or perhaps it was related to environmental factors, such as rise in sea level and sedimentation of valleys, which would have buried sites under alluvium. This possibility is supported by the discovery of Mesolithic deposits in the Theopetra Cave, in eastern Thessaly. These deposits are given seven different dates, ranging from 9780 to 6700 B.C.

SOUTH-CENTRAL EUROPE

Western Zone. The western zone of South-Central Europe includes southern Germany together with adjacent parts of Austria (although knowledge of the Mesolithic from Austria generally is very poor) and Switzerland, a region with a well-studied Mesolithic record. The record is separated into Early and Late Mesolithic, with a date of c. 6600 B.C. dividing the two. The Early Mesolithic, or Beuronien, spanned about 2,500 years, from 7,800 to 10,300 years ago. The types are not so different from those of the Sauveterrian industries described earlier—that is, a magnitude of microliths, including triangles, backed bladelets, and micropoints. Sites from this period are many and include excavated caves, rock shelters, and open-air sites as well as surface lithic scatters. Late Mesolithic sites have trapezoidal microliths (not unlike types found in the Mediterranean Castelnovian assemblages), which presumably were used as transverse arrow points, regular blade technology, and extensive antler working.

One excavated site in the region is Henauhof Northwest 2, located along the old shoreline of the Federsee lake. The site consists of a hearth associated with a concentration of bone and antler fragments. Burned stones and bone fragments were found within the hearth. The tools included a trapeze and other microliths; two borers; two burins and three scrapers; two cores; a few regular, well-made blades; and numerous flakes. Dates of the charcoal were 7,260±180 B.P. (6425–5716 B.C.) and 6,940±60 B.P. (5945–5666 B.C.). Analysis of the organic remains suggested that the site had been a short-term, generalized-activity camp, forming part of a seasonal settlement system. Faunal remains show differences in hunting not unlike the Mesolithic farther south.

Compared with the density of sites in the Early Mesolithic, Late Mesolithic sites are relatively few in the region. Population decline, differential site destruction by natural processes, and reorganization of settlement patterns leading to use of landscapes with lesser visibility have been offered as explanations. A good case has been made that Late Mesolithic groups in this region had wide-ranging networks of exchange and interaction, linking them indirectly to regions in the southwest and southeast of Europe. In addition, exploration has led to an extension of the Late Mesolithic (termed Terminal Mesolithic) that suggests overlap with the earlier food producers in the region and potential interaction between the late hunter-gatherers and the early food-producers about six thousand years ago.

Eastern Zone. The Mesolithic period is not well known in this region (present-day Hungary and western Slovakia). A Sauveterrian assemblage is known from the Slovak site of Sered and one Castelnovian complex apparently has been uncovered in Moravia. Intensive surface surveys and stratigraphic excavations have been undertaken in the Zagyva basin in the northwestern part of the Great Hungarian Plain, which have led to the discovery of several Mesolithic sites (with Sauveterrian tool types) on lower elevations at the edges of ancient riverbeds. It is believed that the rivers most likely supported gallery forests during the Boreal, which would have made them attractive locations for camps, similar to those found near old lakebeds.

CONCLUSION

To a certain extent, the adaptations of the hunting-gathering populations following the Ice Age have tended to be underplayed; they are almost like a people without a history. These populations fall within a "transitional" period, and theorists who study transitions are inclined to look less to origins than to future states when seeking explanations. Thus, research on the Mesolithic tends to focus on the food-producing populations of the Neolithic, which follows and examines relationships between those people and their economies and the hunter-gatherers they displaced. Perhaps a more interesting approach is to examine the Mesolithic hunter-gatherers as humans who developed new strategies in the face of changing environments and social relations.

See also **Iron Gates Mesolithic** (*vol. 1, part 2*); **Franchthi Cave** (*vol. 1, part 2*).

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BARBARA VOYTEK

IRON GATES MESOLITHIC

The Iron Gates region stands out for its exceptional record of human occupation during the Late Glacial and Early Holocene periods and for the unique insight it provides into the events surrounding the transition to agriculture in the Middle Danube basin. Here, along a 200-kilometer stretch of the river Danube that forms the border between Romania and Serbia, settlements of Mesolithic hunter-gatherers and Early Neolithic farmers have been found at more than thirty locations. The distribution of the sites is very much a reflection of the pattern of research. Surveys and rescue excavations undertaken in the 1960s to 1980s prior to construction of two dams across the Danube targeted valley floor areas on both sides of the river that would eventually be flooded. Very little archaeological exploration has taken place in areas farther from the river.

The majority of the known sites occur in the zone where the Danube has cut a series of deep gorges through the southern arm of the Carpathian Mountains. Rapids and whirlpools were a feature of this section of the river prior to dam closure. Sites have also been found downriver, in the more open section of the Danube Valley between the Iron Gates I and II dams. In spite of the contrast in physical setting, the archaeological records of the two zones show many similarities.

Scientific dating methods such as radiocarbon were not easily available at the time of the investigations, and excavators relied mainly on artifact typology and stratigraphy to date their sites. Since the 1990s research on surviving archaeological collections, involving AMS radiocarbon dating and other forms of scientific analysis, has led to a reassessment of the relative and absolute chronologies of the principal sites.

MESOLITHIC SETTLEMENT

Some archaeologists have argued that the Iron Gates Mesolithic exhibits a trend toward increasing social complexity and sedentism, culminating in the Late Mesolithic "Lepenski Vir culture" between c. 7000 and 5500 B.C. However, this view seems to owe more to the archaeologists' expectations than to sound archaeological evidence. It has yet to be demonstrated by, for example, seasonality studies of animal and plant remains or direct evidence of food storage that any of the Iron Gates sites were permanent, year-round settlements. Moreover, although Lepenski Vir has come to epitomize the Iron Gates Mesolithic, many of the archaeological "indicators" of complexity there—including much of the sophisticated architecture, art, and evidence of participation in long-distance exchange networks—probably date to a time when agriculture had a significant impact on the Iron Gates economy.

In fact there is no clear pattern of temporal change in the Iron Gates Mesolithic. The early stages are very poorly documented. Use of caves and rock shelters on the Romanian bank can be traced back to the Late Glacial period, c. 12,000 B.C. An open-air settlement had been established at Vlasac shortly after 9500 B.C., and there were occupations at Padina and Lepenski Vir by the early eighth millennium B.C. The duration of these Early Mesolithic settlements is unknown, and few architectural or other remains survive.

The character of Mesolithic settlement in the Iron Gates region is best represented at Vlasac on the Serbian bank of the Danube and Schela Cladovei in Romania. The evidence from these two sites relates mainly to a restricted period of the Late Mesolithic between 7100 and 6300 B.C. The inhabitants appear to have lived in trapezoidal "pit" houses. Hearths consisting of rectangular pits lined with stone slabs were found in some of the houses, but there were no other internal divisions. Sometimes the hearths were all that survived of the houses.

Burials are an important feature of both sites and occur within the confines of the settlements rather than in formal cemeteries. Eighty-five graves containing the remains of more than one hundred individuals were found at Vlasac, and more than sixty graves have been excavated at Schela Cladovei. Single inhumation was the norm; the dead were placed in simple earthen graves, often lying extended on their backs, but sometimes laid on one side with the legs and arms flexed. The skull was sometimes buried separately and, occasionally, groups of skulls have been found. There is persuasive evidence for the deliberate disposal of individual human bones, groups of disarticulated bones, and body parts still held together by soft tissue, probably linked to practice of excarnation—where the corpse is first exposed to allow the flesh to either rot away or be removed by scavengers. Excarnated bones were either buried separately or added to graves containing an intact body (fig. 1). Ivana Radovanović in *The Iron Gates Mesolithic* (1996) has suggested that excarnation was reserved for individuals of higher status. However, apart from the presence of red ochre in many graves, burial goods are few and provide no clear evidence of social distinctions within the communities. Bones of dogs, the only domestic animal of this period, have been found in association with human remains at Vlasac, and there is one possible example of the separate burial of a dog—a practice known from the Mesolithic elsewhere in Europe.

Stable isotope analysis of collagen extracted from the human bones indicates a diet (and thus an economy) heavily dependent on fish, shellfish, and other aquatic resources. The bones of carp, catfish, and sturgeon were recovered in large quantities in Anglo-Romanian excavations at Schela Cladovei between 1992 and 1996. Many of the fish caught were enormous, some weighing as much as 200 kilograms. Large and small land mammals were hunted for their meat, hides, and pelts, and their bones were used as raw material for manufacturing a range of tools and weapons. Wild plants likely were collected for dietary and other purposes, but their remains have been recovered only in very small quantities, even when fine sieving and flotation have been used.

The chipped-stone artifacts from Vlasac and Schela Cladovei, though more numerous than those made of antler, bone, or boars' tusks, are less distinctive and are made almost exclusively from local sources of flint, radiolarite, and quartz. Decorated items are rare. They consist largely of stones and pieces of bone, often engraved with a net-like motif.

The strongest evidence that the inhabitants of Vlasac and Schela Cladovei engaged in trade and other forms of exchange with neighboring groups is the presence in some of the graves of the shells of marine mollusks, which probably originated in the Adriatic or Aegean. These certainly were acquired through exchange rather than procured directly from the source.

Intergroup contact may be manifested in other ways. Some of the adults buried at Schela Cladovei died violently, shot by arrows equipped with bone points. Others suffered broken bones, including skull fractures, which also may have been the result of violence. The high incidence of arrow wounds at Schela Cladovei is unusual, but such evidence is not unique in the Iron Gates, and numerous other examples have been reported from sites across Europe dating to various stages of the Mesolithic. The causes of the violence at Schela Cladovei and its social context are unknown. It may signify conflict with other groups in the form of feuds or raiding, but retribution or ritual killing within the community (and even accidental shootings) cannot be ruled out.

Growing evidence indicates that the settlement record of the Iron Gates Mesolithic is not continuous. A conspicuous gap in the available radiocarbon dates between 6300 and 6000 B.C. suggests that many sites, including Vlasac and Schela Cladovei, were abandoned during that period. This coincided with a phase of cooler and wetter climate affecting much of western and central Europe, when the Danube and other river systems experienced more frequent and more extreme flooding. Faced with an increased threat from flooding, it is possible that people chose to relocate their settlements onto higher ground, either to more elevated terraces or onto the upland plateau at the edge of the valley—areas that were not surveyed archaeologically in the 1960s and 1970s.

The only site that can be shown to have remained in use during this period is Lepenski Vir. This remarkable site has a number of unusual, even unique, features. The architecture is more elaborate than that of any other site (fig. 2). The trapezoidal buildings, which show considerable variation in size, have specially prepared plaster floors and elaborate hearths, entrance facades, and other stone-built elements. Burials seem to have been deliberately located within or under some of the buildings. The site also has an unusually high frequency of decorated objects including stone "altars" and the famous sculptured boulders. These are between 15 and 60 centimeters in height, and were pecked and ground from sandstone boulders obtained near the site. Many are carved with abstract motifs. Others are figural, although usually only the head is clearly defined with exaggerated features such as large, often downturned mouths and bulging eyes. These representational forms are sometimes described as fish-like or half fish and half human. The frequent placement of the sculptured boulders on the floors of buildings, and the apparently deliberate deposition of parts of red-deer skulls with antlers and parts of animal carcasses inside some of the buildings, can be interpreted as symbolic acts. The shape of the buildings may also be symbolic. On the opposite bank of the Danube is the imposing trapezoidal mountain of Treskavac. Although archaeology does not reveal the belief system of the Iron Gates Mesolithic, it is not stretching credibility to imagine Treskavac as the abode of spirits that exerted a powerful influence on the lives of the local inhabitants. All these features suggest that Lepenski Vir was a special site. Although there was a settlement there before 7500 B.C., many archaeologists believe that it eventually developed into a "sacred place," used primarily for burial and ritual, and the plaster-floored buildings are often described as shrines or temples.

Curiously, the "shrines" and sculptured boulders appear in the archaeological record of Lepenski Vir at a time when many ordinary residential sites were abandoned. By continuing to use the site as a burial ground the group may have been seeking to maintain rights of ownership and inheritance to the land, the river and resources. It has been suggested that the sculptures were apotropaic, representations of ancestors or "river gods" that were intended to protect the site—the ritual home of the ancestors—from the unseen forces that were responsible for extreme and unpredictable floods.

CHANGES WITH REOCCUPATION

The settlements that had been abandoned c. 6300 B.C., including Schela Cladovei and Vlasac, were reoccupied c. 6000 B.C. From the outset a marked change in cultural patterns is apparent. The sites now contain the bones of domesticated livestock (cattle, pigs, sheep and/or goats) although hunting and fishing still contributed to the economy. Changes in material culture and technology are evident, reflected in the appearance of pottery, ground stone artifacts, and new forms of bone tools. There is evidence for trade or exchange in exotic materials, including obsidian and high-quality "Balkan" flint that originated outside the Iron Gates region. A new form of burial, where the body is curled up in the fetal position, was introduced. All these features can be paralleled in early farming settlements of the Starčevo culture that start to appear in other parts of the Middle Danube basin c. 6000 B.C.

Two competing theories seek to account for these changes. Some archaeologists believe that the Iron Gates region, and the Danube gorges in particular, remained a refuge for hunter-gatherers for centuries after cereal cultivation and stock raising were introduced to the surrounding regions; they interpret the appearance of pottery and bones of livestock in the Iron Gates as the product of trade with neighboring farmers. Others argue that the Iron Gates Mesolithic people quickly adopted agriculture, pottery, and other elements of the Starčevo

Fig. 2. Trapezoidal buildings with carefully laid plaster floors, stone-bordered "hearths," and other stone fixtures are a conspicuous feature of Lepenski Vir. In this example so-called altars—large tabular stones with artificially ground hollows in the upper surface—can be seen set into the floor behind the hearth and adjacent to the near side of the building. Such buildings began to be erected on the site during the Late Mesolithic before 6200 B.C., and their construction continued for at least 500 years during which time pottery and farming were introduced to the region. ARCHAEOLOGICAL INSTITUTE, BEOGRAD. REPRODUCED BY PERMISSION.

culture—caught up in the same process of "Neolithization" that saw farming communities established over much of the northern Balkans by c. 5900 B.C. A third possible scenario is that Iron Gates region was colonized by immigrant farmers who ousted or exterminated the indigenous Mesolithic people and took over their traditional sites. While this idea cannot be discounted, as of 2003 there was no scientific evidence to support it. The weight of evidence appears to favor the second explanation. Pottery occurs in such quantity at Lepenski Vir, Padina, Schela Cladovei, and other sites that it is difficult to imagine it was all brought in from outside.

Lepenski Vir has produced other critically important data. This is the only site in the region where the events of the final Mesolithic and Early Neolithic, c. 6300–5500 B.C., can be studied as an uninterrupted process. Research since the 1990s has cast doubt on the elaborate chronological subdivisions of the site proposed by the excavator, and it seems that the architectural and artistic traditions represented by the trapezoidal plaster-floored "shrines" and sculptured boulders persisted throughout this time range.

The people buried at Lepenski Vir are a continuous cross-section of the Iron Gates population of that period. Chemical analysis of their bones reveals a significant change in diet around the time that pottery and other "Neolithic" artifacts appear in the archaeological record. The group ceased to subsist mainly on fish and other aquatic foods and derived the greater part of its dietary protein from terrestrial sources. Such a major change in diet is likely to have required a direct investment in agriculture.

Although the label "Neolithic" can be assigned to the people and culture of the Iron Gates after 6000 B.C., echoes of their Late Mesolithic ancestry survive in the later artwork of Lepenski Vir and in the trapezoidal buildings that continued to be erected there and elsewhere in the Danube gorges.

See also **Transition to Farming in the Balkans** (*vol. 1, part 3*).

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FRANCHTHI CAVE

Franchthi Cave, located on the southern Argolid peninsula of Greece, was excavated between 1968 and 1976 under the direction of Thomas W. Jacobsen of Indiana University. Discontinuous occupation in the cave spans a period from approximately 35,000 through 5,000 years ago, covering the Upper Palaeolithic through the end of the Neolithic, from hunting and gathering to agricultural subsistence.

UPPER PALAEOLITHIC

The Upper Palaeolithic levels, dating to 35,000–10,000 years ago, are characterized by signs of sporadic hunter-gatherer occupation. The stone tools, mostly backed bladelets and microliths fashioned from local flint, were used to process the meat of the steppe ass, the most common animal hunted at this time. Other game included red deer, wild pig, and ibex. Analysis of the sediments inside the cave has identified a major depositional hiatus between 17,000 and 13,000–12,000 years ago. When occupation resumed, plant remains indicate that wild lentils, pistachios, and almonds were collected at this time, and steppe ass continued to be hunted. Land snails also were consumed, as evidenced by two extensive deposits of charred and crushed shells in the cave. Toward the end of the Upper Palaeolithic period red deer became the dominant game animal. Obsidian also appears in small quantities. Analyses of the obsidian have identified it as coming from the island of Melos, about 150 kilometers southeast of the site, in the Aegean.

MESOLITHIC

The Mesolithic period at Franchthi Cave is subdivided into two phases, the Lower Mesolithic (8700–7900 B.C.) and the Upper Mesolithic (7900–7500 B.C.), based on a change in the stone tools and fauna. In the earlier period the lithic assemblage is characterized by various tools made by retouching or microflaking part of the stone flake. When done at one end of the flake it forms an end-scraper, while retouching down one edge of the flake can form a serrated edge on a denticulate tool. The fauna are dominated by red deer, but pig and small fish also are represented.

The Upper Mesolithic saw a reappearance of microliths that were present in the Upper Palaeolithic. While there is evidence of an overall decrease in large fauna, remains of red deer still predominate. At this time as well large fish, such as tuna, appeared in the deposits. The overall increase in remains of plants, animal bones, and stone tools points to intensified occupation of Franchthi Cave during the Upper Mesolithic. While this habitation still may have been primarily seasonal in nature, there is evidence from oxygen isotope analysis of marine shells and plant and animal remains that year-round occupation also occurred.

Obsidian also was more prevalent at this time, which, along with the remains of large fish, suggests more extensive seafaring. Mapping of the seafloor in Koilada Bay through sub-bottom profiling has shown the transgression of the shorelines throughout the period of occupation of the cave, thus bringing the coast closer to the cave and eroding the

Fig. 1. Excavated area of Franchthi Cave looking toward mouth of cave. COURTESY INDIANA UNIVERSITY ARCHIVES. REPRODUCED BY PERMISSION.

coastal plain. The shoreline was exploited for shellfish, as evidenced by numerous shells found in the cave deposits. It is possible that reed boats were used to travel in local seas and to Melos to procure obsidian. Use-wear analysis of some of the stone tools has shown that they were used to cut grasses, perhaps reeds or oats and barley.

Aside from a few fragments in the Upper Palaeolithic period, the first complete human burial dates to the Mesolithic. This man, about twenty-six years of age, was buried toward the front of the cave on a deposit of burned shell. Complete analysis of the bone remains from around and beneath this skeleton indicate that this area also had been used for cremation burials.

NEOLITHIC

Geological studies of the deposits in Franchthi Cave indicate another depositional hiatus of about 500 years between the latest Mesolithic and the earliest Neolithic deposits. The Neolithic period (7200–3500 B.C.) saw substantial changes in subsistence practices at Franchthi Cave with the introduction of domesticated sheep and goats as well as wheat and domestic forms of barley and lentils. The first appearance of domesticates occurs in levels with few or no ceramics. The existence of an aceramic or prepottery phase in Greece has been debated over the years, as the earliest occupation layers of many Neolithic sites had little or no pottery. At Franchthi, the levels containing the earliest domesticated plants and animals but little or no pottery are labeled "Initial Neolithic." The sherds that are present may have dropped in from upper layers or may be in situ and represent the rare use of ceramics by these first farmers.

Structures were built on the coastal plain in front of the cave, an area known as the *paralia,* or "beach," in the Early Neolithic period. Coring in the bay in front of the cave has shown that a small hamlet may have extended about 100 meters beyond the present shoreline. The sea level was about 60 meters below the present level at this time.

Analysis of the ceramics has identified five phases of production, with the earliest phase still represented by relatively few pots, which were small and probably not made for cooking. In the Middle Neolithic most of the pottery was of a ware known as Urfirnis, decorated with geometric designs. These vessels, too, were not made for cooking but may have been for ritual use or special occasions. The Late Neolithic and final Neolithic phases saw the production of coarser ware that would have been suitable for cooking over an open fire, which suggests that cooking methods and food preparation techniques changed at this time.

Beads and amulets were common during the Neolithic. An area used for the manufacture of shell beads was discovered in the *paralia* deposits. The finds consisted of small flint borers and cockleshells or shell fragments in all stages of bead manufacture, including bead blanks, partially drilled beads, and numerous complete beads. Many more human burials are dated to the Neolithic period, predominantly the Middle Neolithic, including numerous infant burials. Grave goods in the form of a small marble bowl and a broken ceramic vessel accompanied one such infant burial inside the cave.

Franchthi Cave was abandoned about 5,000 years ago, probably as the result of a major rock fall that blocked the front third of the cave from the back two-thirds and left a window in the roof of the cave. Limited excavation between the building-sized boulders produced material mainly from the final period of the Neolithic.

COMPARATIVE SITES

No comparable site in Greece, with such a long span of occupation, has been excavated. Survey in the region of Franchthi Cave has uncovered few other Palaeolithic or Mesolithic sites and no Early Neolithic ones. Many of the earlier sites may have been flooded when sea levels rose, however. The Palaeolithic levels have some similarities to sites in Epirus, such as Asprochaliko, Kastritsa, and Klithi. Mesolithic deposits have been found in Thessaly at Theopetra Cave as well as several other cave sites in southern Greece. More typical Neolithic sites are the large tells (*magoulas*) in Thessaly, where stratified remains of villages form large mounds in the Thessalian plain.

IMPORTANCE OF FRANCHTHI CAVE

Franchthi Cave is an extremely important site, owing to the depth of the occupation strata, which provide new data on the chronology of lithic and ceramic sequences of southern Greece. Because of the intensive water sieving that was undertaken, it is one of only two Greek sites that have plant remains from pre-Neolithic levels. Together with studies of other biological remains, such as animal bones, marine mollusks, and land snails, these analyses have provided a fairly complete picture of the subsistence systems and environment throughout the occupation of the cave. Additional studies, such as sub-bottom profiling and pollen analysis from cores taken in the bay, show shoreline transgression during the site's occupation and Holocene vegetation in the region. These studies allow one to picture the environment of the time more accurately, as well as the changes the cave's inhabitants encountered.

Franchthi Cave also provides some of the earliest evidence of the introduction of agriculture to Europe. Although wild lentils and barley were present in the Mesolithic, domesticated forms did not occur until after a 500-year hiatus in occupation, at the same time as domesticated emmer and einkorn wheat as well as sheep and goats. Together with the building of the structures on the coast and the introduction of ceramics and new lithic types, this suggests that the Neolithic inhabitants of Franchthi Cave were newcomers rather than descendents of the Mesolithic inhabitants. The southwest Asian assemblage of cereals, legumes, sheep, and goats was brought by people, most likely from western Turkey, seeking new lands or trade. A similar Near Eastern assemblage of domesticated plants and animals can be traced across Europe between 8,000 and 4,000 years ago, as plants, people, and ideas moved or were exchanged from one region to the next.

See also **First Farmers of Europe** (*vol. 1, part 3*).

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JULIE M. HANSEN

THE MESOLITHIC OF EASTERN EUROPE

FOLLOWED BY FEATURE ESSAY ON:

There is no other region in Europe where Mesolithic settlement was as fully represented and where hunter-gatherer communities continued to flourish until so relatively recently than eastern and northern Europe. Atlantic Scandinavia and the basin of the Baltic Sea, with their network of marine coastlines and freshwater shorelines, provided fertile grounds and rich waters for hunting, fishing, and gathering while the large rivers of eastern Europe, heading south to the Black and Caspian Seas, offered corridors to migratory species of sturgeon, salmon, and trout; to flocks of migratory birds; and to the animals that fed on them. It is impossible to do justice here to the full story of the development and transformation of hunting-gathering communities that utilized this landscape. It is possible only to focus on a few pivotal themes. The main features and principal events of the Mesolithic in this area, which primarily covers the forested regions of Europe east of the line marked by the Rivers Dnieper, Pripet, and Vistula, are discussed here.

During the Late Pleistocene, this area was partly buried under ice. As the ice melted with deglaciation, the sea first flooded the low-lying areas in peninsular Scandinavia, Latvia, Estonia, and Finland. The isostatic rebound of the landmass freed of ice followed, resulting in an overall emergence of the land over time, within the region. These processes resulted in unstable and changing shorelines throughout the region. The beginning of the Postglacial period was marked by a rapid rise in temperature by 5–6 degrees centigrade, to around 15°C (59°F), July mean temperature. Climatic amelioration peaked during the Climatic Optimum of the Atlantic period (c. 7000–4000 B.C.), when the July mean temperature reached 21°C (69.8°F). The introduction of farming, which marked the conventional end of the Mesolithic period, began around 4000 B.C., just as the temperatures began to decline, reaching the current mean July level of 16°C (60.8°F).

Climatic changes facilitated changes in the biome, particularly in more northerly regions. In outline, the forest succession and the associated faunal changes were marked by the predominance of birch and pine in the Preboreal period (10,000–9000 B.C.); pine and hazel in the Boreal (9000–7000 B.C.); mixed oak forest of elm, oak, lime, and beech in the Atlantic (c. 7000–4000 B.C.); and more mixed broad-leaved–conifer forest in the cooler, more arid Subboreal (c. 4000–700 B.C.). The last period was marked by the disappearance of elm, a reduction in the presence of warmth-loving species and their contraction southward, the development of raised bogs over previously more productive wetlands, and the colonization of many eastern parts of the circum-Baltic area by spruce forests.

In terms of terrestrial food resources, these changes meant a shift from the open, reindeer-inhabited landscape of the Late Glacial and Early Postglacial to boreal areas with fauna dominated by moose, beaver, bear, and fur-bearing game. During the Atlantic period, temperate fauna of the broad-leaved woodlands included wild pig, red and roe deer, wild cattle, wild horse, and moose and fur-bearing game. In northern parts of the Baltic Sea basin (Norrland, Finland, Karelia, and northeast Russia), boreal woodland prevailed throughout and boreal fauna remained dominant. For aquatic resources, there were two main trends. First came the gradual colonization of developing aquatic environments by an increasingly broader range of marine and anadromous fish and various species of seal. Second, there were fluctuations in such resources as shellfish or anadromous fish in response to the changing salinity levels and temperatures of the water at different stages in the development of the Baltic Sea basin. In aggregate, these transformations indicated an increasingly rich and varied resource environment that peaked in the Atlantic and Early Subboreal periods (c. 7000–2500 B.C.).

The distribution of food resources also varied from region to region. The presence of the Gulf Stream substantially increased the productivity of the coastal regions along the North Atlantic seaboard, while inland resources concentrated in lacustrine, riverine, or estuarine habitats created by the process of deglaciation and changes in the hydrology of rivers, lakes, and seas. In contrast, the interior regions without many shoreline habitats—mostly moraine uplands, glacial outwash plains, and river basins covered by gravel, sand, and clay—were relatively poor in natural resources.

DEGLACIATION, COLONIZATION, AND THE DEVELOPMENT OF MESOLITHIC SOCIETY

Colonization and settlement of eastern and northern Europe is a key event in the history of hunter-gatherer communities of the area. During the Glacial Maximum (c. 22,000 to 18,000 years ago), the region was partly covered by the Scandinavian glacier. By 18,000 to 16,000 years ago, improved climatic conditions were causing ice sheets to melt and expose new land for colonization by plants, animals, and humans. It took some four thousand years for the retreating ice to reach the southern margin of peninsular Scandinavia, where it lingered for some two thousand years. It was at this time that human groups from surrounding regions began to penetrate the ice-free margins of Fennoscandia, their routes much dependent on water and ice barriers in their path. This process of colonization was gradual, laying foundations for major patterns in the cultural diversity of eastern Europe during the Mesolithic.

Recolonization of eastern Europe took place with progressive settlement from the south. Although archaeological evidence usually is a poor indicator of human migration patterns, the spread of cultural traits (evident in the lithic industry and other artifacts) from the Ukraine and southern Ural region into virgin lands to the north supports the idea of such a dispersal into northern parts of eastern Europe and northern Asia. Many linguists and archaeologists regard the Ukrainian center as the original homeland of people ancestral to Finno-Ugric speakers.

Communities of this eastern tradition (Swiderian culture and the eastern tanged-point cultures) occupied southern flanks of the ice margin in eastern Poland, Belorussia, and northwest Russia at the end of the last glaciation. From these areas people first penetrated the eastern Baltic and the Karelian Isthmus, by about 9000 B.C., and then went on to colonize Finland, reaching the coast of the Bothian gulf between 7500 and 6400 B.C. The end of the Swiderian culture, c. 9000–8000 B.C., marked the transition from an open-country reindeer-hunting culture to more broad-based communities exploiting resources of the forest, lakes, and the sea. One of the earliest fishnets, produced by people of this tradition, was found at Antrea on the Karelian Isthmus and dated to c. 8500 B.C.

Regional variants of this Early Mesolithic cultural tradition include the Komornica culture in northeastern Poland, Kudlaevka in Belorussia, Narva in Latvia, Kunda in Estonia, Veretye in northwestern Russia, and Suomusjärvi in Finland. The Swiderian cultural repertoire included double-platformed cores, tanged points, perforated antler axes, and single-barbed harpoons. In post-Swiderian times there was a trend toward microlithization, the development of the ground and polished axe element and of the antler-point industry, the appearance of bone pin-shaped points and of slotted bone points, an increase in backed pieces and micro-retouched bladelets, and the gradual disappearance of tanged points.

From these initial colonization episodes, we can trace the growth and florescence of Mesolithic communities over the following eight thousand years. It generally is agreed that these communities were characterized by technological, economic, and social complexity; effective use of resources; greater sedentation; and relatively high population densities, more so than in other parts of Europe. The evidence for such forms of complexity, for the logistic, operational structure of these residentially more permanent hunter-gatherers, as well as for the chronology of these developments comes mostly from coastal, lacustrine, and riparian zones.

The chronology of the Mesolithic can be divided broadly into early and late periods. The transformation of the Early Mesolithic Maglemose culture to the Late Mesolithic Kongemose culture marked the division in the southern Baltic region, at c. 7000 B.C. Cultural groups cognate with the Maglemose inhabited the eastern parts of the Baltic (Komornice in northwestern Poland; Neman in northeastern Poland; Neman, Narva, and Kunda in the eastern Baltic; Sandarna in southern Sweden; and Suomusjärvi in Finland). Salient features of their technological equipment included an evolved bone and antler industry, core and flake axes, and microblade/microlith technology that declined in use from the west to east, where the older tanged-point industry prevailed within such traditions as the Kunda in Estonia.

The beginning of the Late Mesolithic, at about 7000 B.C., was marked by the introduction of broader rhombic and trapezoidal microliths, a shift from microblade to core-and-blade technology, and numerous regionally specific new items. Regional groupings include the Kongemose and, subsequently, the Ertebølle in Scania, the late Suomusjärvi (Litorina Suomusjärvi) in Finland, the Chojnice-Piènki in northwestern Poland, the Janisławice in northeastern Poland, and the late Neman, Narva, and Kunda in the eastern Baltic and similar cultural units in Russia and the Ukraine.

The introduction of ceramics into this cultural context marked the beginning of another phase in the prehistory of hunter-gatherers in eastern Europe. It is becoming increasingly clear that ceramics were first introduced into the area from southern Siberia at an earlier time than previously thought, possibly originating in China, where ceramics date to the Late Palaeolithic. The Volga-Ural interfluve (where ceramics are dated to 8000 B.C.) and the Volga River corridor (first dated wares from 6000 B.C.) may have served as source areas for the distribution of ceramic technology among hunter-gatherers of eastern Europe. Pottery came into general use by 5400 B.C.

In southern Scandinavia, ceramic-using hunter-gatherers are regarded as still being of the Mesolithic Ertebølle culture, since little else changed in their cultural repertoire. In Finland, the Suomusjärvi culture ended at this time, and the Neolithic Combed Ware took over. In the eastern Baltic and Russia, the addition of ceramics to the existing cultural assemblages ushered in the Forest Neolithic. In keeping with the long-established tradition in Russian and Soviet research terminology, the term "Neolithic" is used here solely in its technological sense (to signal the introduction of ceramics) rather than in an economic one (to denote introduction of agro-pastoral farming). The pottery-using communities of northern Europe continued to manage their indigenous undomesticated resources through hunting, fishing, and gathering, with the addition of locally developed practices of resource management that may have led to taming but not to full domestication of some resources. In this sense, the Combed Ware Neolithic and Forest Neolithic cultures of eastern and northeast Europe are comparable to the better-known Ertebølle and related culture units of southern Scandinavia, northern Germany, and the Netherlands. The introduction of imported domestic plants and animals—cattle, sheep, goats, pigs, horses, pulses, and cereals—occurred very gradually from the south to the north of the region, mostly during the last five thousand years.

MESOLITHIC SOCIETY: SUBSISTENCE AND LAND USE

As in other parts of Europe in the Mesolithic, in eastern Europe the varying spatial and seasonal distribution of natural resources elicited a dual technological and economic response, which can be grouped under strategies of diversification and specialization. Economic diversification consisted of "encounter foraging" practiced by foraging groups with respect to a wide range of resources. This practice is reflected in the faunal evidence by the broad spectrum of food remains, made up of such land mammals as deer, pigs, cattle, horses, beaver, hare, and fish and game birds, and was characteristic of inland habitats. Economic specialization depended on the interception of seasonally aggregated migratory resources, especially sea mammals (seal, in particular), anadromous fish, waterfowl, fur-bearing animals, and reindeer in the north. Hunting often was carried out from seasonal aggregation sites or specialized camps, where the majority of faunal remains belong to a single species, as, for example, waterfowl at Narva-Riigiküla and seals at Konnu, Kopu, Loona, and Naakamäe, all in Estonia, and elsewhere in eastern Europe.

Recovery of plant remains depends on the season of a site's occupation, the preservation conditions, the method of retrieval and sampling, and the processing technique. Despite the biases against finding evidence for plant use introduced by these factors, the body of information on the use of wild plants in Mesolithic Europe is growing steadily. Nuts, such as hazelnuts, as well as water chestnuts, berries, roots, tubers, and leafy plants formed an important element in the diet and were the focus of food-procurement strategies of Mesolithic hunter-gatherers. Moreover, in some areas, such as western Russia, southern Finland, Poland, Lithuania, and eastern Latvia, pollen evidence for burning and clearance is so extensive as to indicate deliberate woodland clearance and the maintenance of more open landscapes by Late Mesolithic groups as a part of a promotional strategy to increase the productivity of nut and fruit trees, shrubs, wetland plants, and, possibly, native grasses.

Artifactual evidence points to a widespread distribution of soil-working tools (hoes and antler mattocks), especially in lowland zones, which, together with the presence of reaping and grinding equipment, supports the argument for the existence of a plant-processing toolkit. There is little doubt that fishing, fowling, and hunting of sea mammals in coastal areas was an important part of the economy among the Late Mesolithic and Neolithic communities of eastern Europe. The distribution of fish weirs, fish traps, and nets shows that delayed capture was a common practice, at least in the Late Mesolithic, although fishnets had been in use since the Early Mesolithic.

The fishing and sea hunting toolkits also included equipment for individual hunting by fishhook, fish spear (leister), and harpoon. Remains of boats and paddles are common on sites with good preservation of organic materials. The development of specialized methods of fishing, sealing, and fowling finds confirmation in faunal remains from many coastal areas, pointing to the existence of a logistic system of resource procurement. This sort of exploitation of seal and other coastal resources grew in the Late Mesolithic (after 7000 B.C.) and among ceramic-using hunter-gatherers, which is evident from studies of fauna, site locations, and the human diet. Indeed, some researchers have suggested, for example, that the adoption of ceramics significantly facilitated the processing and storage of seal oil and so encouraged specialization and trade.

Within such a system of economic organization, defined by the practice of hunting, fishing, and gathering, subsistence strategies may have evolved to include elements of resource management or husbandry and together produced an alternative to the agropastoral farming characteristic of the Neolithic. In northern and eastern Europe, there are indications that such an integrated system operated to varying degrees in some regions and that it was based to a large extent on the intensive use of plant foods, aquatic resources, and wild pigs. These practices may have included rudimentary forms of farming, using slash-and-burn clearance of woodland and the sowing of crops into the ash-enriched, but otherwise impoverished brown soils and podzols predominant in the area.

Let us look more closely at one typical settlement. Abora is a settlement along the shores of Lake Lubana in eastern Latvia, dated between 4100 and 2200 B.C. Similar hunting-and-gathering villages have been found along lakeshores elsewhere in Latvia and in northeastern Poland, Lithuania, northern Belorussia, Estonia, and northwestern Russia. As a rule, the cultural layers are associated with the most productive phase in the development of these lakeshore environments, marked by eutrophic fen or grass-peat deposits. Like Abora, the other settlements have substantial, elaborated wooden dwellings, often built on posts or wooden piles, with ridged roofs with overhanging eaves. Internally, the dwellings are subdivided into rooms or have only one room with add-on sheds, bark floors, and stone-lined or boxed-in hearths. This design is typical of the substantial wooden architecture at Abora and other sites.

The sizes of dwellings range from 30 to 50 square meters. Large concentrations of material have been found within the buildings, pointing to fishing, hunting, and plant gathering, possibly even some form of cultivation. There is a difference of opinion concerning the extent of agropastoral farming. Nonetheless, large quantities of water chestnuts, hazelnuts, seeds of hemp, and hemp pollen, as well as pollen indicators of clearance and ruderals suggestive of open landscape, are signs of possible plant husbandry focused on native plants rather than cereals. Other evidence suggests the processing of hemp and nettle fibers in making clothes and cordage.

In contrast to coastal and lacustrine regions, the upland interior did not present early opportunities for residential permanence. The inland pattern was marked by greater residential mobility, firmer reliance on terrestrial resources, and more direct procurement strategies. Seasonally occupied base camps were located on the shores of smaller lakes and watercourses. From there, people moved in periodically during the year to temporary habitation sites and specialized camps within larger territories. Seasonal aggregation sites, which were a part of both the more sedentary coastal and the more mobile settlement patterns, played an important role within the inland organization of landscape. These were the main locations for the coming together of different communities for trade, exchange, social activities, and courting, as well as for the performance of rituals. To support large gatherings, such places often were placed in good fishing locations by rapids or at river narrows connecting larger lakes.

Long-distance contacts, circulation of exotic prestige items and sought-after raw materials, as well as channels for the dispersal of innovations were all maintained through trade and exchange. In eastern Europe the use of skis and sledges in winter and of boats in the summer months facilitated such contacts. The ritual dimension of such means of transport is shown by moose-headed carvings tipping the ski runners in northwest Russia and elsewhere and by carvings of moose placed on the sterns of boats; moose were perceived as a messenger animal linking the worlds of water, earth, and especially sky. Examples of regional and interregional trade linking vast distances are too numerous to describe in detail. They include the circulation of flint and ochre in Poland; green Olonets slate and flint from Karelia across Finland, northwestern Russia, and the eastern Baltic; and amber from the eastern Baltic coast and flint from the Valdai Mountains within the eastern Baltic and Finland to northern Poland and other parts of northern Europe, the Black Sea, and Caspian regions. More evidence derives from the importation of metal artifacts, polished stone axes, and other items from outside the area.

MESOLITHIC SOCIAL ORGANIZATION

Our understanding of social structure and ideology in the Mesolithic—the Late Mesolithic in particular—is based principally on the evidence from burials, rock carvings, and sculpted, "ritual" artifacts found alone or among domestic debris. The distribution of major burials reflects not only the intensity of research but also the favorable ecological conditions of these areas for hunter-gatherer settlement: all burial grounds occur in coastal areas or in major lacustrine or riverine zones, marked by the concentration of aquatic resources. Burial grounds as such may have acted as territorial markers, indicating increased sedentation, territoriality, and claims to ownership of land and resources.

The burial grounds cover the entire Mesolithic period, from c. 10,000 B.C. to the end of the third millennium B.C. Some are considered cemeteries, in that the interments are grouped in burial grounds marked exclusively for ritual and burial; others are isolated interments within or underneath houses or within settlements. Some long-used locations, such as Zvejnieki in Latvia, saw burial customs change from cemetery burial in the Mesolithic to individual burial within the settlement among the ceramic-using hunter-gatherers of the so-called Forest Neolithic (c. 4000–2000 B.C.).

With 315 excavated burials, the cemetery at Zvejnieki, Latvia, ranks with Oleneostrovskii Mogilnik as among the largest in eastern Europe. The cemetery was used for more than four thousand years, between 7300 and 2800 B.C. Mortuary practice changed from the early (7300–6100 B.C.) to the later period (6100–2800 B.C.), when amber objects replaced tooth pendants as the most common grave goods and principal symbols of value. In the later period, too, burials were strongly associated with settlements, which is shown at Zvejnieki by the black soil transported from an adjacent settlement and deposited as grave fill. Despite these and other changes reflected in burials, we find throughout this period the same use of wild-animal symbolism as at Oleneostrovskii Mogilnik, as well as differences in social status similar to those at Oleneostrovskii Mogilnik. As at Oleneostrovskii Mogilnik, there are both individual and collective burials, indicating, perhaps, the presence of corporate groups. Gravestones, small cairns, or stone linings marked some interments—features that notably are present in other parts of eastern and northern Europe.

The ending phase of the Zvejnieki cemetery is contemporary with burials at Abora, Latvia, where sixty-one interments were placed in the central part of a residential hunter-gatherer settlement. Single, dual, and collective burials as well as perforated tooth pendants, and sculptures of waterbirds, moose, beaver, bear, and snake attest to the same range of burial practices and symbolism seen at Zvejnieki and Oleneostrovskii Mogilnik. The absence of pottery is striking, since the Abora community belonged among ceramic-using hunter-gatherers. The same social and ideological arrangements appear to have lasted in this region until the middle of the second millennium B.C.

MESOLITHIC COSMOLOGY

Hunter-gatherer communities of long duration in the temperate and boreal zones of Eurasia organized their lives according to basic elements of a framework that promoted cultural and ideological continuity. Such structures included environmental variables, seasonal food-procurement regimes, and cosmological systems and were interpreted and reinterpreted by individuals, communities, and outside groups linked by contact and exchange. Social practices called for deliberate decisions and the manipulation and replication of tasks, during the course of which people introduced various changes. The new knowledge and skills then were incorporated into the existing tradition in relationship to existing rules. As an overarching system of beliefs, mediated through ritual practice, this ideology provided the supervisory context within which social practices played out.

The key components of this overarching belief system, abstracted from Siberian and northeast European ethnohistorical data, focused on key structures. The first is that the universe is divided into three worlds defined by earth, water, and sky. A second structure was the notion of reciprocity between human beings, animal beings, and a supernatural, spirit world. A third was the role of the shaman as a religious leader of the community whose principal role was to act as a mediator between the three worlds in a three-level universe by practicing techniques of ecstasy (shaman), aided by his or her ritual equipment and spirit helpers. Ritual equipment almost always included a drum or other musical instruments, dress, bag, horned mask, and models of main spirit helpers. These models included waterbirds (as swimmers and flyers they can lead the shaman to all three worlds), the bear (as the master of other animals beings, and a celestial being), and the moose or deer (celestial beings too as guides to and in the heavens).

In the hunter-gatherer prehistory of eastern and northern Europe, the symbolism of rock-carving sites, of carved utilitarian objects, and of the ritual context of burials clearly related to the culture's system of beliefs. Material representations are to be found on sculpted terminals of wooden household utensils, such as spoon-bowls and ladles; zoomorphic axes and mace-heads; rock carvings, and zoomorphic ornamentation on pottery. Moose, bear, and waterbirds are the most common designs.

Rock-carving and rock-painting sites of northeastern Europe give perhaps the best record of the cosmology and ideology of the resident hunter-gatherers. Painted or engraved at several hundred such locations are thousands of images representing principally anthropomorphic figures, cervids, boats, sea mammals, bears, waterbirds, fishes, reptiles (snakes and lizards), tracks or footprints, weapons and hunting and fishing gear, and abstract designs. The youngest of such rock carvings can be dated through geological methods to c. A.D. 500.

In addition to such ritual locations, we find items of material culture in burials and on domestic sites. They also occur in what might be called "lost" locations, often deposited in bogs and wet places, perhaps as votive artifacts that were carved, sculpted, or otherwise altered to instill ritual meaning in them. Such artifacts were widespread in the Stone Age and among later hunter-gatherer societies of the circumpolar regions. They refer to "messenger animals," capable of communicating with nonterrestrial worlds. Among these items are bear- and moose-headed effigies (also known as terminals, because they sometimes are depicted in rock art mounted on poles) and diverse objects carved with the representation of these and other animals, for example, waterfowl, swans, ducks, snakes, beavers, and even human beings.

For the traditional societies of the boreal zone, birds, specifically waterbirds, played a role in guiding the dead to the underworld and in myths of world creation and regeneration. Given the multidimensional symbolism of the migratory life cycle of waterbirds, which is marked by regeneration (in spring) and death (in autumn), it is hardly surprising that zoomorphic artifacts, such as duck-headed ladles, are found commonly in archaeological contexts. These items are present among cultures ranging from the Narva in the eastern Baltic (4000–2500 B.C.) to the Ust-Poluy on the lower Ob River in western Siberia (500–300 B.C.).

Moose- and bear-headed terminals, which are depicted on poles at Namforsen, Sweden, and in rock carvings on the shores of Lake Onega (where Oleneostrovskii Mogilnik is located), find a direct parallel in the shaman's *turu,* a ritual rod used to mediate between the natural and supernatural worlds. Carvings of moose also may have had a broader significance; after killing and consumption, appropriate treatment of the carcass was thought to ensure the revival of the moose and continued success for the hunter.

The bear was as an animal of veneration, honored with special treatment; it was to be addressed with circumspection and only on ritual occasions. In Lapland as well as in western Siberia, communities engaged in a ritual of sending back the bear to bear country. Hunters would walk and sing together with bear soup, part of which was poured into a river as a votive offering; in this way, the essence of this messenger animal was returned to the "cosmic river." In Lapland, we find ritually buried bear skulls and other bear graves that were accorded elaborate treatment. Sculpted bear axes, bear-headed terminals, and images of bears in rock art are recurrent features of the symbolic repertoire of northern hunter-gatherers. It is important to note that the presence of such artifacts also served to ritualize habitual spaces where routine tasks occurred (such as cooking food) and which archaeologists often interpret as only practical, functional spots.

Finally, we can distinguish the existence of shamans in the prehistoric record of eastern and circum-Baltic Europe. Both rock art and burial evidence contains a range of symbols that, in ethnographic contexts, would be identified with the roles of a shaman. In rock art we find petroglyphs of anthropomorphic figures with horns and masks, from the shores of Lake Onega in Karelia, for example. There also are numerous petroglyphs of persons wielding moose-headed terminals, from Namforsen and other places, which correspond to the numerous finds of the artifacts themselves. In both instances, we can interpret the figures as shamans dressed in the guise of animals and carrying the *turu,* or tree of life, symbolizing the ability to undertake a journey between different worlds, aided by reptiles and horned animals.

We also find interments that differ significantly from standard practice. Grave architecture, treatment of the body, and grave goods all clearly signify shamanistic roles and symbols. For example, four shaft graves at Oleneostrovskii Mogilnik containing four individuals (two males, one female, and one juvenile) in seated or reclining positions (while standard practice was to bury the dead as flat inhumations), can be comprehended as shamans' graves. There are other exceptional burials that can be attributed to shamans. Among them are the rich burial of a thirty-year-old man from Jasnisławice, Poland, dated to 5600–5400 B.C.; a double burial from Duonkalnis, Lithuania, dated to about 5900 B.C.; and a triple burial from Vedbæk-Bøgebakken, Denmark, apparently of a male with a female range of goods, a female, and a child. As at Oleneostrovskii Mogilnik, female grave goods interred with a male might indicate the office of a shaman.

At Zvejnieki, both earlier (6200–3300 B.C.) and later (3300–2200 B.C.) phases contained extraordinary burials attributed to ritual specialists or shamans. In the earlier period, some 2,400 animal tooth pendants were arranged into headdresses and buried with the deceased at one location. These burials belonged to nine males, eight adolescents, two females, and two other adults of undetermined age and sex, representing about 7 percent of all the burials, or about 25 percent of those with pendants. Ornamental headgear decoration has been found at only two other places, Oleneostrovskii Mogilnik in Karelia and Duonkalnis in Lithuania.

Amber pendants, rings, beads, and sculptures replaced tooth pendants in the later, Pit-Comb Ware ceramic phase. In four cases mortuary masks of red or blue clay covered the faces of the dead (three adult males and one adolescent), with amber rings pressed into the eye sockets. Similar finds were made at Hartikka and Pispa, southern Finland, and at Tudozero, northern Russia. Both headgear and masks form an essential part of the shaman's ritual equipment, and we know of shamans being buried with their gear. These artifacts complement the more specific symbolism of finds representing messenger animals, such as bear, beaver, moose, snakes, and waterbirds.

CONCLUSION

More than in any other part of Europe, hunter-gatherers in the east and north confronted the challenges of a changing natural environment and of historical development in the surrounding regions. They successfully utilized the opportunities made available to them by deglaciation and the rapid development of postglacial habitats. They were selective in their choice of cultural innovations associated with agropastoralism, Neolithic technologies, and, later, metallurgy. Equally, they managed effectively the introduction of agropastoral farming and exploited the opportunities offered by contacts and trade with the more complex cultures to the south and west, as they gradually became part of a world trading system.

These "pick and choose" strategies resulted in original cultural transformations and in effective systems of management, which, in turn, led to remarkably long-term cultural stability and a social life of complexity unknown elsewhere among hunter-gatherers of Europe. This society was characterized by a hunting-gathering lifestyle into times more recent—in some cases, the early historical period—than in any other part of Europe, except northern Scandinavia. These peoples contributed in no small measure to the genetic and cultural heritage that forms the basis of contemporary modern society of eastern Europe today.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **Oleneostrovskii Mogilnik** (*vol. 1, part 2*).

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MAREK ZVELEBIL

OLENEOSTROVSKII MOGILNIK

As the mists were lifting above the lake, a small boat—a dugout canoe—was taking the chieftain's body on his last journey, beyond the water toward the island of the dead. Like a shadow, the island emerged from the mist, surrounded by the dark green waters of Lake Onega. The shaman pounded his drum; the elders wielded symbols of their community, shaped in the image of the moose; and the boatmen hurried on to release their load. As the boat drew closer to the shore, a pair of swans took off from the shallows. This was a good omen. They were taking with them the soul of the deceased, his freed and timeless soul, northward to the underworld, and the mood of the living lifted with the mists. The soul of the old chieftain was about to be buried amid feasting and ceremonies, together with his earthly remains, symbols of office, ceremonial dagger and other weapons, headdress, pendants and necklaces, and various other possessions. Rays of the early summer sun broke through the cloud, more than eight thousand years ago.

In local folklore Oleneostrovskii Mogilnik (also called Olenii Ostrov or Deer Island) was known as the island of the dead, but it was not until the mid-twentieth century that the local population discovered that the island held the largest Mesolithic cemetery in Europe. More than eight thousand years ago people were buried there, and the picture sketched here is based on a reconstruction of events occurring at that time (fig. 1). The body in the rich grave numbered 100 may indeed have belonged to a shaman or a chieftain.

Located on a small island within Lake Onega in Karelia, the cemetery was discovered as a consequence of quarrying activities in the 1920s, and

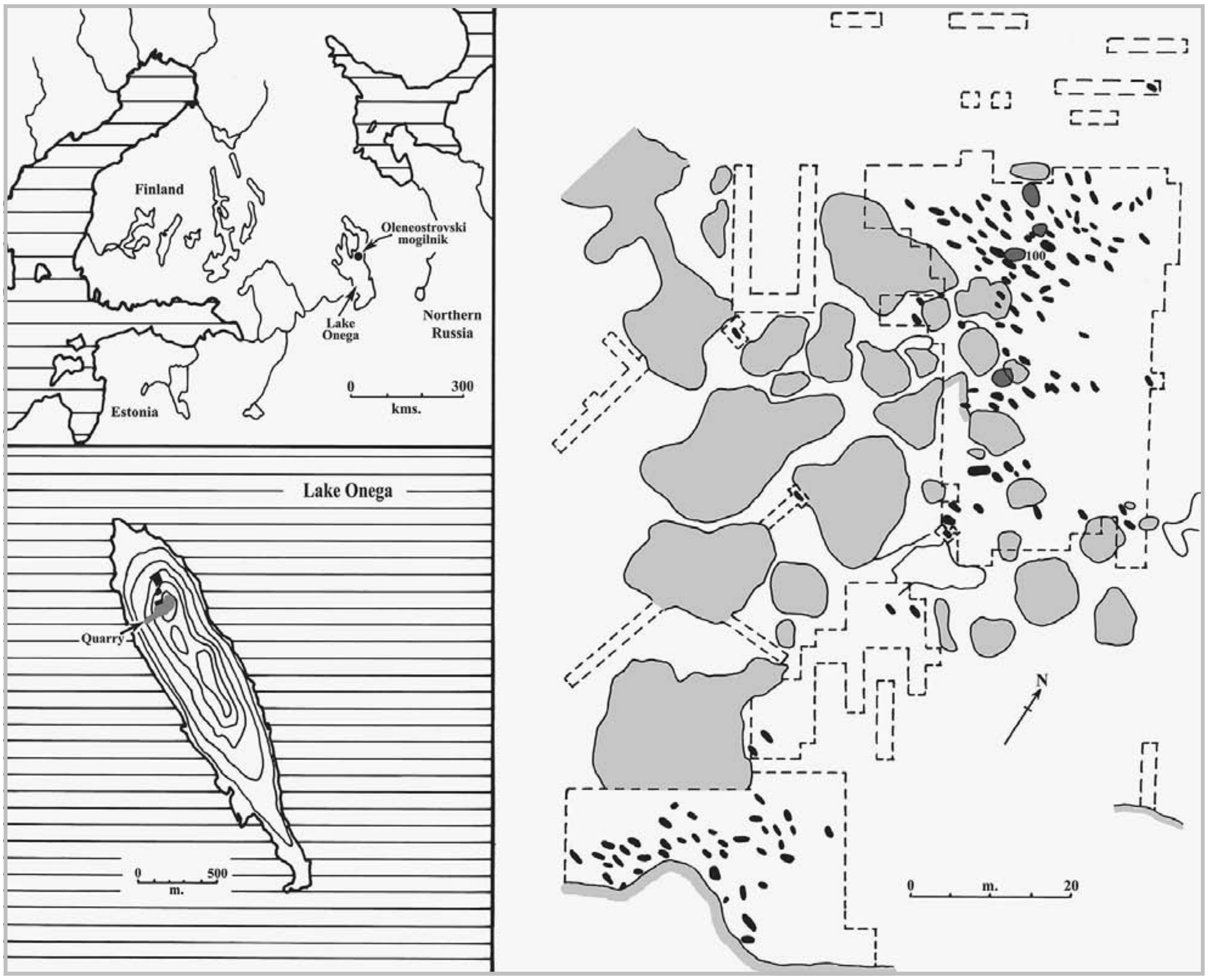

Fig. 1. Plan of Oleneostrovskii Mogilnik cemetery. Courtesy of Marek Zvelebil. Reproduced by permission.

many of the graves were destroyed or disturbed before excavation. Excavated by Soviet archaeologists in the 1930s and 1950s, the cemetery was subsequently interpreted in several different ways. In all, archaeologists managed to excavate 177 burials in 141 distinct mortuary features, but the total number of burials must have been nearer 500. Radiocarbon dating of the skeletons places the cemetery in a period between 6400 and 6000 B.C. This unexpectedly early date is fully consonant with the Mesolithic character of artifacts from the site.

It seems that two groups, possibly lineages or clans, were using Oleneostrovskii Mogilnik. This is evident from two spatial clusters within the cemetery: the northern cluster is associated with moose sculptures (fig. 2) and the southern cluster with snake and human effigies. The snake and human representations seem to be combined into a single zooanthropomorphic tradition, different from the northern group, whose identity was symbolized by moose representations. Thus, two separate populations shared the use of Oleneostrovskii Mogilnik. The northern cluster was used by people with northern European and Uralic features, more indigenous to the area, while the southern area was used by people with southern European and Siberian features, who might have been newcomers to the area. This interpretation underlines the genetic heterogeneity of the people who used the cemetery. Rather than supporting the existence of two distinct, noncommunicating groups, these graduated differences in appearance and genetic makeup instead may reflect "unimpeded gene flow" across the forest zone

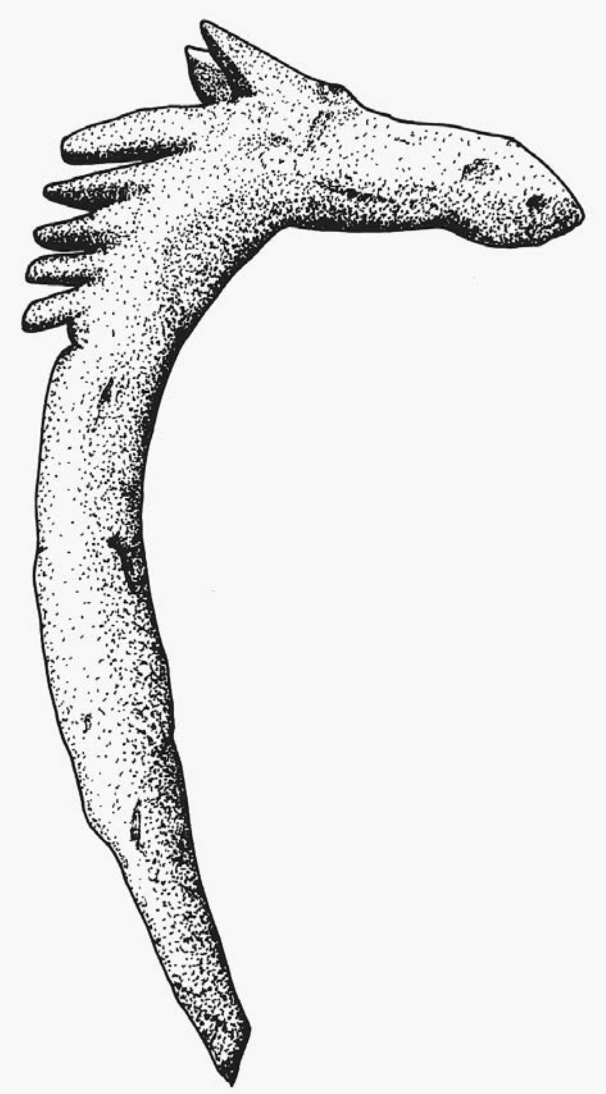

Fig. 2. Moose-headed terminal from graves at Oleneostrovskii Mogilnik cemetery. COURTESY OF MAREK ZVELEBIL. REPRODUCED BY PERMISSION.

of eastern Europe, brought about by long-distance travel, intermarriage, and partner exchange that was usual among the northern hunter-gatherer populations.

In all, 7,132 artifacts were found with the burials, and the vast majority consisted of the pierced incisors of moose (4,372 pieces) and beavers (1,155 items) and bear tusks (170 artifacts), modified to hang as a part of a headdress, pendant, or necklace. The remaining artifacts included six bone daggers, thirteen flint and sixty slate ritual knives, carved bone or stone pendants, and fourteen sculptures made of antler. More utilitarian tools included harpoons, fishhooks, sinkers, awls, needles, flint blades, scrapers, spearheads, and arrow points made from both bone and flint. Unworked animal bones were relatively rare and included those of beaver, reindeer, moose, wolf, bear, and dog.

The number and composition of grave goods, together with burial arrangements and elaboration of the graves, formed the basis of mortuary analysis and interpretation of the social composition of the Oleneostrovskii society. Such mortuary analysis revealed the existence of at least seven social dimensions, expressing band membership; social differentiation related to gender, age, and personal wealth; and three other specialized ranks. Gender distinctions were expressed through the articles placed in the graves of the deceased. Bone points, bone harpoons, axes, flakes, and slate knives were associated with males. An absence of implements but inclusion of ornaments and perforated beaver incisors was associated with females.

The types of perforated tooth pendants exhibited a clear hierarchical order relative to each other, which corresponded to the number and variety of other goods found in the graves. Graves with bear tusks denoted the wealthiest people, followed by graves containing either moose or beaver incisors, and, finally, graves with no pendants. These wealth ranks varied with age, so that the adults possessed the greatest quantities, while the young and the old had fewer goods. Such age-dependent change was less pronounced among females, possibly indicating that female wealth markers were obtained through either affinal or consanguine ties to males.

In four shaft graves at Oleneostrovskii Mogilnik, there are interments that are significantly different from the others, and in terms of grave architecture, treatment of the body and the grave goods relate to shamanistic roles and symbols. In contrast to the others, these graves are oriented westward. They include two males, one female, and one juvenile—in a seated or reclining position. Their interpretation as shamans' graves relies on their western orientation (while others faced east), which can be explained as facing the entrance to the underworld, the domain of spirit ancestors of the shamans and of the rulers of the underworld. The recovery of beaver mandibles from one of these graves reinforces the argument, since mandibles of beaver form part of the shamans' attire among some Siberian groups, in reference to the perceived medicinal and ritual qualities of the beaver. The presence of beaver incisors in the shaft graves, irrespective of sex, is significant, as this category of pendants normally is associated with females at Oleneostrovskii Mogilnik. Both men and women took on the shaman's role as spiritual mediator with the underworld; consequently, the shaman's robe retained symbols of both genders.

Two other special ranks are represented at the cemetery. The first can be seen in a series of eleven individuals, all male, who were interred with bone projectile points as the sole grave good, suggesting the presence of a sodality, or all-male hunting group with special abilities or responsibilities connected to hunting. The second rank is represented by a set of nine graves—two in the southern cluster and seven in the northern one—where the deceased were buried with carved effigies. This social status could be held by adults of either sex and was most common among older individuals. It was independent of personal wealth, as all three wealth ranks were represented among these burials. The apparent relationship between the effigies and the spatially separate clusters of the cemetery suggests that these persons held some office or social position related to the central ritual identity of the bands. The range of ages among the officeholders (from adolescent to old) and the independence from personal wealth may suggest an ascriptive or hereditary dimension to this social position.

The elaborate burial in grave 100 represents one of the shaft burials, where the individual, a robust middle-aged male, was buried in a reclining position. The deceased was sent off to another world with more than five hundred artifacts carefully placed over and around his body, particularly around the head and shoulders, around the pelvic region, and below the knees. This arrangement suggests that some of the pendants were attached to what was perhaps a funeral garment and possibly a headdress. The deceased was equipped with a quiver that held arrows and a large bone dagger with flint inserts. It has been suggested that the placement of these artifacts, the almost vertical positioning of the body, and other features of the burial rite indicate that the deceased was exposed for viewing intentionally, so as to produce a memorable visual effect.

The construction of the grave was equally elaborate. The body was buried in a long pit covered in ochre, sealed by a layer of sand, and topped by large stones. Possibly, an external sign, such as a wooden pole, marked the location of the burial. There were three other persons interred in such vertical or sloping shaft graves. Both males and females could assume this social status, and it seemed to have a positive correlation with an individual's wealth, as three of the four individuals possessed grave assemblages of the highest wealth level. The range of artifacts and the conditions of burial are consistent with one researcher's observation that these are the graves of ritual specialists, or shamans. It was the shamans, or the effigy holders, who were most likely to act as community elders or chieftains.

In summary, while the ritual roles could be inherited (as evidenced by child or juvenile effigy holders), the wealth could not. It tended to decline in old age. Such patterned decline in status goods with age may reflect intergenerational circulation of symbolic artifacts as age- and gender-related social roles were passed from one age group to another. Much of the grave equipment reflected the age and sex-specific social role of an individual at the time of death. At the same time, both men and women could acquire a high-status position, although men tended to acquire higher rank more often than did women.

Over what period of time was Oleneostrovskii Mogilnik used? The length of use and the frequency of interments have a major bearing on the broader significance of the cemetery. O'Shea and Zvelebil's reconstruction of the Oleneostrovskii Mogilnik cemetery and its society suggests that a community of about four hundred to five hundred people used the cemetery. The duration of its use was relatively brief, perhaps 80 to 120 years, or four to six generations. Other researchers have identified chronological differences between the northern and southern clusters within the cemetery and posit a longer period of use, perhaps as long as five hundred years. On the available evidence, this would mean one burial every three years.

Even if we accept that the total number of people buried was about five hundred, it would mean that there was about one burial per year. Used so intermittently, Oleneostrovskii Mogilnik could not have acted effectively as an ideological and ethnocultural sacral center, a necropolis founded by a chieftain ancestor that was central to the identity of the group, or a focus for seasonal gatherings meant to maintain extensive social ties of the broader community. Even though burial of people at Oleneostrovskii Mogilnik probably was selective, its adduced function would have required one or two ceremonial gatherings per year (late spring and early autumn). This would suggest a shorter, rather than longer episode of use, on the order of one hundred to two hundred years.

Oleneostrovskii Mogilnik is only one among several burial grounds in northern and circum-Baltic Europe displaying such mortuary variation. Other similar cemeteries have been found in Scandinavia, Northwest Russia, and the eastern Baltic. Mortuary analysis of major burial grounds, such as Oleneostrovskii Mogilnik, Skateholm (Sweden), or Zvejnieki (Latvia), indicates that many of the Mesolithic communities in northern and eastern Europe correspond to the "delayed-return" foragers in the ethnographic record (i.e., foragers invest in food-procuring activities that have long-term results, such as building fish weirs or dams). Social structure in the Mesolithic appears to have been more hierarchically ranked than was the case among the more complex hunter-gatherers of modern times. Status distinctions along the major social dimensions of age, sex, and achieved status are discernible in general terms, and there is evidence for inherited social differentiation (inherited social stratification) at Skateholm, Zvejnieki, and Oleneostrovskii Mogilnik as well as at other cemeteries along the Atlantic coast in Denmark, France, and Portugal.

The Oleneostrovskii Mogilnik cemetery also gives a wealth of information about the cosmological beliefs held by the Mesolithic hunter-gatherers. This system of beliefs, structured by analogy to more modern Siberian shamanism, is based on the concept of a three-tier universe (upper or sky world, middle or earth world, and the underworld associated with water, ocean, and the north). The tiers are linked by a *turu,* or a tree of life, providing a conceptual axis linking the three worlds. It is further based on the existence of more souls than one, including at least the free soul and the body soul. The body soul is manifested by breathing and it lives and dies with an individual; the free soul enters a human or an animal at birth, perhaps from an ancestor, and departs at death to the underworld, or sometimes to the upper world depending on the status of the individual. Communication takes place between human beings and deities, spirits, and animal beings for the benefit of the whole living community. Most communication was conducted by shamans with the help of spirits, among whom the most prominent took the shape of waterbirds (as swimmers and fliers that could lead the shaman to all three worlds), bear (as the master of other animal beings), and moose or deer (as a messenger celestial being, a guide to the heavens, and a link between the three worlds). Artifacts at Oleneostrovskii Mogilnik are replete with symbolism that can be understood by reference to these meanings, and similar motifs and symbols are replicated on rock carvings and paintings of the region, as at Besov Nos on Lake Onega, on the White Sea petroglyphs, and elsewhere in northern Europe.

It is within this ritual and cosmological context that people from the Oleneostrovskii Mogilnik community were buried—often on islands or promontories; marked by ritual separation by water from settlements; and guided by animal spirits, such as images of swans, duck, or moose and deer, to the other worlds. Ceremonies involved extraterrestrial communication by shamans with the aid of ritual equipment: the drum, mask, headdress, bag, and bones or images of ritually significant animals—beaver, snake, waterbirds, deer, and bear. Finds at the cemetery reflect this ritual code of practice.

In such ways, people of the Oleneostrovskii Mogilnik community and beyond—indeed, the people of the Mesolithic in northern and temperate Europe—could make sense of the world around them. With the aid of such understanding, they could organize their social roles and relationships and negotiate with one another for power, prestige, and social standing in the community within an accepted code of practice. These social roles and social standings were played out and remembered in rituals surrounding death and symbolized by artifacts deposited in their burials. Oleneostrovskii Mogilnik, together with other burial grounds, offers an exceptionally informative and specific glimpse into the social lives and communal beliefs of hunting and gathering people eight thousand years ago.

See also **Skateholm** (*vol. 1, part 2*).

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MAREK ZVELEBIL

3

TRANSITION TO AGRICULTURE, 7000–4000 B.C.

INTRODUCTION

Archaeologists have long regarded the transition from hunting and gathering to agriculture as one of the most important developments in human history. V. Gordon Childe (1892–1957) and Robert Braidwood (1907–2003) were among the first scholars to emphasize the importance of this change in human society. At its root was the shift from the reliance on wild plants and animals to domesticated plants and livestock. Domestication is the process by which humans are able to control the reproduction of plant and animal species and thus select for various desirable characteristics. In the Near East, just before ten thousand years ago, people began to select for desirable characteristics in wheat and barley and in sheep and goats. Later, cattle, pigs, lentils, and peas were added to the list of early domesticates. Throughout the millennia that followed, many more species of plants and animals were domesticated in other areas around the world, including China, Africa, and several regions in the Americas.

The transition to agriculture in the Old World traditionally marks the beginning of the archaeological period known as the "Neolithic," the final major division of the Stone Age. For many years, archaeologists noted that the Neolithic also saw the emergence of pottery production and ground stone tools, although these traits now have been shown to occur in pre-agricultural societies as well. Today, archaeologists see that the adoption of domestic plants and animals is only a single symptom of a major societal and economic transformation. During this period, people changed their views of many things, including the returns expected from their quest for food, acceptable levels of risk and uncertainty, their ability to change their environment, property rights and residential stability, definitions of kinship and residential groupings, and the benefits of more children. Most of these changes began back in the Mesolithic period, but they came together during the Neolithic to produce a dramatic change in society.

Farming spread from the Near East across Europe between 8,500 and 4,000 years ago. In some areas colonizing farmers dispersed into new habitats. Elsewhere, local hunter-gatherers adopted crops and livestock. Archaeologists must differentiate between these two processes, a challenging task. Despite some claims for local domestication, it appears that all the principal species of plants and animals used by the early European farmers initially were domesticated in southwestern Asia, so there is no "pristine" center of domestication in Europe itself. Radiocarbon dating has been immensely helpful in tracing the spread of agriculture in Europe.

Around 6500 B.C. the first European farmers appeared in Greece. Immigrants from Anatolia colonized fertile floodplains, lived in houses built of mud brick or adobe, grew emmer and einkorn wheat, and raised sheep and goats. These communities were similar to contemporaneous settlements in the Near East, although some of the details are significantly different. Native foragers in other parts of Greece also made the transition to agriculture, as reflected at sites such as Franchthi Cave.

From its initial European toehold in Greece, agriculture spread along two routes: west through the Mediterranean basin to Spain and Portugal and north and northwest along the Danube drainage and then into the river valleys that drain into the Baltic and North Seas. Within about two thousand years of the first appearance of agriculture in Greece, farming reached the Atlantic Ocean and the English Channel. It did not spread at a uniform speed. Sometimes the leading edge of farming jumped forward very quickly, and sometimes it stood almost still for centuries.

The Mediterranean dispersal followed coastal routes. Domestic livestock, especially sheep, as well as cereals and pottery appeared at sites along the coasts of Italy and southern France, such as Arene Candide (in Liguria, Italy), which differed little from the camps of the local foragers. Apparently, these items were passed along from community to community and integrated into the hunter-gatherer economy. Watercraft probably were crucial in enabling this contact.

The spread of agriculture north from Greece into the Balkans was the result of either colonization by farmers or local adoption of crops and livestock. The attraction of early farming communities to alluvial soils hitherto sparsely settled by foragers suggests that some population movement occurred. It is apparent, however, that certain Mesolithic groups adopted domestic plants and animals. In the Iron Gates gorges along the Danube, the inhabitants of such sites as Lepenski Vir (in Serbia) brought crops and livestock into their economy alongside fish, deer, and wild plants.

In the river valleys of central Europe, colonization by farmers was the primary means by which agricultural communities were established. Known from their incised ceramics as the Linear Pottery culture (alternatively, *Linearbandkeramik* or LBK), these people lived in timber longhouses, sometimes more than 30 meters long, along the tributaries of major central European rivers. They usually settled on a fine-grained soil called "loess" that they could farm for many years without much of a decline in fertility. In the west Linear Pottery communities reached the area of Paris, while in the north some ventured onto the North European Plain along the lower Oder and Vistula Rivers. Unlike the pattern in southeast Europe, where sheep and goat were the major livestock species, bones of domestic cattle are the most common types found on Linear Pottery sites.

The coasts of the Baltic and North Seas and the Atlantic Ocean were densely settled by Mesolithic hunter-gatherers. Nearly a thousand years after the Linear Pottery farmers appeared in the adjacent inland areas, the foragers of northern and western Europe saw no need to adopt domestic plants and animals. Their hunting, fishing, and collecting economy was more than adequate. Gradually, however, these peoples selectively adopted domestic plants. Shortly after 4000 B.C., cultivation and stock keeping became more important than foraging in northwestern Europe, Scandinavia, Britain, and Ireland. As in the Mediterranean area, such watercraft as dugout canoes made it possible to transport domesticated plants and animals to the British Isles and much of southern Scandinavia.

A similar pattern is observed in the alpine regions of central Europe. Around the upland lakes of Switzerland and adjacent areas of Germany, France, Italy, Austria, and Slovenia, Neolithic settlements replaced the camps of Mesolithic foragers. Originally thought to have been built on wooden piles placed out over the water of the lakes, these "Swiss lake dwellings" are now known to have been on the lakeshores. Their marvelous preservation of organic material, such as seeds, cloth, wood, and netting, has provided a glimpse of artifacts and food remains not often recovered at other sites.

Not everyone in Europe converted to agriculture. In parts of northern and eastern Europe, foragers continued relatively unaffected by the farming way of life, despite evidence for contacts between the two populations. Fishing and hunting continued to be the primary sources of food for many more centuries. These forest peoples readily adopted pottery, however, so it seems that they were in contact with farmers and made a conscious decision not to imitate them completely.

After the initial establishment of agricultural communities, it took some time for the mature farming systems that characterized later prehistoric periods to emerge. New types of cereals, such as bread wheat, and rye, were introduced, and different combinations of livestock species were tried and refined over the next two millennia. New local styles of pottery and houses soon replaced those of the earliest farmers, and extensive trade networks connected farming communities. The first traces of competition and warfare are seen in the archaeological record. At the same time, however, it is important to note just how quickly agriculture spread throughout Europe. It clearly was an idea that appeared at an opportune time, when conditions were ideal for its rapid adoption and dispersal.

PETER BOGUCKI

CROPS OF THE EARLY FARMERS

It is generally accepted that the first farmers of Europe grew crops that had been cultivated in the Near East for two thousand years before reaching the shores and inland plains of Greece. Plant remains from Early Neolithic sites indicate that the earliest farming villages, dating to about 6700 B.C., grew emmer, einkorn, and bread wheat; two-row barley; lentils; bitter vetch; peas; and flax. With the exception of emmer wheat, wild species of all of these plants can be found in modern Greece, and several have been recovered from pre-Neolithic levels at Franchthi Cave in the southern Argolid. Nonetheless, there are no data to show that these species were domesticated in Greece; rather, they appear to have been imported along with domesticated emmer wheat from the Near East.

THE FIRST FARMERS

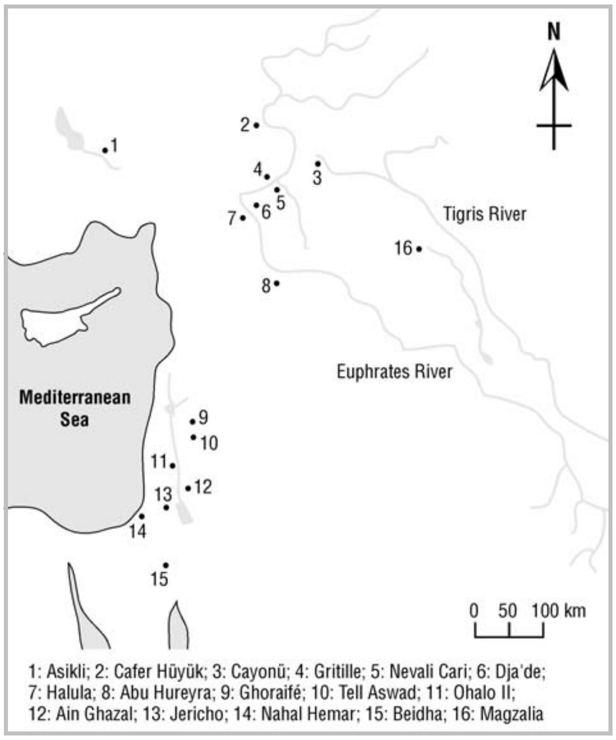
The only site in Greece to have produced pre-Neolithic plant remains is Franchthi Cave in the southern Argolid. There, wild barley (*Hordeum spontaneum*) and wild lentils (*Lens species*) were collected as early as 10,000 B.C., at the end of the Upper Palaeolithic and throughout the Mesolithic occupation of the cave, until about 6000 B.C. It is possible that both of these plants as well as wild oats (*Avena species*) were cultivated during this period, but there is no conclusive evidence to support this suggestion. In addition, there was a depositional hiatus in the cave sediments that lasted about five hundred years, after which domesticated emmer wheat and domestic sheep and goats appeared in the deposits. Neither wild nor domestic barley turned up again until the Middle Neolithic period, about 5000 B.C. A few lentils are present in the Early Neolithic levels, but it is not possible to state whether these lentils are wild or domesticated.

In northern Greece, in particular the Thessalian plain, remains of the earliest farming communities are found at the base of large multiperiod mounds, or *magoulas*. These Early Neolithic villages are fully agricultural, with the complete assemblage of Near Eastern crops. There is no underlying Mesolithic material at these sites to suggest the use or even presence of the wild progenitors of these crops. Until the results of analyses of plant remains from Mesolithic levels at Theopetra Cave, in northern Thessaly, have been completed, it is necessary look to the Near East for the origins of these crops.

CEREAL CROPS

The earliest domesticated plants found on Near Eastern sites are einkorn wheat (*Triticum monococcum*), emmer wheat (*Triticum turgidum* subspecies *dicoccum*), two-row barley (*Hordeum distichum*), rye (*Secale cereale*), lentils (*Lens culinaris*), peas (*Pisum sativum*), bitter vetch (*Vicia ervilia*), chickpea (*Cicer arietinum*), and flax (*Linum usitatissimum*). In addition, poppy (*Papver somniferum*) was domesticated in western Europe, from where it spread eastward. With the exceptions of rye, chickpea, flax, and poppy, all of these species occur in the earliest Neolithic sites in Greece.

The identification of domesticated plants is not always straightforward, especially given the distortions and other damage resulting from carbonization, the most common form of preservation on archaeological sites. Nonetheless, with cereals it is more often possible to identify domesticated versus wild forms from archaeological material. The principal difference between wild and domesticated cereals is the capacity of the wild plant to propagate its seeds through the breakage of the rachis into segments (spikelets) upon ripening; thus the plants are referred to as "brittle rachis" types. Each spikelet carries one or more seeds, depending on the species. When it falls to the ground, the spikelet becomes embedded in cracks in the sediment during the dry spring and early summer months. There it lies dormant until the autumn rains, when a certain proportion of the grains germinate. The rachis segments of the wild type have a smooth scar where the segments have separated from each other by the formation of an abscission layer at the base; this is similar to the layer of tissue formed at the end of a leaf petiole that causes the leaf to fall from the tree in autumn. On a domesticated cereal the tough (non-shattering) rachis segments that have been separated through threshing have a rough, jagged scar, but otherwise they may be found with several segments or a whole ear still intact.



Selected sites where remains of wild and domesticated grains have been found. DRAWN BY JULIE M. HANSEN.

The change from the wild-type brittle rachis to the domestic-type tough rachis is the result of a spontaneous mutation at a single point on the chromosome. Within any wild stand of cereals there will be a small percentage of these mutated forms. The conscious or unconscious selection for and subsequent cultivation of this type of cereal eventually led to the development of fully domesticated fields. How and why this took place is still the topic of debate, and a thorough discussion of this issue is beyond the scope of this essay. Suffice it to say that it is possible to identify wild and domesticated cereals on the basis of the remains of the rachis or spikelet segments.

A second difference between wild and domesticated cereals is in the size and shape of the grains. With sufficient well-preserved material, it usually is possible to distinguish the two. Careful measurements of the length, width, and breadth of the grains and the ratios of these measurements also have proved effective in separating wild and domesticated forms as well as one species from another. It is useful to examine each crop, their wild progenitors, and their natural distribution in the Near East to gain insight into the plants grown by the first farmers of Europe.

Einkorn Wheat. The wild progenitor of einkorn is *Triticum monococcum* subspecies *boeoticum* (fig. 1), which is widespread today in central Anatolia, with stands in the Levant and the Balkan Peninsula as well. It grows on rocky, dry soils and is hardier than other species of wheat. Remains of wild einkorn have been found on such Epipalaeolithic sites as Abu Hureyra and Mureybet in Syria. The earliest certain remains of domesticated einkorn wheat are found at Cafer Hüyük in southeastern Turkey, dated to 7400–7000 B.C. Although it is not as common as emmer wheat, einkorn is present in small quantities in the earliest farming sites in Thessaly, such as Argissa, Otzaki Magoula, and Soufli Magoula, dated to about 6200 B.C.

Emmer Wheat. The wild progenitor of emmer is *Triticum turgidum* subspecies *dicoccoides* (fig. 1), which is found in the modern southern Levant, Southeast Turkey, and the Zagros Mountains. It grows in oak park forest and steppe or steppe forest

Fig. 1. Some early cereal grains. ADAPTED FROM ZOHARY AND HOPF 1988.

on basalt and limestone. The wild species of emmer wheat has been recovered from the site of Ohalo II in Israel, dated to nineteen thousand years ago. The domesticated form is identified from Cafer Hüyük X–XIII (7400–7000 B.C.), although it also may be present at Tell Aswad (Syria), dated to 7600–7700 B.C. Emmer wheat is present on nearly all Near Eastern sites dated to 7300 B.C. or later that have yielded plant remains. It also predominates on the earliest farming sites in Europe and was the primary domesticated cereal crop as agriculture spread from east to west across the Continent.

Early naked wheat is of two types that are difficult to distinguish in the archaeological record. Bread wheat (*Triticum aestivum*) is the result of a cross between emmer wheat and *Aegilops squarrosa,* a wild grass that is distributed principally in modern northern Iran and farther east. It also occurs in eastern Turkey and northern Syria. Macaroni, or hard wheat (*Triticum durum*), is a naked wheat resulting from a mutation of emmer wheat that causes the grain to be released easily from its husk.

Bread wheat and hard wheat can be distinguished only through careful examination of spikelet remains. Such remains are not often preserved on archaeological sites in quantities sufficient to facilitate this distinction, however. Thus most palaeoethnobotanical reports record naked wheat as *Triticum aestivum/durum*. The first clear evidence of naked wheat on an archaeological site in the Near East comes from Asikli in Turkey, dated to 6800–6400 B.C. It first appears in Greece at the site of Knossos on Crete, dated to 8200–7600 B.C., and on the mainland at Otzaki Magoula in Thessaly, for which no radiocarbon dates exist. These remains, however, occur in the earliest levels of the site that are contemporary with the Knossos remains and those at Argissa, also in Thessaly, which dates to 6200–5400 B.C.

Barley. Barley also is found both as a hulled and a naked variety as well as in a two-row and a six-row form. The wild progenitor of two-row hulled barley, the earliest domesticated type, is *Hordeum spontaneum* (fig. 1), which is fairly widespread in the so-called Fertile Crescent, that is, in the Levant, and in the foothills of the Taurus and Zagros Mountains. Genetic data suggest that barley may have been domesticated in two areas of the Near East. A possible form of domesticated barley occurred at Tell Aswad about 7700 B.C. The earliest securely identified domesticates are from Ain Ghazal in Jordan, dated to 7000–6500 B.C.

Wild barley was found at Franchthi Cave in Greece in Upper Palaeolithic and Mesolithic levels dated between 8500–6700 B.C. No barley was found after this point, however, until domestic two-row barley was found in Middle Neolithic levels dated to just after 5980–5640 B.C. Thus it is not possible to argue for indigenous domestication of this species at Franchthi Cave or elsewhere in Greece.

Six-row barley results from a mutation of the two-row type, causing three grains to develop in each spikelet rather than two. It is difficult to distinguish two-row barley from six-row barley in an archaeological sample without sufficient numbers of seeds. The morphological difference between the two species is the basal twisting of the lateral grains of six-row barley. When these lateral grains are seen in a sample, it can be stated with some certainty that six-row barley is present. Their absence does not necessarily mean, however, that this species is not present but only that the lateral grains have not been recovered, preserved, or recognized. At the same time, the presence of twisted grains does not preclude the presence of two-row barley as well. Naked barley is a later development in the Near East, occurring first in Pre-Pottery Neolithic B (PPNB) sites, such as Jericho, Tell Aswad, and Abu Hureyra between 7000–6400 B.C.

Rye. Rye (*Secale cereale*) was thought to have been initially domesticated in Europe, where it is an important modern crop, but studies of plant remains from Epipalaeolithic and Pre-Pottery Neolithic sites in Syria have shown that it was first domesticated in the Near East. The wild progenitor of domesticated rye is most likely *Secale cereale* sp. *vavilovii,* which grows in fairly dense stands on the lower slopes of Mount Ararat in eastern Turkey and in south-central Turkey near the border with Syria. In the past the distribution of this plant was probably more widespread. Another species of wild rye, *Secale montanum,* and domesticated rye were found in the Epipalaeolithic levels of Abu Hureyra, Syria, dated to 11,000 to 10,600 years ago. Domesticated rye appears with domesticated emmer and einkorn wheat in the PPNB levels of this site as well as at Can Hasan III in Turkey. The first appearances of domesticated rye in Europe are in the Late Neolithic site of Skoteini in Euboeia, Greece, and several Eneolithic sites of the Gumelnitsa culture (5000–4300 B.C.).

Legumes. The three important legume crops that are found on Early Neolithic sites are lentils (*Lens culinaris*), peas (*Pisum sativum*), and bitter vetch (*Vicia ervilia*). Chickpeas (*Cicer arietinum*) are also among the early domesticated legumes in the Near East, but they do not become common until the Late Neolithic in Greece. The principal difference between wild and domestic legumes, as with cereals, is their ability to propagate their own seeds. The pods of wild legumes are dehiscent, that is, they split upon ripening, thus scattering the seeds. In domesticated legumes the pods are indehiscent and remain closed when they mature. Since pods are rarely preserved on archaeological sites, it is the increase in seed size that generally has been used to distinguish between wild and domesticated species, but this is a gradual development and cannot be established with certainty at the earliest agricultural sites. Thus legumes from Neolithic contexts are not always identified as the domesticated species, although they usually are presumed to have been cultivated.

The wild progenitor of domestic lentils is *Lens orientalis,* which has a distribution in the foothills of the Zagros and Taurus Mountains, a distribution similar to those of the wild cereals. This species, along with two others, *Lens nigricans* and *L. ervoides,* also are known from modern Greece. Lentils were recovered from Upper Palaeolithic and Mesolithic levels at Franchthi Cave in Greece, but it is not possible to determine their species. The lentils from Neolithic levels in the cave are, on average, somewhat larger than the earlier specimens, but there is a significant overlap in seed diameter; thus it is not possible to state with certainty that the Neolithic lentils are the domesticated *Lens culinaris.* Together with the depositional problems mentioned earlier, this precludes the possibility of determining whether or not lentils were domesticated in Greece separately from a Near Eastern origin. Lentils are present at one Mesolithic site (Balma Abeurador/Hérault) in southern France, dated to about 6700 B.C., but all other finds are from Neolithic or later contexts, where the other Near Eastern crop plants are present.

It is possible to distinguish wild peas (*Pisum humile*) from the domesticated variety (*Pisum sativum*) on the basis of the rough seed coat found in the former. Unfortunately, seed coats are not often preserved in archaeological material, making identification uncertain at times. Wild pea was identified at Franchthi Cave from Mesolithic levels on the basis of the rough seed coat that was preserved on one specimen. Botanical evidence suggests that peas were domesticated in the Near East, probably from populations of *P. humile* in Turkey and Syria. Like lentils, peas have been identified from Balma Abeurador/Hérault in southern France and elsewhere only in Neolithic and later contexts.

Modern use of bitter vetch is primarily as fodder for animals, but it was a common legume collected in the Epipalaeolithic of the Near East and probably was cultivated in the earliest agricultural sites. Wild bitter vetch grows in modern Turkey and northern Iraq and can be found as a weed in cereal crops. In Europe bitter vetch was identified in the Upper Palaeolithic levels of Franchthi Cave in Greece and also occurs in the Middle Neolithic at this site. In Thessaly the earliest appearance of bitter vetch is in the Aceramic Neolithic levels of Sesklo. Along with lentils and peas, it is present at Balma Abeurador but is otherwise found only on Neolithic and later sites in Europe with the Near Eastern assemblage of crop plants.

The wild progenitor of domesticated chickpea is *Cicer reticulatum,* which grows in modern Southeast Turkey. It can be distinguished from the domesticated form by the reticulate or netlike pattern of ridges on its seed coat, which becomes smooth in the domesticated species. The earliest remains of chickpeas are reported from Pre-Pottery Neolithic A (PPNA) levels at Jericho and PPNB levels at Cayönü and Abu Hureyra. In Greece the first evidence of chickpeas is at the Early Neolithic site of Otzaki Magoula in Thessaly, but it does not appear on other sites until the Late Neolithic. It is not found in the northern Balkans or elsewhere in Europe until the Bronze Age.

Flax. Wild flax (*Linum bienne*), the progenitor of the domesticated species, is widespread from western Europe to the Near East and Caucasia. It grows in moist or wet environments near springs. The primary morphological difference between wild and domesticated flax forms is the development of an indehiscent capsule and larger seeds in the latter. Wild flax has been identified from Epipalaeolithic and Early Neolithic sites in the Near East. Domesticated flax is present from Pre-Pottery Neolithic B levels at Ramad in Syria, dated to c. 7200 B.C. The latter findings were attributed to the domesticated species on the basis of seed length, which ranged from 3.2 to 4.1 millimeters; the wild species do not exceed 3.0 millimeters. Domesticated flax has been recorded from Early Neolithic sites in northern Greece, and it is present in the earliest farming sites in central Europe south of the Danube, dated to 5700–5500 B.C. It occurs with the full complement of Near Eastern domesticated plants and was brought into the region at this time.

Poppy. The only plant that most likely was domesticated in Europe is the poppy (*Papaver somniferum*). The wild progenitor of this plant is *Papaver somniferum* subspecies *setigerum,* which is native to the western Mediterranean basin. The primary difference between the wild and domesticated plants is the indehiscence of the capsule in the domesticated species. Poppy seeds are underrepresented on archaeological sites, because they are so small that their recovery depends on careful flotation methods with screens of 0.5-millimeter mesh or smaller. Poppy seeds occur on Late Neolithic sites in southern France and Spain as well as in central Europe. Thus it is a later addition to the suite of cultivars introduced from the east, although the absence of poppy from earlier sites may be due to the recovery techniques rather than to their absence from the sites. Remains of poppy seeds or capsules have not been recovered from Neolithic contexts in the Near East or southeastern Europe.

FARMING PRACTICES

The conditions under which crops were grown, such as soil types, season of planting and harvesting, and crop-processing methods, can be determined to some extent from the weed assemblage associated with the crop plants. Weeds have a range of environmental requirements that dictate the types of soils in which they can grow best, such as light, sandy loam versus heavy clay-rich soils. Like all plants, weeds will flower and set seed within a particular time range corresponding to climate and daylight length. In some cases, this timing mimics that of the crop the weed infests, such as wild oats, which set seed at the same time, late spring, as do the winter-sown cereals emmer and einkorn wheat. Crop-processing activities, such as the method of harvesting, may be determined by knowing such characteristics as the height of weeds that occur in archaeological deposits. The presence of low-growing weeds among the cereal grains may indicate that the crops were harvested by cutting the stems fairly low to the ground. With respect to the earliest agricultural sites in Europe, relatively few remains exist overall, and many of the small seeds cannot be identified as to species or even genus. Nonetheless, it is possible to suggest some agricultural practices from the available evidence.

At the preceramic site of Argissa in the Thessalian plain, plants such as oat (*Avena species*), ryegrass (*Lolium temulentum*), and corn cockle (*Agrostemma githago*) are typical weeds of winter-sown cereals and would have infested the emmer and einkorn crops. At the same time, the presence of species belonging to the Chenopodiaceae family (e.g., lamb's-quarter) and the Polygonaceae family (e.g., dock) suggest that some crops may have been spring grown on heavy soils. The exact species represented from these families have not been identified, so it is not possible to be certain of this suggestion.

At the Early Neolithic sites of Sesklo in Thessaly and Toumba Balomenou in Boeotia, heavier soils also were cultivated, based on the presence of bedstraw (*Galium aparine*) as well as Chenopodiaceae and Polygonaceae species. Species of these families along with mallow (*Malva* species) and purslane (*Portulaca* species) also provide an indication of possibly spring-grown crops. *Portulaca* is a typical weed of legume crops. At these early agricultural sites cereals might have been sown in the autumn, when the rains made the soils easier to work with a hoe. Legumes, such as lentils, peas, and bitter vetch, could have been sown on the same land in the spring, after the cereal harvest. There is not enough evidence to indicate that fallowing and crop rotation were practiced, although it certainly is possible.

Analysis of the settlement pattern of the earliest farming village in Thessaly suggests that, while some sites were located in the floodplain of the Peneios River, others were established to the south, well away from this watercourse but still in the lowlands of the plain. Still others were in the uplands 100 to 200 meters above sea level. In each of these areas the soils would have varied, and thus the farming practices and weed types also would have been somewhat different. Farmers nearest a river that flooded annually may have taken advantage of the deposition of silt to plant crops primarily in the spring. In the drier areas of the basin and in the uplands, farmers would have had to rely on autumn and winter rains and would have planted their crops accordingly.

The scale of farming most likely was small. None of the excavated sites has shown evidence of storage facilities in the form of pits, silos, or large ceramic vessels that could have held a large surplus of grain or other crops. Rather, it seems likely that agriculture provided sufficient food for the households with seed held back for the next year's crop. Storage, in this case, could have been in the form of baskets or bags that have not survived.

SUMMARY

The primary crops grown by the first farmers in Europe initially were domesticated in the Near East and brought to Greece about eight thousand years ago. Although wild forms of a number of the crops can be found in preagricultural sites in Greece and France, the domesticated forms of these plants appeared with the rest of the Near Eastern assemblage of crops. Poppy is the only plant that initially was domesticated in Europe, although there is no clear evidence for its presence before the Late Neolithic.

In Greece the earliest farming villages are located in various types of environments, such as near rivers, on drier lowland, or in uplands. For those sites for which data exists, it seems that planting took place both in the spring on heavy soils and in the autumn on drier rain-fed soils. Farming would have been conducted on a small scale with sufficient cereals and legumes for the household rather than production of surplus for the community or for exchange.

See also **Archaeology and Environment** (*vol. 1, part 1*); **Beginnings of Farming in Northwestern Europe** (*vol. 1, part 3*); **Agriculture** (*vol. 2, part 7*).

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JULIE M. HANSEN

LIVESTOCK OF THE EARLY FARMERS

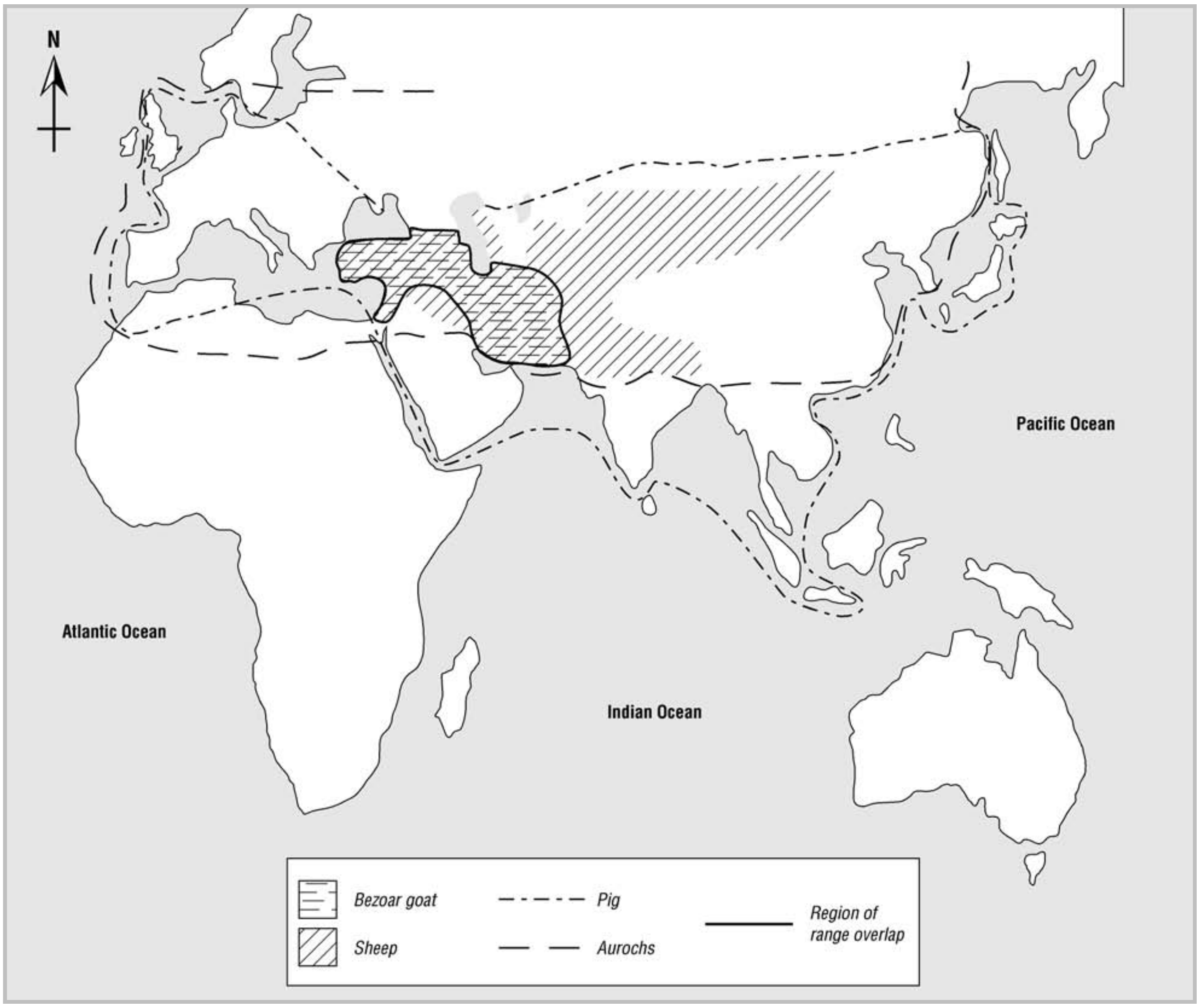
Although dogs, the first domestic animal, were already widespread among the later hunter-gatherers of Europe, livestock (domestic herd animals) appeared only with the first farmers (Early Neolithic). Like plant agriculture, these animal domesticates originated in the Near East. While in the Near East plant agriculture precedes herding, domestic plants and animals arrived in Europe as part of a mixed farming package. By the time it reached Europe, this package included the main farm animals of today (excluding the horse): cattle, sheep, goats, and pigs. However, they would not have looked much like our familiar barnyard animals, since they were still quite close to their wild ancestors in appearance.

ANIMAL DOMESTICATION

Animal domestication is a complex process involving both biological and social changes that may occur at different rates. The key change is from hunting to herding: controlling the movement and breeding of animals and protecting them from predators. This control may be loose or tight; stricter control will lead to more rapid biological changes. On the other hand, if livestock are allowed or even encouraged to interbreed with wild populations, as is sometimes the case even today, there will be no genetic isolation of wild and domestic populations and therefore little opportunity for biological differentiation.

Once a domestic population is isolated, a number of physical and behavioral changes are likely to occur. These include changes in the color of the coat, the size and shape of horns, the shape of the face, and body proportions. The breeding season may become longer and less seasonal. Early herders may have deliberately selected for docile behavior; in any case more placid animals fare better under domestication. This probably accounts for the reduction in brain size seen in most domestic animals. Although the reasons for this are unclear, the early domesticates (including dogs, sheep, goat, cattle, and pigs) decreased in size compared to their wild ancestors. While herders sometimes may have selected for smaller animals that were easier to control, it is likely that most of this happened without conscious intervention. Domestic animals often must subsist on limited food (due to the restriction of their movements), which would favor smaller animals. Human control of breeding and protection from predators would also relax some of the pressure to be large. In any case, this is a particularly useful feature of domestication from the archaeological point of view. Size change can be detected by measuring the anatomical features of the animal bones recovered from archaeological sites, providing one of the key methods for identifying animal domestication.

Size changes must be interpreted cautiously, however. Work on goats from Ganj Dareh in Iran, the site with the earliest evidence of goat domestication, shows that an apparent reduction in size actually results from killing off most of the larger males at an early age. Zooarchaeologists usually only measure mature bones, since it is difficult to compare measurements of bones that have not reached their



Ranges of the wild ancestors of early livestock. ADAPTED FROM DAVIS 1987.

full size. This illustrates that size reduction, which does occur later in the domestication process in many animals, must be assessed by examining the entire range of measurements, not just by comparing means. There is also geographical variation in the size of both wild and domestic animals, so assemblages from different areas should not be compared uncritically.

Size diminution can happen quite rapidly, within a few generations, if control of breeding and movement is strict, or even within a single generation if it results not from genetic change but from limited food. However, under looser herding regimes it may be very slow to appear. Therefore, another important technique for detecting ancient herding is based on the demographic changes to the population of herded animals, which can be reconstructed in archaeological assemblages from age and sex profiles. While herding practices will vary depending on the goals and wealth of the herder, no herd will last long unless the herder takes care to preserve an adequate breeding population. This means keeping a large number of females into adulthood, while males are more likely to be slaughtered early. Hunters often target prime adult animals, but herders tend to slaughter animals for meat at a younger age. Adult animals eat more and are expensive to maintain, especially through the winter when they may need to be provided with fodder. Thus an animal bone assemblage resulting from hunting wild animals will tend to have mostly adults, with males present in equal or even greater numbers than females. An assemblage derived from herded animals, on the other hand, will be dominated by younger animals. Generally only mature animals can be sexed osteologically, and these will be mostly female. Unusual hunting strategies may sometimes mimic herding, but in general this approach, combined with other supporting data, provides a good indication of domestication.

Since the 1900s, an additional tool has become available through the application of DNA "fingerprinting" techniques to animals. By comparing the DNA of wild and domestic animals, geneticists can establish their degree of relatedness and suggest which wild populations are ancestral to the domesticates. Using the "molecular clock" (the estimated rate of random mutations in mitochondrial DNA), they can also estimate the date at which domestic and wild populations separated. This application of genetics is in its infancy, and results are often contradictory. So far most of the studies are based on living animals, although some are beginning to include ancient DNA from archaeological bones. Studies based solely on living animals present a problem in that domestic animals have been much affected by breeding programs of the last few centuries, and wild populations have been dramatically reduced. We can expect that an increased use of ancient DNA and more cooperation between geneticists and archaeologists will soon lead to improvements in research and that DNA studies will make a major contribution to tracing the origins of domestic animals in the near future.

Herding also leads to profound changes in the human population. Caring for animals means that at least part of the human population must adapt itself to the animals' needs: taking them to pasture, often at a distance, or providing them with fodder. Human labor must be devoted to tending the flocks, and therefore is less available for gathering, hunting, fishing, and other tasks. Domestic animals have owners, changing property relations among the people and providing a new source of wealth. Unlike other kinds of material wealth, such as metals, animal wealth is capable of reproducing and augmenting itself (although also capable of sudden and drastic loss through drought or epidemic). The wealth value of domestic animals may have been as important as their food value in the spread of herding. Finally, while it is more intangible, one of the most important changes that animal herding effected on humans may have been the alteration in worldview and ideology. The herders' attitude of control and husbanding of resources for future benefit is likely to have had profound consequences beyond herding. Indeed, there are indications of a major shift in religion and ideology at about the time of animal domestication in the Near East, with this new view then spreading with herding into Europe and elsewhere. Briefly, occasional images of gazelles are replaced by a proliferation of imagery of bulls and human females. This new imagery has been interpreted in various ways, most stressing a new concern with either fertility or dominance of the natural world (and perhaps of the human world as well). There is debate about whether the adoption of herding brought about this shift, or whether the change in attitude came first and made animal domestication thinkable, but it is clear that the two are closely linked.

SHEEP AND GOATS

Sheep and goats appear to have been the first livestock to be domesticated, at roughly the same time (about 10,000 years ago), in the Near East. While they soon became linked in a mixed herding economy, they appear to have been domesticated separately in different locations.

Domestic sheep (*Ovis aries*) are descended from the Asiatic mouflon (*Ovis orientalis*). The mouflon found on Mediterranean islands are not native, but are actually feral descendents of early domestic sheep brought by Neolithic settlers. Wild mouflon inhabited the foothills and lower mountain slopes from central Anatolia through the northern Levant to Iran. The earliest occurrence of domesticated sheep is often given as about 11,000 B.C. at Zawi Chemi Shanidar in Iraq. However, this claim, based on an early application of demographic techniques, is now rejected by specialists. At present, solid evidence of sheep domestication first appears in the northern Levant region (Syria and southeast Turkey) at about 7500 B.C., although there are some indications that the process may have begun there somewhat earlier. Both genetic and archaeological evidence support an independent domestication in South Asia at roughly the same time, but these sheep are of less relevance to Europe.

There have been claims for independent local domestication of sheep in southern France and Iberia, but it is now clear that these are based on either mixing of deposits from different periods or misidentified ibex and chamois. With no good evidence for wild ancestors in Europe, the sheep of the early farmers can confidently be considered domestic livestock. These early sheep would have looked very much like the wild mouflon. They were a little smaller, and the horns were reduced, especially in females. Like the mouflon, they lacked wool, having a brown, hairy coat. Mouflon and early domesticates have a short woolly undercoat in the winter that is shed in the spring. Woolliness, attested by artistic depictions and textile remains, first appears about 3000 B.C. Thus the sheep of Europe's first farmers were used for meat. Demographic profiles suggest that sheep's milk was not consumed in significant amounts at this point in time, either.

The wild ancestor of domestic goats (*Capra hircus*) is the bezoar goat (*Capra aegagrus*). The range of the wild goat is similar to that of the mouflon, but it tends to occupy higher and more rugged terrain. Bezoar goats do not occur in Europe. Just as with sheep, the animals that were once believed to have been a wild subspecies of the goat on Crete are now known to be descended from domesticated bezoar goats. The closely related ibex (*Capra ibex* and, in the Pyrenees, *C. pyrenaica*) is found in Europe and has sometimes complicated identifications. The ibex, however, has never been domesticated. Demographic evidence from bone assemblages indicates that goats were domesticated in the Zagros Mountains region of Iran and Iraq (somewhat east of the area of sheep domestication) at about 8000 B.C.; changes in horn shape twisting followed slightly later. Genetic evidence suggests that while there may have been two additional domestications (or additions of wild females to domestic flocks), these were much later.

By at least 7300 B.C. and possibly earlier, domestic sheep and probably domestic goats were present in central Anatolia, and their bones exhibit size reduction from the wild form. It is not yet known whether these animals spread from the apparent center of domestication to the east or whether they were independently domesticated locally. In any case, this is likely to have been the ultimate source area for European domestic sheep and goats.

CATTLE

The wild ancestor of cattle (*Bos taurus*), the aurochs (*Bos primigenius*), has been extinct since 1627. In contrast to sheep and goats, the aurochs (plural: aurochsen) was widespread across the northern Old World, ranging across most of Europe and Asia as well as North Africa (fig. 1). Thus there were potentially more areas in which cattle could have been domesticated. Genetic evidence suggests two independent domestication events, in the Near East or Europe (taurine cattle) and in South Asia (zebu). Some have also claimed an independent domestication in North Africa, but the evidence is so far not definitive. The archaeological evidence does support domestication events in South Asia and in Europe or the Near East, but the details of domestication in the western area remain unclear. All evidence suggests that cattle domestication followed that of sheep and goats (except perhaps in Africa). This is not surprising, considering that the aurochs was a large and dangerous animal with huge horns.

Çatal Hüyük, a Neolithic site in central Anatolia (7300–6200 B.C.), has been cited as a center of cattle domestication, on the basis of limited data from a preliminary report in the 1960s. However, work at the site in the 1990s has shown that the cattle here were wild. There is suggestive but not definitive evidence for domestic cattle in southeast Anatolia (Çayönü) at about 8500 B.C. and in the Levant about 7500 B.C. Cattle were transported to Cyprus (where they were not part of the native fauna) by 8000 B.C. Although this demonstrates their importance to the human colonists, it does not necessarily mean they were herded. Neolithic settlers brought many animal species to Cyprus, some of which seem to have been left to run wild and then hunted (e.g., fallow deer). The introduction of cattle was ultimately unsuccessful. Cattle disappeared from Cyprus within a few centuries and did not reappear until the Late Chalcolithic/Early Bronze Age (by then they were clearly domestic). Domestic cattle appeared in western Anatolia and in Greece by 6800–6500 B.C., but without a sequence indicating local domestication. Although eastern Anatolia seems the most likely location of initial cattle domestication, further research is needed.

PIGS

Domestic pigs and their ancestor, the wild boar, are usually placed in the same species (*Sus scrofa*). The

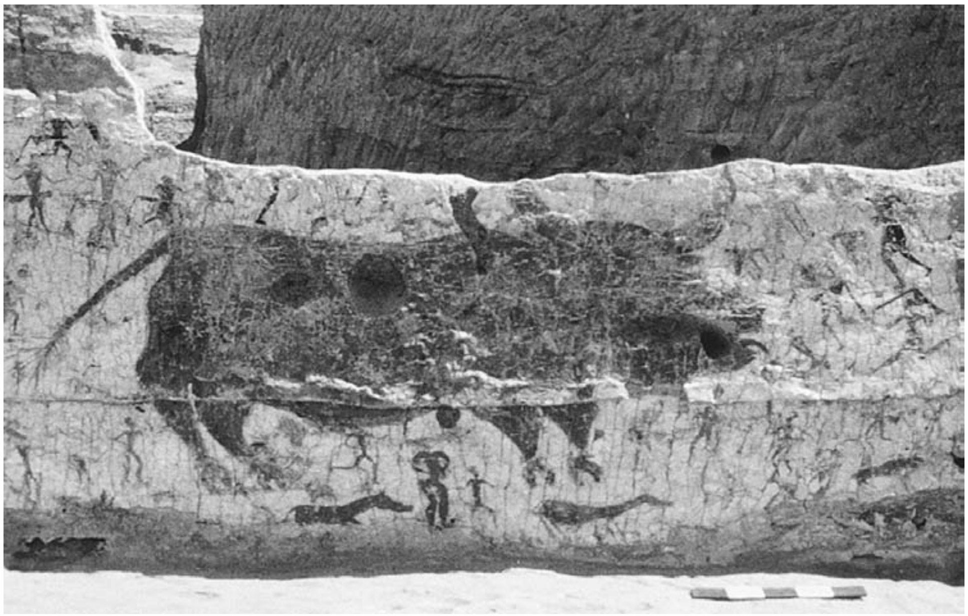


Fig. 1. Rock carving of Neolithic cattle. PHOTO COURTESY PICTURES OF RECORD, INC. REPRODUCED BY PERMISSION.

range of wild boar is similar to that of cattle, and the history of pig domestication is even less well known, although new research (particularly by the group headed by Keith Dobney at the University of Durham) may ameliorate this situation. Genetic evidence supports separate origins for European and Asian domestic pigs, but as of 2003, it cannot yet address how many domestication events occurred or locate them more precisely. Archaeological evidence supports separate domestication in China and in Europe or the Near East, with eastern Anatolia the most likely candidate in the latter area. This is the only part of the Near East where pigs are abundant at early archaeological sites. Pig domestication has been claimed at Hallan Çemi in eastern Anatolia at about 10,000 B.C., a site otherwise lacking domestic plants and animals. The evidence presented as of 2003 is less than fully convincing, however. There is somewhat more convincing but still less than definitive size and demographic evidence from nearby Çayönü at about 8500 B.C., accompanied by cereal agriculture. By 7000 B.C., pigs in the domestic size range appeared in the Levant, and by 6800 B.C. in Greece. While it is possible that pigs were domesticated independently in Europe, and occasional claims have been made to this effect (e.g., the Crimean region, southern Scandinavia, Iberia), the evidence is weak. Eastern Anatolia is currently the only area that approximates a sequence of intensive use and progressive change in size and demography.

EARLY HERDERS OF EUROPE

As outlined above, evidence indicates that the livestock of Europe's first farmers derived from animals domesticated in the Near East. In Europe, herding spread together with plant agriculture. Roughly speaking, mixed farming spread from southeast to northwest, with an additional early route along the borders of the Mediterranean on the south.

Southeast Europe. This area includes Greece and the Balkans and extends slightly into Hungary. The earliest sites with domesticates are in Greece, mainly in Thessaly and Greek Macedonia. Even at these first sites, starting about 7000 B.C., all four herd animals were present. Sheep and goats, especially sheep, predominated in these Mediterranean zones. About a thousand years later, farmers and their herds expanded into the northern Balkans. Although cattle and pigs later become more numerous in these temperate zones, to which they are much better adapted than sheep and goats, the earliest farmers for the most part raised mainly sheep and goats, retaining the Mediterranean pattern. This likely reflects different uses for the small and large stock, with sheep and goats providing daily meat and cattle reserved largely for feasts and sacrifices. There may have been initial resistance to using cattle as an ordinary meat supply.

Southwest Europe. Early farmers and their livestock reached Italy, southern France, and Iberia at about the same time as the northern Balkans, following a coastal route. The occurrence of small numbers of domestic sheep and goats in Mesolithic (hunter-gatherer) deposits has led to claims of local domestication. As noted above, these can be dismissed since the region is now known to be outside the range of the wild ancestors. Another interpretation is that these animals were acquired by local hunter-gatherers from nearby farming communities, whether through exchange, bridewealth, or theft. This remains a definite possibility, but as of 2003 the evidence derived from multiperiod cave sites and could also be interpreted as the result of postdepositional mixing of sediments. At many sites the domestic fauna is limited to sheep and goats. However, the early Neolithic is known almost entirely from cave sites, which may have been special-purpose herding camps not representing the full range of activities. The few open sites that have been excavated also include domestic cattle and pigs. It would appear, then, that early livestock arrived in southwest Europe as a package but that the herding regime of sheep and goats differed from that of cattle and pigs. The cave sites suggest seasonal movement of the small stock to upland grazing.

Central Europe. Mixed farming expanded from the northern edge of southeast Europe into central Europe at about 5500 B.C. All four herd animals are present at these early sites, with cattle predominating. By this time cattle had also become more prominent in the assemblages of the source area in temperate southeast Europe. Ceramic sieves that may have been used in cheesemaking (perhaps this will ultimately be confirmed by evolving techniques of residue analysis) suggest that dairying played some role in herding. Domestic pigs are present but scarce in these Early Neolithic (*Linearbandkeramik,* or LBK) assemblages. Since this was prime habitat for pigs, this scarcity probably reflects a cultural devaluation rather than economic necessity. Indeed they gain importance through time in this region.

Eastern Europe. Eastern Europe here refers roughly to the European portion of the former Soviet Union, although the focus is on the area north of the Black Sea (modern Ukraine and vicinity). Agriculture and herding came much later to the north, only with the Bronze Age or even later. North of the Black Sea lies a region of steppe, cut by major rivers running roughly north-south: the Bug, the Dnieper, and the Dniester. Before the domestication of the horse, the steppe zone was difficult for people to settle. Thus agriculture and herding appeared first in the river valleys. Starting at about 6000 B.C., the Mesolithic hunting and gathering groups who already occupied these valleys began to acquire domestic animals, mostly cattle and pigs, from their Neolithic neighbors in southeast and central Europe. Evidence as of 2003 suggests that this was much more a gradual process of adoption than a migration of incoming farmers.

Northwest Europe. Farming and herding reached the Atlantic fringe of Europe (Brittany, the Netherlands, southern Scandinavia, and Britain) only about 4000 B.C. The livestock consisted of cattle, pigs, and sheep, with cattle predominating in the earlier Neolithic. Many of the faunal assemblages studied are from ceremonial sites and may not reflect daily consumption patterns. On the other hand, they indicate the importance of cattle, in particular, in feasts and rituals. In 2003, residue analysis of British Neolithic pottery confirmed what had been argued (somewhat controversially) on the basis of demographic data: that cattle were used for dairy production as well as for meat. There is debate about the roles of colonization by farmers from Central Europe versus adoption of "neolithic" traits by the substantial populations of local hunter-gatherers. In any case, it is fair to say that the local Mesolithic population played an active and important part in the transition to agriculture and herding. Particularly in southern Scandinavia, there may have been an extended period of gradual adoption of herding, initially on a small scale.

SUMMARY

The livestock of Europe's first farmers—comprising sheep, goats, pigs, and cattle—was almost certainly derived from animals domesticated in the Near East, although later interbreeding with local wild or tamed cattle and pigs may have occurred. These four animals spread as a package, along with cereal agriculture from southeast Europe, gradually through the rest of the continent. The earlier farmers in southern Europe tended to raise mostly sheep and goats, even where these were ill-suited to the local environment. Later farmers, including the first farmers to reach central, eastern, and northwest Europe, switched to cattle as the primary herd animal.

See also **Humans and Environments** (*vol. 1, part 1*); **Domestication of the Horse** (*vol. 2, part 4*); **Animal Husbandry** (*vol. 2, part 7*).

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NERISSA RUSSELL

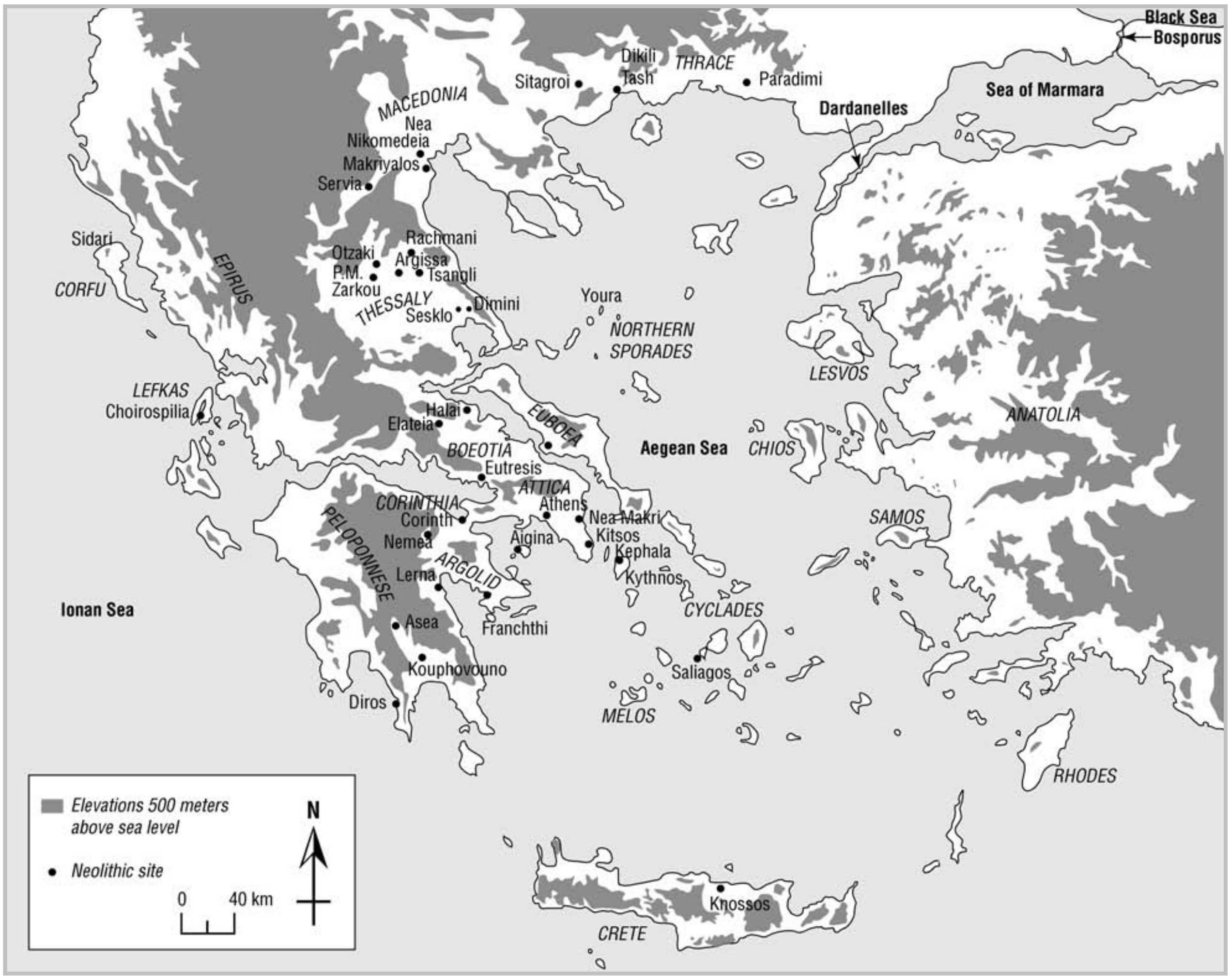
FIRST FARMERS OF EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

The first farmers in Europe arrived on the shores of Greece as migrants in the first quarter of the seventh millennium B.C. They brought with them an economy based on the cultivation of wheat, barley, peas, and beans and the herding of sheep, goats, cows, and pigs. The striking feature of this Early Neolithic ("New Stone Age") culture was its life in compact villages. These villages were recognizably modern in form and had populations of perhaps 300 or 400 people, four times larger than the loosely organized bands of foragers that had preceded them in the Palaeolithic and Mesolithic periods. The first farmers came from western and southern Anatolia (modern Turkey) and sailed across the Aegean Sea to Crete and mainland Greece. A second wave of migrants, much smaller than the first, may have infiltrated into northern Greece by land through Turkish Thrace. The precise coordinates of the point of origin and the forces that set all these migrants in motion remain among the most controversial issues in Aegean prehistory.

Greece before the arrival of Neolithic immigrants was sparsely inhabited. Upper Palaeolithic foragers (c. 42,000–15,000 B.C.) had occupied many parts of Greece, including Thessaly, Epirus, and the Argolid, at the end of the Pleistocene era. They left behind hearths, animal bones, plant remains, and stone tools in small caves and rock shelters. After the last glacial maximum (c. 20,000 B.C.), most of the known Palaeolithic sites were abandoned, and by the end of the Pleistocene the human presence in Greece was greatly reduced. Large tracts of land, and all of the islands, appear to have been unoccupied for several millennia. People trickled back into the country during the following Mesolithic period in the early Holocene (c. 9000–7000 B.C.). Mesolithic sites are found in Epirus, Thessaly, the Argolid, and some islands (e.g., Corfu in the Ionian Sea, Youra, and Kythnos in the Aegean). Mesolithic foragers were evidently seafarers specializing in the intensive exploitation of marine and other aquatic resources, such as shellfish and large deep-sea fish. They confined their settlements to the coastal fringes of the mainland, where they left their stone tools, plant remains, hearths, and human burials in caves and at open sites situated among the sand dunes that overlooked the estuaries and lagoons that were formed by the rapidly rising level of the sea. The best-known site of this period was excavated at the Franchthi Cave in the southern Argolid (Peloponnese) in the 1960s and 1970s.

It was for a time thought possible that these Mesolithic foragers, whose origins and connections,



The concentration of sites in eastern and central Neolithic Greece (as shown) suggests that migrants came from the east, probably Anatolia. ADAPTED FROM RUNNELS AND MURRAY 2001.

if any, are with the Palaeolithic foragers who preceded them, may have independently taken the first steps toward the domestication of plants and animals that form the backbone of the later Neolithic economy. This hypothesis of independent local invention of agriculture, however, is not supported by archaeological evidence and has been abandoned. The first farmers brought their village-based farming economy with its domesticated plants and animals with them from regions where it was already an old and established pattern. The archaeological record shows that the farmers appeared suddenly c. 7000–6800 B.C., bringing with them not just a new economy but also an entirely new way of life, material culture, and settlement pattern. There is a clear cultural break between the latest Mesolithic communities and the new Neolithic village-based societies.

CHARACTERISTICS OF GREEK NEOLITHIC VILLAGES

Before turning to the important question of the homeland of the migrants and the reasons for their migration, the characteristics of Europe's earliest farming culture should be described. The chronological range for the first farmers spans the early seventh to the early sixth millennium B.C., a period archaeologists call the Early Neolithic period. The Neolithic in Greece as a whole consists of four periods, designated Early, Middle, Late, and Final, and it ends c. 3200 B.C. with the beginning of the

Bronze Age. This article is concerned only with the first of these periods.

The first villages are found in the eastern half of the country, from Macedonia in the north to the Peloponnese Peninsula in the south. The largest concentration of villages is in Thessaly. The islands were not inhabited, except for the largest (such as Crete, Euboea, and Corfu), where there were no more than one or two sites. The mainland cannot be described as densely inhabited. There are probably no more than about three hundred Early Neolithic sites, and their total population at the time was no more than a few tens of thousands. The villages are found well inland, often near a copious spring or a perennial river, such as the Peneios River in Thessaly. The early farmers apparently selected only the best and most reliable soils for farming. Studies of pollen from cores taken from lakes and swamps show that forest cover was not adversely affected by clearing of fields for nearly a thousand years after the first farmers arrived. One can conclude from this that village farming was simple, based on the clearing of small fields that could be cultivated with digging sticks and hoes to grow wheat, barley, and pulses. Herds of cattle and sheep were grazed on meadows in nearby hills. Villages were relatively few in number and small in size, and they were distributed more or less evenly throughout large areas: there are about 120 Early Neolithic sites in eastern Thessaly with an area of nearly 1,000 square kilometers, and this is the most densely populated region. There was little competition among the villages for resources, and if one can judge by the seemingly undifferentiated architecture and burial practices, little in the way of social competition within them.

This does not mean that these farming communities were simple in the way of the earlier Palaeolithic bands. The material culture recovered by archaeologists throws much light on the lives of these people, pointing to a level of complexity unparalleled in earlier periods. Early Neolithic villages had an open plan, as can be seen at Nea Nikomedeia in Macedonia (fig. 1) and Sesklo in Thessaly, with rectangular houses of wattle-and-daub construction (upright wooden poles set in foundation trenches and with smaller branches woven between them and plastered over with puddled clay) or of mud brick laid in courses on fieldstone foundations (fig. 2). Roofs were thatch and clay supported by cross beams and a system of internal clay buttresses or wooden supports. Windows and doors, judging from surviving clay house models found on Neolithic sites, were few and simple. Internal arrangements were not very complex either: an open central hearth for light, heat, and cooking; some stone- or clay-sided boxes for storage; and a few raised benches of clay to serve as furniture. Textiles probably brightened and softened the interiors, and the outside walls were perhaps painted. The decorations on the walls of the house models have geometric designs resembling textiles and painted pottery.

The inventory of Neolithic material culture is rich and varied. Metals in the earliest period were unknown. Shell and bone were used to fashion hooks, fastenings for clothing, and personal ornaments in the form of bangles and amulets. Curious mushroom-shaped plugs of fine stone are thought to be studs for the ears or lips. Stamps of stone and clay with geometric designs reminiscent of textile designs may have been used to stamp pigment on skin and textiles or perhaps to mark ownership of goods. Fine-grained rocks, often imported from distant sources, were fashioned into ground stone celts, rectangular or trapezoidal implements with beveled edges mounted in antler sleeves and wooden handles, used as axes and adzes. Flaked-stone tools were fashioned from long parallel-sided blades of flint and obsidian. The high quality of the blades suggests that specialized flintknappers served Neolithic communities, and the importation of obsidian from the island of Melos to all the mainland sites is evidence of organized long-distance trade. Remarkable also are large blades of light-brown flint, nearly a chalcedony, that were imported from outside Greece, perhaps from Bulgaria or Romania. Small figurines of clay and stone—often, but not exclusively, depicting females—have abstract proportions and features, especially curious coffee bean–shaped eyes. These easily recognizable figurines have excited considerable discussion, particularly from proponents of a so-called mother goddess cult. Careful analysis of the figurines and their contexts has failed, however, to provide a clear-cut explanation of their meaning, and they may be anything from children's toys to representations of votaries or a variety of ghosts, spirits, or deities.

Decorated pottery constitutes one of the most interesting classes of finds from Early Neolithic vil-

Fig. 1. Site plan of Nea Nikomedeia. Open village plan for Early Neolithic settlements in Greece. REPRINTED WITH PERMISSION OF CAMBRIDGE UNIVERSITY PRESS AND GERARD MONTHEL (AFTER PYKE AND YIOUNI 1996).

lages. In the earliest phases it is painted in one dominant color, either red or black, but it soon came to be painted with abstract geometric designs that again call to mind shapes seen in modern local textiles and basketry. The shapes are simple, with small rounded bowls and jars predominating. The shapes and their specific decorations vary from region to region, which suggests to archaeologists that after an initial colonization the different regions of Greece (e.g., Thessaly, Peloponnese, Crete) began to develop along parallel but independent lines. The analysis of the designs found on the pottery of the later phases has been used to establish connections between sites within regions, perhaps resulting from the practice of marital exogamy (in this case, female potters moving from their home villages to their husbands' villages). The Neolithic pots do not seem to have been used for cooking or storage, and one

Fig. 2. Typical Neolithic house construction of stone foundations, mud-brick walls, and clay-covered wooden roof. REPRINTED WITH PERMISSION OF CAMBRIDGE UNIVERSITY PRESS AND GERARD MONTHEL.

of their most important uses was perhaps to signal status and communicate symbolic messages encoded in the decoration.

Such glimpses into the social lives of the first farmers offered by the evidence of jewelry, figurines, and pots are tantalizing but incomplete. As already noted, the generally undifferentiated house architecture within settlements does not point to great differences in wealth or status. Although larger and more finely constructed buildings have been identified at Nea Nikomedeia and Sesklo, these may be shrines, chieftains' houses, or some other kind of public buildings. The evidence is too slight to reach reliable conclusions.

Burial practices are widely believed by archaeologists to be good indicators of the status and standing of the living, and rich graves found among poor ones are usually interpreted to mean that similar differences in wealth existed among the living. Neolithic burial practices are as difficult to interpret as the figurines, pottery, and architecture. Children are found buried under house floors, but this sort of intramural burial is common in societies around the world and through time. Adult burials, curiously, are only rarely encountered. The detailed study of the Neolithic burials at Franchthi Cave serves to illustrate the evidence. In the millennium from 6500 to 5500 B.C. there are eight burials consisting of infants or young children interred in pits. Adult burials are missing, although individual bones from adults were found throughout the site. Even given the limitations of preservation and excavation, it must be inferred that the majority of adults were disposed of elsewhere. To judge from earlier and later burial practices in Greece, adult bodies were disposed of in ways that may have included cremation, exposure, and interment.

Burial goods are sparse. Only one grave had unequivocal offerings, a baby with a broken (ritually "killed") pot and a small marble bowl with three feet. Clear indications of differences of wealth and status are otherwise not seen. The different methods of disposal for adults and infants may be an indication of rank, status, and position. At Franchthi there were also isolated bones from hands and feet among other parts of the body, some of which were found in rooms of houses. This interesting emphasis on body parts may be an echo of the widespread Near Eastern practice of honoring ancestors by retaining body parts (often the head) for veneration in houses. While it is too soon to draw firm conclusions about Europe's first farmers from this scanty evidence, clearly the belief systems and social lives of these people may have been more complex than the simple architecture of the villages would otherwise lead one to believe.

THE ORIGINS OF THE FIRST EUROPEAN FARMERS

Whence came the first farmers in Europe? Nearly a century of archaeological research has given a decisive answer to this question. All lines of evidence point to the Near East, specifically the region stretching from the Levant north through Syria and Turkey to the Zagros Mountains in Iraq, as the place where village-based agricultural economies made their first appearance. This core area, a vast arc encompassing many different environments and climatic niches, was labeled the Fertile Crescent by the American archaeologist James Henry Breasted. The wild ancestors of the plants and animals that form the core of modern agricultural economies are found here, as are the remains of Early Neolithic sites, such as Jericho, Abu Hureyra, and Jarmo. These sites date from as early as 10,500 B.C., much earlier than any sites in Greece. The principal characteristics of these early villages include rectangular houses made of mud brick on stone foundations in open villages, pottery, "coffee bean–eye" female figurines, and polished stone axes. The material culture is much the same as that found in Greece and many parts of Southwest Asia as well.

Although the chief characteristics of Neolithic life were developed in the Fertile Crescent, the Neolithic culture of Greece has a particular resemblance to the Neolithic cultures found in Anatolia (modern Turkey). Research in the late twentieth century established that Anatolia was one of the core areas where Neolithic civilization got its start. Large Early Neolithic towns are found here, as early as any found in the Near East (e.g., Çayönü in the southeast and Aşıklı Hüyük, Çatal Hüyük, Can Hasan, and Hacılar on the Anatolian Plateau). These sites flourished at the end of the eighth millennium B.C., the culmination of a long period of established village life. They provide close parallels with the early Greek Neolithic culture, particularly features such as internal adobe buttresses in houses, figurines, decorated pottery, stamps with geometric decoration, and an industry of obsidian blades. The Greek Neolithic can be seen as a peripheral extension of the Anatolian cultural core.

Undoubtedly some, perhaps all, of the inhabitants of Early Neolithic Greek sites arrived as immigrants. On the island of Crete the site at Knossos (later the site of a Minoan palace) was founded nearly nine thousand years ago. This typical Neolithic village has no precedent on the island. The village has rectangular houses built of mud brick on rectangular foundations in a typical Neolithic open plan. The monochrome pottery, figurines, axes, and obsidian blades have no exact parallels, but they are very similar to the cultural products of Anatolia. Taking into account that there were no human inhabitants of the island before the foundation of this village and that the domesticated plants and animals (wheat and barley, sheep and goats) the villagers cultivated had no wild ancestors on the island, the conclusion that the farmers at Knossos arrived as seafaring migrants is inescapable—and indeed unsurprising. The exploitation of obsidian from the quarries on the Cycladic island of Melos, documented at Franchthi Cave throughout the Mesolithic period, is clear evidence for the presence of seafarers plying the Aegean Sea in the two millennia preceding the appearance of Neolithic villages in Greece. Mesolithic sites are found on some islands (e.g., Kythnos and Corfu), as are some Neolithic sites, not only on Crete but also on Corfu, Youra, and Euboea. The existence of these islands (with their resources of fish, birds, seals, turtles, and obsidian) was most likely well known to the inhabitants of coastal Anatolia long before the time of the first migrations of farmers.

Where in Anatolia did the first farmers come from? The exact location is not known, but the southern coast around Antalya and the western coast in the general vicinity of Izmir are likely candidates. These points on the Aegean coastline have always been the natural outlets for the inhabitants of the fertile Anatolian Plateau, even into the modern day. Neolithic sites are known in these areas, but no one site or group of sites can yet be identified as the "mother culture" for the Greek Neolithic. Colonists would have followed strings of islands from the Dodecanese to the Cyclades and to Crete and the mainland, never losing sight of land as they moved among the islands that are scattered across the Aegean like stepping-stones. Alternatively they could have taken a northern route through Turkish Thrace into Macedonia and Thessaly. From the Early Neolithic sites in northwestern Turkey clustered around the Sea of Marmara (the Fikirtepe culture), migrants could have sailed south through the strait known as the Dardanelles into the Aegean, retracing as it were the voyage of Jason and the Argonauts, or they could have traveled westward along the land route that later became a Roman military highway called the Via Egnatia, which connected Constantinople (Istanbul) to ports on the Adriatic Sea. Perhaps all of these routes were exploited at one time or the other.

Immigrant farmers may have encountered small pockets of Late Mesolithic peoples when they arrived on Greek shores. It has been argued on the basis of the occurrence of certain Mesolithic stone tool types among those of more characteristic Neolithic type that the farmers at Franchthi Cave may have taken some of the locals in their midst. No evidence exists to indicate that the Mesolithic peoples themselves took any independent steps that led to agricultural origins. Their sites were few, very small, and widely scattered. In contrast, Neolithic sites were much larger, more densely concentrated, and usually completely new foundations. (Franchthi Cave, Sidari in Corfu, and perhaps Theopetra in Thessaly may be exceptions.) The plants and animals cultivated and herded are typical Near Eastern domesticated species, and there is little or no evidence for independent experimentation in the Mesolithic with plant or animal domestication. In short, all the evidence available points to a major cultural break between the Mesolithic period and the succeeding Neolithic period.

EXPLAINING NEOLITHIC MIGRATION

The hypothesis that the first farmers migrated in sufficient numbers to colonize new lands can no longer be seriously doubted. The archaeological evidence already discussed supports it, as does the pattern of radiocarbon dates for Early Neolithic sites with progressively younger dates as one moves westward from the Near East into Europe. These dates show a steady march of Neolithic culture across the Continent. There are also strong genetic links between modern-day Europeans and Near Easterners that can be explained by assuming a shared ancestry, something that has been confirmed by genetic studies beginning in the 1980s. This migration, or demic diffusion as it is called by archaeologists, certainly was a major force in Greece and southeastern Europe, even if the migrants mixed to greater or lesser degrees with native populations left over from the Mesolithic as they appear to have done in northern and western Europe.

A theoretical model used to explain demic diffusion, the Wave of Advance, was developed in biology to predict the pattern of spread of new species of animals through novel environments. According to this model, a population of organisms is more or less stable at its geographic center but tends to expand at its margins in small-scale random movements of individuals. These movements collectively create a bow-shaped wave where population continues to advance geographically, even if at a very slow and locally unpredictable way. Imagine mice introduced to a deserted island. Once established they will begin to spread. Behind the frontier, geographically speaking, that divides the part of the island with mice and without mice, the mouse population will eventually stabilize as the animals adapt to their new environment. On the edge, however, because mice have no competitors in the uninhabited area, the population will continue to grow, and mice will spread. The resulting moving population edge or frontier is the Wave of Advance. Theoretically at least, early farmer populations behaved much the same way. Even after the population in much of Anatolia had reached a balance point among people, the land suitable for agriculture, and the technology to exploit that land, the population would continue to expand outward, at least along the frontier, to new valleys and new shores where there were few competitors for land and resources.

The Wave of Advance is a good descriptive model, but archaeologists want also to account for the specific historical and individual circumstances that induced particular cultural groups to leave their homelands and cross the Aegean to Europe. The circumstances, or incentives, that induced or persuaded early farmers to take the risk of an open-sea crossing to Greece or the equally dangerous overland passage through Thrace were no doubt many and complex. The general line of speculation, however, focuses on a relatively narrow range of possibilities. The idea of population pressure at home can be eliminated. The available farmland in Anatolia was by no means exhausted by Early Neolithic farmers, and millions of people live there in the twenty-first century, demonstrating that, technology permitting, the agricultural potential of the region is vast. The technology of early farmers, however, was based on the considerably less-efficient use of local irrigation, digging sticks, and hoes. The best soils located near springs and rivers were perhaps preferred by these farmers, and they were willing to move from valley to valley or island to island in search of them. Perhaps there was a population movement analogous to that which brought the Norse to Iceland, Greenland, and Vinland: limitations imposed by the inheritance of the best land to only one or a few children. Those who did not stand in line to inherit land sufficient to support new families, especially those on the frontier, may have elected to move into uninhabited lands, where they could have their pick of choice lands to cultivate.

Another possibility for the migration of early farmers to Greece is that adventurers, who have lived in every age, explored new lands and then returned with like-minded family and friends to become colonists. The study of the homesteaders and pioneers in the New World has revealed that the motives of these people were truly diverse. Some sought the wilderness to found utopian social or religious communities, and the same thing has been suggested for the earliest Aegean farmers. Perhaps they were escaping from the social and economic upheavals that apparently affected much of the Near East and Anatolia c. 7000 B.C. and after. Many sites were burned or abandoned at this time, and there is evidence for local displacements of populations that continued for some time. These disruptions may have been caused by climatic change, warfare, economic and religious movements, or some other kind of social convulsion. Whatever the explanation, the Aegean migrants may have been attempting to avoid the conditions at home by moving to remote and previously uninhabited regions.

The precise historical reasons for the coming of the first farmers to Europe may never be known, but it can be said with some certainty that Greece was the first part of Europe to have an established Neolithic culture. The newcomers originated in Anatolia and the Near East, and once they were established on European soil, they developed an independent and distinctive civilization that flourished for millennia. The descendants of these first farmers may well be the ancestors of modern-day Greeks, who can fairly lay claim to being the first Europeans in the modern sense. Without any doubt, the discovery by archaeologists of this prehistoric migration of farmers from Anatolian shores to the Greek mainland is one of the great intellectual achievements of modern science.

See also **Franchthi Cave** (*vol. 1, part 2*); **Knossos** (*vol. 2, part 5*).

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CURTIS RUNNELS

ACHILLEION

The densest group of Neolithic settlements in all of Europe is found in the rich plain of Thessaly in central Greece. Most of these sites are related to Sesklo, a Thessalian site where first the "Neolithic triad" (pottery, domesticated plants, and animals) was identified in 1901. Ever since, this red-painted pottery has been referred to as "Sesklo" ware, no matter where it is found. Achilleion, a Sesklo site, is located on the southern edge of the eastern part of the plain. A Greek-American team excavated this site in 1973 and 1974, and the director, the late Marija Gimbutas, published the results in 1989. Achilleion produced a long sequence of radiocarbon dates (c. 6400–5600 B.C.) and is among the earliest of Neolithic sites in Greece. The goals of the project were, first, to explore this site for evidence of a "prepottery Neolithic," that is, levels with domestication but no pottery; second, to obtain data for radiocarbon dating; and, last, to understand the life of the villagers, as evidenced by their houses, pottery, tools, technology, symbols, and what they traded, herded, hunted, planted, and gathered.

STRATIGRAPHY AND LIVING SPACE

Four squares, each 5 by 5 meters (A–D), were placed at the summit of the low-lying mound, and sterile soil was reached in A, B, and Test Pit East at a depth of 5 meters. Test pits and small soundings were dug to establish the extent of habitation. Based on the soil stratigraphy, the carbon dates, and the seriation of a huge sample of pottery (more than 100,000 sherds), four phases were defined (Achilleion I–IV) covering about eight hundred years of early to classical Sesklo.

Building practices changed over time. The standard, adopted in Achilleion II, of stone foundations with walls made of posts interlaced with brush and sealed with mud plaster varied over time only by number and size of rooms. Excavation near a house wall exposed a "courtyard" of Achilleion III (c. 6000 B.C.) filled with artifacts and features that included an unusual stone and clay platform with round, pebble-lined indentations, 30 centimeters in diameter, at each corner. On the platform were five figurines, stone cutting and grinding tools, and associated pottery sherds, apparently representing outdoor domestic activity of a communal nature.

The two-room structure of Achilleion IV was referred to as a "shrine" because figurines, special pottery, and tools were clustered in one room; although this interpretation is debatable, the recovery of figurines and other cult objects indicates a lively symbolic life. Exposure of other "living" floors illustrates the dense combination of tools, artifacts, rubbish piles, partial structures, hearths, ovens, and other items of the material culture of Neolithic village life.

POTS AND POTTERS

The Achilleion I (c. 6500 B.C.) villagers produced simple monochromatic pink, gray, tan, or dark brown wares; later potters added dark red-brown (Achilleion II) and, in phases III and IV (c. 6000–5700 B.C.), burnished red-buff and red-orange. Favored shapes were rounded, open and closed, some with high necks and ring-bases. Linear designs of red paint on a white slip background were first tabulated in late Achilleion I (triangles and crossed lines) and the very characteristic step pattern introduced in phase II (c. 6300–6150 B.C.). Products of phase III and IV (c. 6000–5600 B.C.) seem to have been the work of more knowledgeable and adventurous potters launching checkerboard, boxes, filled-lozenge, nesting chevrons, and the most recognized of Sesklo motifs—the flame pattern and its elaborations. Potters making crude and fine wares had developed into crafters.

TOOLS, TASKS, AND CRAFTS

The many and varied artifacts and features imply workers, crafters, and apprentices or helpers in a village in which men and women, young and old, all participated. Among the numerous items (and associated workers' activities) were: clay spindle whorls and spools (shepherds, spinners, weavers); fine and coarse pottery and polishers (potter specialists); imported obsidian for cutting tools (traders, cooks, farmers); stone adzes, axes, and grinders and carbonized plant remains (stone carvers, sowers, reapers, cooks, consumers) (fig. 1: 3, 6); mat impressions on clay (basket and mat makers); bone tools (herders, hunters, and cooks) and the recycling of bones ground and shaped into tools (fig. 1: 7).

Conservation of resources was detected by presence of the "silica gloss" on the edge of small chipped stone blades—part of a composite sickle. These were inserted, as "teeth," into a groove prepared in a wood or antler handle. As the sickle was used in reaping, free silica in the plants fused onto and dulled the teeth. The reaper removed, rotated, and reinserted them, producing a reusable sickle; and his/her conserving behavior is identifiable when the shiny silica gloss covers opposite margins of the small blades.

ANIMAL AND PLANT HUSBANDRY

The settlers planted and reaped domesticated cereal crops (emmer and einkorn wheat, barley, and perhaps oats), either in mixed fields or separately. They added lentils in Achilleion I and II and peas in Achilleion III and IV. Wild pistachio nuts, acorns, and wild grapes were collected. Subsistence also was based on those animals husbanded by the villagers: sheep, goats, cattle, pigs, and dogs (the latter not for food); all had been domesticated by the time the first pit house had been erected in Achilleion I. The same mixed seed material and faunal remains have been identified from other early Neolithic Thessalian sites.

Wild animals did not play an important role in the diet, but hunters exploited the forested mountains for red deer, ibex, wild cat, and boar as well as the plain for wild cattle and fallow and roe deer. Wild ancestors allow for local domestication, but it is assumed that sheep and goat, already domesticated, were brought to Thessaly from either the north or the east (the Balkans in the case sheep and Anatolia for goats).

SYMBOLISM

Achilleion is noted especially for the recovery, in an archaeological context, of a large and varied assemblage of small clay schematic human and naturalistic animal figurines (fig. 1: 1–5). These items were studied by the excavator Marija Gimbutas, who interpreted them as symbols of the "gods and goddesses of Old Europe," representing prehistoric religion, cult practice, and matriarchy. "Old Europe" encompasses Neolithic through Chalcolithic Greece and the Balkans (c. 7000–3500 B.C.), where virtually all excavations of prehistoric sites reveal similar figurines and various cult objects. The Thessalian sites of these millennia were the richest, and the ubiquity of the pottery designs and especially the figurines, with masks as faces and "coffee bean"

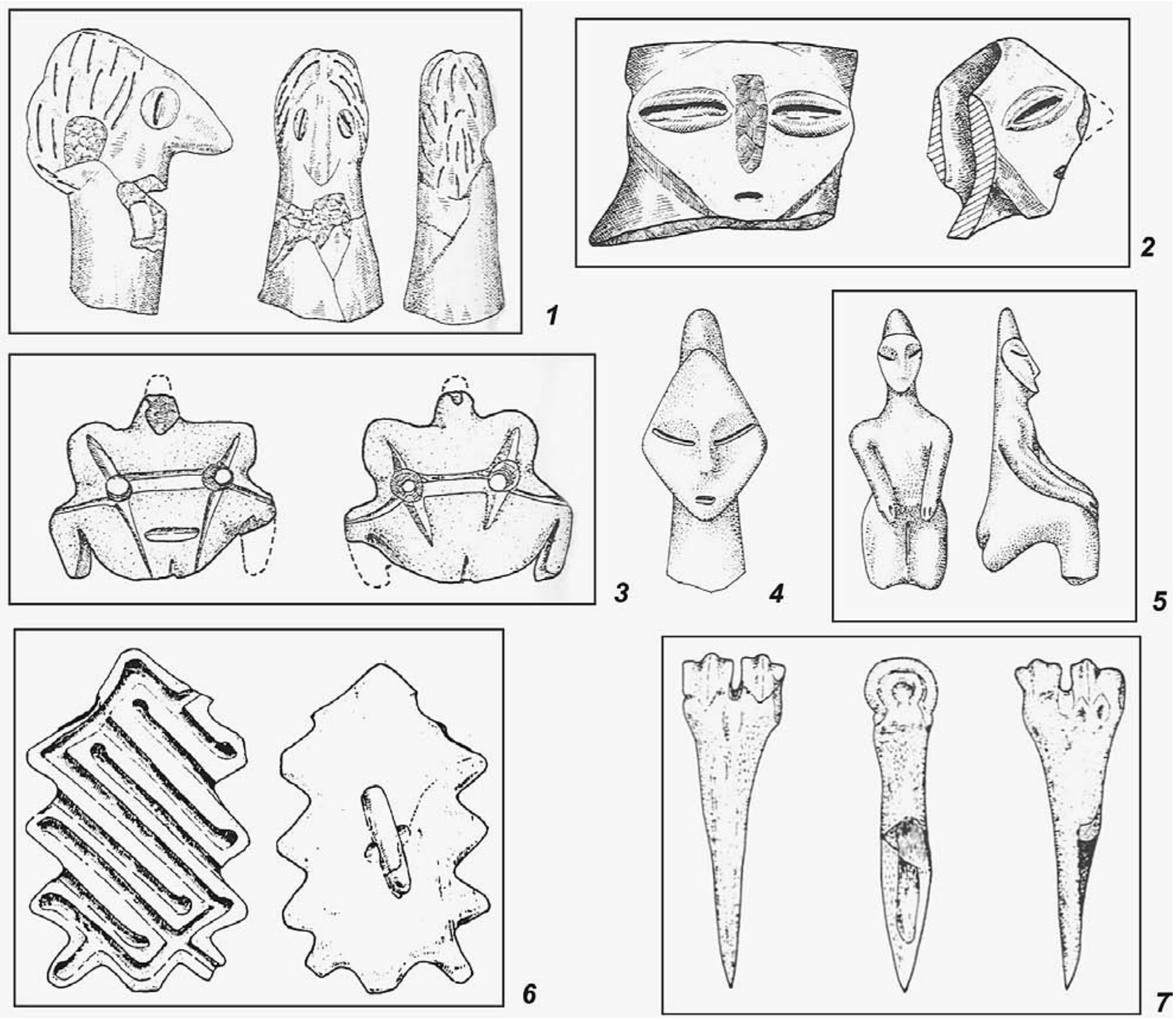

Fig. 1. Examples of figurines and tools (from Gimbutas, Winn, and Shimabuku 1989), measurements: height, width in centimeters: (1) head with coiffeur (from "shrine" of Achilleion IV), baked clay, 6.1, 4.6; (2) face mask (with "coffee-bean" eyes) on rim shard (Achilleion IV), baked clay, 3.4, 2.9; (3) polished black "greenstone" frog (Achilleion I), 3.2, 2.9; (4) face mask (removable) on stand (Achilleion III/IV), mask: 3.8, 3.0, stand: 5.9, 2.0, baked clay; (5) seated figure (male god?), head reconstructed (Achilleion IV) 5.2, 3.7, baked clay; (6) labyrinthine alabaster seal or mini-game board with handle for suspension (Achilleion III), 6.3, 3.9; (7) bone awl (Achilleion III) 6.5, 2.3. COTSEN INSTITUTE OF ARCHAEOLOGY, UCLA. REPRODUCED BY PERMISSION.

eyes (fig. 1: 1, 2, 4, 5), suggests that they were easily recognizable symbols standing for a kind of cultural association. Some of them also may symbolize a household cult of regeneration (fig. 1: 3).

Gimbutas's analysis has been the subject of controversy and is part of an ongoing debate that has been summarized by Richard Lesure. Nevertheless, her ideas captured the popular imagination and led some feminist writers to proclaim that once God was a woman.

THE CONTRIBUTION OF ACHILLEION

The rich recovery of material culture provides an opportunity to look at how life at Achilleion worked—in some ways quite sophisticated and elaborate for the mid-seventh to mid-sixth millennia B.C., without even considering the symbolism embedded in the ubiquitous and challenging figurine assemblage. For example, a raw material, obsidian, was used systematically for small cutting blades over the eight hundred years of settlement, possibly because it holds a sharp cutting edge. The source of this volcanic glass is the island of Melos in the Cycladic group, some 300 kilometers away. Transporting raw materials from afar required considerable effort, which endows them with extra value. Although it is not known what the Achilleion villagers offered in return, one can infer that planning, organization, and a long-term procurement strategy (or strategies) were successfully in operation—a certain and exciting example of the abilities and social dynamics of the villagers.

One of the goals of this excavation was to locate a pre-pottery Neolithic level, which had been reported when Dimitrios Theocharis, the late dean of Thessalian prehistory, tested the site in 1961. The evidence from the lowest Achilleion I levels (c. 6500 B.C.), however, always included pottery. The absence of this pre-pottery horizon at Achilleion suggests that the first settlers probably were not a local population but rather agriculturalists from elsewhere who brought with them the knowledge of pottery making and fully domesticated plants and animals—the Neolithic triad. Based on the pottery styles, and present knowledge of plant and animal domestication, these first settlers could have been from Anatolia or the Near East, who arrived with maritime traders or colonists or both, as suggested by Catherine Perlès and Kostas Gallis. Chronology is an essential issue in prehistory because there are no written records. Thus the forty-two calibrated radiocarbon dates from Achilleion, tied to the development of an Early to Middle Neolithic village, is a contribution in and of itself, one which will reverberate in terms of this time period in Greece and throughout the Balkans for some time to come.

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ERNESTINE S. ELSTER

LAST HUNTERS AND FIRST FARMERS ON CYPRUS

The Mediterranean islands produced some of the most sophisticated ancient cultures in the world. Nonetheless, archaeologists know relatively little about the islands' early prehistory. There is scant evidence that most were occupied before the Neolithic period, the economic transition from mobile hunting and gathering to domestic food production and sedentary ways of life. The traditional paradigm was that the Mediterranean islands were late recipients of Neolithic colonists, who imported complete Neolithic "packages," consisting of domesticated plants and animals and a sedentary lifestyle, but left few material linkages to their homelands. Many researchers believed that the Neolithic on the islands was little more than a footnote within the broader Neolithic world. New research, however, is altering this view substantially. A focus of these studies has been the eastern Mediterranean island of Cyprus, where investigations are dramatically fueling the debate about when and why the island was occupied.

PRE-NEOLITHIC HUNTERS

With few exceptions, there are limited data supporting pre-Neolithic occupation on virtually any of the Mediterranean islands. Claims for earlier occupations are unsubstantiated. Then came the discovery of Akrotiri Aetokremnos ("Vulture Cliff") in Cyprus (fig. 1), which documented an occupation at c. 10,000 B.C. calibrated. This small collapsed rock shelter ranks as the earliest well-documented human presence on any of the insular Mediterranean islands. Aetokremnos not only is the oldest site on Cyprus, but also, and more controversially, it is associated with a huge assemblage of the endemic and extinct Cypriot pygmy hippopotamus. More than 500 individual hippos are present, as are smaller numbers of other animals. The evidence suggests that humans were instrumental, at least in part, in finalizing the extinction of these unique animals.

Fig. 1. Overview of Akrotiri Aetokremnos. This site is located on the steep sides of the cliffs in the center of the photograph. COURTESY OF ALAN H. SIMMONS. REPRODUCED BY PERMISSION.

While there are numerous Pleistocene fossil sites in Cyprus and other Mediterranean islands, these animals have not been associated with humans. Skeptics of Aetokremnos dispute such a connection, but a careful reading of the evidence strongly supports the direct association of pygmy hippos with cultural activities. When all aspects of Aetokremnos are examined, the most parsimonious explanation is cultural in nature. A small group of humans could have been the trigger to eradicate remnant hippo populations who were suffering ecological stress due to climatic change and thus were on the verge of extinction.

Aetokremnos is significant for several reasons. First, it firmly establishes a human presence on Cyprus in the early tenth millennium B.C., making it one of the earliest occupied Mediterranean islands. Here the distinction made by John Cherry between "occupation" and "colonization" is important, as Aetokremnos appears to represent a relatively short-lived (about five hundred years or less) occupation rather than an actual colonization episode. Second, Aetokremnos has ramifications for how islands are occupied, indicating that Neolithic technology was not necessary. Third, Aetokremnos is one of the very few sites anywhere in the world dating to the Pleistocene-Holocene boundary that shows a direct relationship between extinct megafauna and human hunters. Finally, Aetokremnos has challenged research paradigms on many of the Mediterranean islands concerning the nature of archaeological data. For many years scholars believed that the islands were too impoverished to have supported hunter-gatherer populations. The archaeological "signature" of such groups, however, is quite ephemeral, and it is now clear that small sites, such as Aetokremnos, have been ignored for far too long.

NEOLITHIC FARMERS

Although many of the Mediterranean islands have Neolithic occupations, most archaeologists believed that these first colonists were relatively late, ceramic-bearing Neolithic peoples. They arrived from the mainland and developed somewhat isolated and in many ways "impoverished" insular cultures compared with their Levantine or Anatolian neighbors. Cyprus was little different, except that the Cypriot Neolithic is the most developed and oldest of any on the Mediterranean islands and has an aceramic component. It was during the Aceramic Neolithic that Cyprus actually was colonized.

The Aceramic Neolithic in Cyprus is termed the "Khirokitia culture" after the type site for the period, a large and substantial agricultural settlement. During the Khirokitia culture, lasting from c. 7000 to 5000 B.C., there were few Levantine or Anatolian parallels, and overall it often was viewed as less sophisticated than its mainland counterparts. This is expressed by an unrefined chipped-stone technology and typology, by the continuance of circular structures rather than a transformation to rectangular ones, and by limited evidence of substantial ritual or symbolic behavior. Khirokitia peoples settled in various locations, but major communities were situated within 10 kilometers of the Mediterranean Sea.

These colonists apparently arrived on an island with few resources; certainly the endemic fauna no longer existed. They introduced a limited number of domesticated plants and animals, including caprines, pigs, and apparently wild deer, presumably for hunting. Oddly cattle were conspicuously absent until the Bronze Age, despite their occurrence in Neolithic contexts on the mainland and on other Mediterranean islands. The Khirokitia culture is followed, after an apparent chronological gap, by the Ceramic Neolithic (the Sotira culture). While this is a pattern similar to that on the mainland, the Sotira culture also is often characterized as relatively nondescript.

Until the discovery of Aetokremnos, the Khirokitia culture represented the first occupation of Cyprus. Aetokremnos presented a chronological dilemma, in that it is some three thousand years earlier and there is little evidence to suggest that it was ancestral to the Khirokitia culture. Perhaps those responsible for Aetokremnos chose not to participate in the tumultuous changes associated with the Neolithic revolution on the mainland and simply decided to leave for uncharted but nearby territory. They could have been generalized late Natufian or Early Neolithic (Pre-Pottery Neolithic A [PPNA]) people who arrived on an unoccupied island, found residual herds of a unique fauna, hunted them into extinction, and then left. But they did not forget Cyprus. It is here that new research has made Aetokremnos more plausible and added to the complexity of the Cypriot Neolithic. These investigations, which must be evaluated not only in a Cypriot context but also within a broader perspective assessing the transmission of a Neolithic "package" from the mainland, have documented an earlier component to the Aceramic Neolithic. They also suggest much more complex economic strategies than previously believed. In particular there is now evidence of cattle.

These findings revolve around three newly studied sites. Two coastal occupations, Parekklisha Shillourokambos and Kissonerga Mylouthkia, predate the Khirokitia culture, with radiocarbon determinations of c. 8000 B.C., if not earlier. These discoveries extend the Aceramic Neolithic on Cyprus to a period roughly contemporary with the early mainland Pre-Pottery Neolithic B (PPNB) and has been termed the "Cypro–PPNB." Both sites share artifactual similarities with the Levant and contain complex features, including wells. Significantly neither is a large village of the type typically associated with the Cypriot Neolithic. Of particular importance is the documentation of limited quantities of *Bos* (cattle) at Shillourokambos, thereby placing this important economic species firmly within the Early Neolithic of Cyprus.

The third site is Ais Yiorkis, a small non-village locality. It is significant for several reasons, including its location in an upland rather than a coastal setting; the presence of a technologically refined chipped-stone assemblage; and especially its economic implications, because limited numbers of *Bos* have been found, similarly to Shillourokambos. Unlike Shillourokambos and Mylouthkia, Ais Yiorkis appears to date to the early Khirokitia culture, although additional radiocarbon determinations are required to resolve its chronological placement.

SIGNIFICANCE

What does this research mean to the early prehistory of both Cyprus and other Mediterranean islands?

First, it is now known that people were in Cyprus much earlier than has been suspected and that the island could support a primarily hunting adaptation. Second, this research unfolds a story of an economically sophisticated Neolithic adaptation. Not all early settlements were restricted to the coastal areas of Cyprus, nor were they all villages. Cattle have been found at two nontypical sites, indicating an economic dichotomy selecting against keeping them in villages. The cattle from Ais Yiorkis and Shillourokambos also may have ritual significance; certainly there is considerable evidence on the mainland for ritual treatment of cattle during the Neolithic. Was there a similar reverence for these animals in Cyprus? Finally, these investigated sites apparently contain limited architecture; such localities previously have not been accorded much attention on the Mediterranean islands. This is significant because it is now apparent that small, limited-visibility sites often contain far more substantial and diverse materials than was anticipated.

In summary, Cyprus clearly was a Neolithic "colony" far earlier and longer than researchers initially believed, and at least during the earliest Neolithic (the Cypro-PPNB) close relationships were maintained with the Levantine mainland. It also is apparent that principal economic animals, including cattle, were under enough human control to be transported by sea to Cyprus during the Neolithic. The island can no longer be considered an isolated cultural backwater of the Neolithic world. From at least the Late Epipalaeolithic, Cyprus, with its strategic Mediterranean location, was a component in a world on the cusp of the Neolithic revolution.

See also **Copper Age Cyprus** (*vol. 1, part 4*); **Bronze Age Cyprus** (*vol. 2, part 5*).

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ALAN H. SIMMONS

TRANSITION TO FARMING IN THE BALKANS

FOLLOWED BY FEATURE ESSAYS ON:

The nature of the transition from foraging to farming in southeastern Europe is the subject of considerable debate among archaeologists. It is not possible to draw a neat distinction between the argument for adoption and even innovation of agricultural practices by local foragers and the establishment of farming communities by immigrants. New data suggest that the widely accepted model of Neolithic colonization by makers of painted pottery from early farming communities in Greece and Anatolia may not hold true. Pottery and domesticates found in contexts associated with indigenous hunter-gatherers indicate that Mesolithic foragers may have played an important role in the adoption of the Neolithic economy.

The Balkans make up a complex geographic region in the shape of triangular peninsula with a wide northern border, narrowing to a tip as it extends to the south, embedded in southeastern Europe. The Turkish word *balkan,* which means "woody mountain," was introduced in the fifteenth century to name a mountain in northern Bulgaria. It was adapted quickly to the more general area of the mountain ranges between the Adriatic and the Black Seas. The term "Balkan Peninsula" was first used in the nineteenth century to designate this area. We use the term "Balkan" today in cultural and political nomenclature, but it also is appropriate in denoting a concrete geographical and historical region.

In the northeast and north, the Balkans are exposed to the steppe regions of the Ukraine and to the Carpathian Basin. The Black, the Aegean, the Mediterranean, and the Adriatic Seas surround them in the east, south, and the southwest. The straits of the Bosporus and the Dardanelles in the southeast are a natural gateway between the Balkans and Anatolia and beyond to Asia. In the northwest, the valley of the Danube and the flat Pannonian plain connect it to central Europe. Proceeding north from Greece into the central and northern Balkans, one moves from a dominantly Mediterranean and sub-Mediterranean environment into an increasingly Continental one. Mountains divide the region into small units, in which distinct ethnic groups have been able to sustain themselves. They also subdivide every district into vertical ecological zones, ranging from more valuable lowland farming areas to less valuable wooded or rocky uplands. This variety of ecological niches supported different cultures in close proximity to one another.

THE MESOLITHIC ROOTS OF THE BALKAN NEOLITHIC

By the beginning of the Boreal period (c. 8000 B.C.), the environment of the Balkans was similar to that of today. The region was populated with hunter-gatherer groups, but while their presence in central and northern Europe is well documented, only a thin settlement pattern is observable in the Balkans. Mesolithic sites are unequally distributed throughout the region, and some clusters are reported along the Aegean seacoast as well in Thessaly, the Dinaric Alps in the Adriatic, the Ionian hinterland, and along the Danube in the northern Balkans. It has been hypothesized that the Mesolithic social system comprised exogamous and territorial bands economically based on common access to resources. Indeed, the conclusion often drawn is that large parts of the region were completely uninhabited during the Early Postglacial period, and the absence of Mesolithic habitation from many areas has been accepted as a fact by numerous scholars.

The initial appearance of Neolithic communities, characterized by tell type sites in Thessaly, therefore was linked to the farming communities that were believed to have migrated from the Near East and colonized the southern Balkans. It became broadly accepted that immigrating farmers brought all the knowledge and skills of farming, with cultivation removing many of the risks and uncertainties, allowing accumulation and redistribution and thus making sharing undesirable.

In this orthodox model, the transition to farming in the Balkans was related to intrusive agricultural communities originally from Anatolia that established Neolithic settlements, from which they gradually colonized the entire region. Thus, the microregion settled first by Anatolian migrants, and identified as the primary center of "Neolithization" in Europe, corresponds with the distribution of "preceramic" and "monochrome" pottery occupations in the active floodplains of Thessaly on the southern tip of the Balkans. The colonization of the entire region is believed to relate to a subsequent wave of northward migration that was recognized in the dispersal of pottery with white or red painted decoration in the northern and eastern Balkans and of Cardial-Impresso pottery along the Adriatic coast.

The prevailing assumption of many archaeologists has been that fully formed Neolithic communities spread northward along a dynamic agricultural frontier zone. This model suggests a steady expansion of people into Europe, driven by population growth resulting from agricultural surpluses and the displacement or absorption of the sparse hunter-gatherer populations. Archaeologists often have drawn maps of the distribution of Early Neolithic sites and dates that have depicted a continuously moving Neolithic frontier in which there was no prolonged chronological overlap between hunter-gatherers and the onset of early farming. The lack of evidence of hunter-gatherer sites in the Balkans led to speculation that an extremely sparse Mesolithic population would have allowed farmers to expand and colonize the region rapidly.

It is evident, however, that the present distribution of Late Mesolithic and Early Neolithic sites has been very much affected by long-term and catastrophic processes that restructured the geomorphologic features and reshaped the relief of the Balkans in the Holocene. In plotting sites on a general map of southeastern Europe and in hypothesizing spatial discontinuity between Mesolithic and Neolithic settlements, we must take into consideration the fact that the patterns available to research are the outcomes of consecutive cycles of alluviation, erosion, and sedimentation; the rise in Mediterranean sea level; and modern anthropogenic impacts on the landscape. Many coastal and riverside sites still remain unavailable, and others have been erased entirely from the surface as the result of intensive present-day agricultural activities. The distinction between Neolithic and Mesolithic sites also has been based on general typological categorizations that were used to define the cultural sequences of hunter-gatherers and farmers. This dichotomy maintains the perception that farming practices could be embedded only in typologically determined Neolithic "cultural" contexts. From this point of view it is impossible to ignore the fact that the spatial distribution of Early Neolithic settlements may not reflect the actual spread of farming practices and changes in subsistence strategies.

The idea that early farming in southeastern Europe spread through its adoption by local foragers, rather than through migration, is still not accepted widely. The Balkans often are excluded as an area of primary domestication of wild einkorn (*Triticum boeoticum*), although on the tip of the Balkan Peninsula present-day habitats for wild einkorn exist. Among the archaeobotanical remains collected from the Mesolithic deposits in the Theopetra cave in Greece, wild einkorn wheat has been reported. Although einkorn wheat appears to be less common than two other founder cereals, emmer wheat (*Triticum dicoccum*) and barley (*Hordeum vulgare*) in the Levantine Neolithic, this is certainly not the case in the Balkans, where much richer remains of einkorn wheat are available. Einkorn prevails over emmer wheat in the number of pure hoards, retaining its principal role throughout the Neolithic and even later periods. In emphasizing the importance of new subsistence practices introduced by first farmers, such as replacement of collected seeds by cultivated cereals, we should not overlook that the Neolithic pollen records in the Balkans do not reflect forest clearing and the creation of patches of cultivated land. Thus, we should not exclude the possibility that indigenous foragers were more involved in the establishment of farming communities in the Balkans than archaeologists admit.

THE "NEOLITHIZATION" OF THE BALKANS

A revolution in cuisine occurred when Neolithic villagers started to use pottery. Since V. Gordon Childe put forward the idea that pot making is a virtually universal characteristic of Neolithic communities as well an indicator of its cultural identity and origin, the appearance of pottery in the Balkans has been considered to mark the dispersal of Early Neolithic cultures from Anatolia. In the absence of precise dating evidence and without the retrieval of botanical and faunal remains, the assessment of any particular site in the Balkans as being of Neolithic age traditionally has been made on the presence of pottery fragments.

From this perspective, after the Anatolian immigrants, who either did not use pottery or made monochrome pottery, gained their initial toehold on the floodplains of Thessaly, subsequent northward expansions were correlated with regional pottery distributions assumed to reflect two streams of migrating farmers. The first was defined by the dispersal of white or red painted pottery that marked the inland migration toward the southern Carpathian Basin, which eventually became the Starčevo-Körös-Criş complex of Neolithic cultures. The second migration was linked to the Cardial-Impresso pottery dispersal, restricted to the eastern Adriatic and Ionian coastal area. In one microregion recognized in the central Balkans in Bosnia, the two streams overlapped. The combination of painted and Cardial-Impresso pottery identified in the Early Neolithic settlement deposits at Obre was interpreted as a composite Starčevo-Impresso culture.

The validity of this model of northward migration and colonization by farmers has been questioned. Emphasis has been laid on the growing evidence of pottery deposited in the so-called aceramic settlement layers, which strongly contradicts the concept of a Pre-Pottery Neolithic in Greece. Some researchers, however, continue to interpret the transition to farming in Greece as having taken place through the arrival of the first occupants, bringing with them the full Neolithic "package" of domesticated plants and animals but not pottery. The idea of a demographic explosion in the floodplains of the rivers and lakes in Thessaly first occupied by immigrant farmers and a subsequent rapid migration toward the northern Balkans also remains speculative. Indeed, it took twelve hundred years to colonize the nearest floodplains in Macedonia and another three hundred years to reach the Danube in the northern Balkans.

The traditional concept of white painted ware as the earliest Neolithic pottery of the central and eastern Balkans also has been called into question. Several clusters of well-stratified sites exist, where layers of unpainted pottery—with monochrome and Impresso decoration—are separated stratigraphically from those of white painted ceramics. Such monochrome and Impresso assemblages in Poljanica, Orlovec, Koprivec, and Obhodov in the eastern Balkans have been related contextually to microliths, trapezes, and rudimentary agriculture. In the central and northern Balkans forty-six sites with early ceramics have been identified. Essentially, archaeologists found that the monochrome and Impresso pottery at these sites is embedded contextually in semisedentary or sedentary hunter-gatherer occupations in the region, such as at Lepenski Vir and Padina in the Danube gorges. The pottery assemblages consist principally of monochrome ceramics of simple forms and limited Impresso techniques. Ninety percent of the pots are undecorated, and the decorations on the rest consist of impressed ornaments, shaped by fingertips and fingernails, the edges of freshwater shells, and awls.

Unfortunately, most of the Iron Gates pottery assemblages are still scantily published. In interpreting the Mesolithic cultural phases at the Lepenski Vir I and II sites, the excavator pointed out that monochrome pottery fragments had been found lying on the floors of fifteen Mesolithic trapezoidal buildings. In the initial reports, the Lepenski Vir pottery was discussed out of its context, owing to its presumed inconsistency with a model of hunter-gatherer technology that excluded ceramic manufacture; instead, it was attributed to vertical displacement of Neolithic artifacts and post-depositional disturbance. Later research confirmed, however, that the pottery indeed was associated with the famous stone statues and other decorated sculptures, altars, and artifacts ornamented with various symbols and deposited on the floors of the same buildings.

Most intriguing is the correlation of complete pots found in situ, stone statues and sculptures, and groups of newborns and children buried below the floors in the rear of certain buildings. A remarkable symbolic structure was preserved in centrally positioned trapezoidal building 54. A pot with spiral ornaments, illustrating local decorative principles and symbolism, was placed deliberately in what was identified some years ago as the sanctuary of a sun deity. It was associated with the burials of two newborns, red and black sculptures, and an altar.

It has been hypothesized that early ceramics at Lepenski Vir indicate increased interaction between the two social networks, farming communities outside the gorge and the hunter-gatherer community inside, which led to the collapse of the latter group. Alternatively, it is possible that the pots served as containers for foods that appeared in the context of a dietary shift from aquatic resources to terrestrial resources. As stable isotope analyses have shown, terrestrial resources probably included a major agricultural component, despite the fact that domesticates have not been documented in these contexts.

In contrast to the prevailing assumption that pottery is a marker of settled Neolithic life, it is possible to argue to the contrary. We can say instead that the pottery at Lepenski Vir was a new technology and a novel medium used for visual display, whether as serving dishes for the living or in sacrificial rituals to dead children buried beneath the buildings. This pottery acted as an integral part of a set of symbols consisting of standardized settlement architecture, location of burials and burial practices, stone sculptures and statues, and mortars and altars, which, taken together, reflect an ideological integration and define a cultural identity of non-farming communities in the region.

A similar pattern of early monochrome and Impresso pottery dispersal has been seen in Ionian and Adriatic coastal areas. In some contexts, it was connected with hunter-gatherer stone tool assemblages. This ornamental principle evidently was of long duration, as painted pottery did not exist in coastal regions before the Middle Neolithic. Although no direct evidence of pre-Neolithic pottery production is available in the Balkans, we can take into account the presence of some unbaked clay masses as well as certain associated monochrome, primitive, and slightly baked pottery documented in a Late Mesolithic context in the Theopetra cave. We also have mentioned the typologically and chronologically well grounded hypothesis that Thessalian ceramic techniques were developed on the spot and were not part of the baggage of immigrating farmers.

Not many radiocarbon dates are available for the Balkans, to anchor the irregular distribution of monochrome and Impresso pottery chronologically. The dates we have show the evident contemporaneity of the contexts, whether in the southern or northern Balkans or in Ionian or Adriatic coastal areas. These styles of pottery occurred over a very broad area but in a narrow time span in the Balkan interior and along the Ionian and Adriatic coasts during the second half of the seventh millennium B.C. Probability distributions of the radiocarbon dates from Lepenski Vir, Donja Branjevina, and Poljanica in the northern and eastern Balkans, Sidari on the island of Corfu, and Vela Spilja on the eastern Adriatic coast reflect striking parallels with one another and with early pottery-using levels at Sesklo and Achilleion in the southernmost part of the Balkans. No chronological gap is evident between the first appearances of pottery in Greece and pottery in the Balkans. The contextual attachment of monochrome and Impresso pottery to the hunter-gatherer world and its widespread distribution contradict the traditional models of centers of so-called Neolithization and subsequent migration toward the margins of the Early Neolithic world.

The basic premise of this discussion is that the dispersal of farming in southeastern Europe was embedded in the existing regional, pre-Neolithic social and historical structures. Dispersal was effected by the network of social relationships and contacts and by traditional socially and culturally defined principles of inter-generation and inter-community transmission of knowledge. Through contact in the course of local and regional migrations, people were the agency for such transmissions, for the incorporation of such innovations as domesticates and pottery, and for changing the structural framework of the social context.

THE EVIDENCE FROM DNA

Evidence from the tracing of lineages in mitochondrial DNA (mtDNA) from extant European populations supports the evidence from pottery distributions of a strong indigenous component in the transition from foraging to farming in the Balkans. It is believed that most modern European mtDNA was formed neither through Early Upper Palaeolithic colonization by modern humans nor as a result of Neolithic immigration from the Near East. Instead, mtDNA is thought to have been distributed via Late Pleistocene movements within Europe itself. It has been suggested that less than 10 percent of extant lineages date back to the initial colonization of Europe by anatomically modern humans and that perhaps 10–20 percent of lineages arrived during the Neolithic. Most other lineages seem to have arrived during the Middle Upper Palaeolithic and expanded during the Late Upper Palaeolithic. The Neolithic contributions to extant mtDNA vary regionally, with incoming lineages in the minority, compared with the situation of the indigenous Mesolithic. This is true even in those regions where pioneering colonization of uninhabited areas has been postulated. Regional analysis shows that the Neolithic contribution to mtDNA of incoming lineages was about 20 percent in southeast, central, northwest, and northeast Europe. In Mediterranean coastal areas, it was even lower than 10 percent, similar to the percentage in Scandinavia.

Although this research is still in its infancy and the subject of some controversy, the available mtDNA evidence indicates that immigrating farmers played a relatively subsidiary role in the introduction of farming to the Balkans. It appears instead that populations that had been resident in the area for thousands of years were not replaced or driven out by immigrating farmers from Anatolia. The archaeological boundary that reflects the isolation of the Adriatic coast is evidence of the dominant social and ideological continuity, which correlates well with the low percentage (about 10 percent) of incoming Near Eastern genetic lineages. Elsewhere in the Balkans, the higher contribution of Near Eastern genetic stock (about 20 percent) may correlate with circulation of people and goods over long distances, which accelerated the social and ideological restructuring of hunter-gatherer communities.

THE ESTABLISHMENT OF FARMING COMMUNITIES IN THE BALKANS

After these early traces of indigenous ceramic innovation and adoption of Neolithic characteristics by hunter-gatherers, a more robust and consolidated group of Neolithic communities developed in many parts of the Balkans during the final quarter of the seventh millennium and the first part of the sixth millennium B.C. Marked differences exist between the settlements found in the southern Balkans and those in the central and northern Balkans. The former sites are more closely related to contemporaneous sites in Greece, while the latter reflect a clear adaptation to a temperate, Continental environment. Named for type sites and geographical features, the southern complex embraces cultures known as Kremikovci and Karanovo I, while the northern complex comprises the Starčevo-Körös-Criş cultures.

In contrast to the earlier distribution of monochrome and Impresso pottery in both interior and coastal areas, a clear distinction between the Adriatic coast and the Balkan interior emerged at this time. While red or white painted pottery was adopted throughout most of the Balkans, a Cardial-Impresso ornamental technique came into use during the final centuries of the seventh millennium B.C. along the Ionian and Adriatic coasts, in a band that extended 30 kilometers into the Adriatic hinterland. Neither painted pottery technology nor accompanying artifacts arrived on the eastern Adriatic coast. The pattern may suggest selective processes of integration of the "Neolithic package" into existing hunter-gatherer social systems and subsistence strategies.

The Kremikovci–Karanovo I Complex. Starting around 6200 B.C., numerous substantial Neolithic settlements appeared along the rivers of western and southern Bulgaria and adjacent territories. These floodplain communities adopted some, but not all, of the architectural techniques in use in Greece, building houses from timber and clay but without stone foundations or mud bricks. Their sites comprised clusters of small, rectangular, one-room or two-room houses that were repaired and rebuilt over time to form mounds, or tells, of superimposed habitation. Later houses were built in line with the floor plans of earlier ones, indicating continuity of occupation over several centuries.

Two of the most important Early Neolithic sites in this area are found at Chevdar in western Bulgaria and Karanovo in south-central Bulgaria. At both these sites, farming communities chose locations close to good alluvial soils for the cultivation of einkorn and emmer wheat, barley, peas, beans, and vetch. At Chevdar, palaeobotanical analysis of large, homogeneous samples points to a sophisticated crop-processing technique. Among domesticated animals, sheep and goats were the most important, with cattle and pigs in subsidiary roles. In the lowest layer of the Karanovo tell (Karanovo I), rectangular houses were about 7–8 meters on a side and often contained ovens and grindstones.

The pottery of the Kremikovci–Karanovo I complex consists of first white and then red painted ceramics in a variety of vessel forms. In addition to pottery vessels, Neolithic peoples began making figurines and models of human beings, animals, furniture, and buildings. Of greatest importance are the anthropomorphic figurines found from Macedonia north to southern Hungary. Many represent women; others have no recognizable sexual features, although they are seldom explicitly male. Although archaeologists are not certain of the purpose of these figurines, Douglass Bailey has suggested that they were part of the ceremonies by which the social units reflected by the architecture of these settlements were created and maintained.

Burials from Kremikovci–Karanovo I sites are relatively scarce. Many of them are of children or infants. Inhumation burials are found commonly under house floors or close to buildings, sometimes in rubbish pits. It is difficult to generalize about the nature and quantity of grave goods. When grave goods are present, they generally consist of ceramic vessels, bone tools and ornaments, and flint tools.

The Starčevo-Körös-Criş Complex. The earliest Neolithic in the central and northern Balkans is defined by the Neolithic settlements clustered into the Starčevo-Körös-Criş complex. It consists of groups known as "Starčevo" in the central Balkans and "Körös" in the Carpathian Basin. Coarse barbotine (a rough application of clay that then is streaked with a finger or a stick, so that parallel ridges are raised) and impressed wares dominate in both groups. In contrast, red monochrome and painted pottery items are insignificant components in the development of these groups.

Orthodox interpretations of the southeastern European Neolithic transition still maintain that part of the population of these southern Balkan communities migrated northward separately and established the Criş group in enclaves in Transylvania, Romania. The primary Criş colony was recognized at Gura Baciului and defined by red monochrome pottery and white dotted decoration. The concept of a Starčevo culture was introduced in the 1920s when the type site at Starčevo, about 20 kilometers east of Belgrade, was excavated. In the 1930s Harvard University and the American School of Prehistoric Research became involved in research at this site. At the same time, excavations started at the site of Kotacpart in Hungary. Pottery similar to that at Starčevo was found at other sites located along the Körös River in Hungary, representing a group that became known as the Körös culture. A lack of well-stratified sites still favors typological ceramic sequences as a basic tool in establishing the Early Neolithic chronological framework in the region.

This grouping takes into account typological similarity and variation in pottery styles, but it also is driven by the recognition of modern political territorial boundaries. Thus, "Starčevo culture" relates to the Early Neolithic sites in Serbia, whereas "Körös" is applied to those groups located in southeastern Hungary and "Criş" to Early Neolithic sites in Romania. Radiocarbon dating shows that the Starčevo-Körös-Criş complex appeared as early as 6200 B.C. and lasted until the second half of the sixth millennium B.C., indicating a chronological overlap with the Early Neolithic sites of Thessaly, Macedonia, and southern Bulgaria and with the early *Linearbandkeramik* settlements of the Carpathian Basin.

It is not just pottery distribution that marks the Starčevo-Körös-Criş complex. High-quality "Balkan" flint, also termed "yellow-spotted" flint, represents the most abundant raw material within the complex. Although a clear picture of the source of this raw material is still lacking, there are indications that certain regions of northeastern Bulgaria are the most probable locations for its origin. At other sites, local raw materials were used, particularly in more northern areas. At the Körös site of Endrőd 39, however, a hoard contained 101 blades made from Bulgarian flint.

The Starčevo agricultural settlements in the valleys are situated on riverbanks or low terraces, set on mounds of alluvial sand and levees that rise above marshes. The settlement patterns are considered to be "tactical" in the sense that locations were occupied according to short-term needs rather than long-term strategies. There is little spatial differentiation within the settlements. Starčevo sites contain rich remains of cultural material and food residues, but with thin stratigraphic layers and enigmatic evidence for permanent structures. Quadrangular houses are reported in the latest phase, but some researchers have claimed that pits that form the main archaeological features at Starčevo sites are pit dwellings or pit huts.

The best example of a Starčevo settlement is the late seventh and early sixth millennia B.C. camp at Divostin in Serbia. The dwellings at Divostin were round or elliptical in plan. Some had concentrations of stones in the middle of their floors, which would have supported posts holding up the roofs of pit houses. In some buildings, small hearths were built. The Divostin pit houses were not very large, measuring no more than 4–5 meters in diameter. They were no deeper than 0.5 meters. A variety of ceramics, flint tools, animal bones, and anthropomorphic figurines were deposited in the dwellings. In the Danube gorges, Starčevo settlements frequently were stratified above Mesolithic habitation layers, and the houses maintained a uniform trapezoidal form and size as well the spatial structure of the settlement. The pattern is in marked contrast to the long-term tell settlements and surface houses found at this time in the southern Balkans.

Emmer and einkorn wheat, six-row barley, and peas have been found at Starčevo settlements, but a lack of attention to seed retrieval has minimized empirical support for hypotheses on the nature of plant exploitation. It is broadly accepted that agricultural practice may have been minimal at this time. There are many Starčevo sites, on the other hand, whose animal bone assemblages have been analyzed in detail. Domesticated sheep and goats prevailed in stockbreeding, but cattle and pigs did not play a significant role in the subsistence patterns of the Starčevo and Körös cultures. The habitats were less well suited for breeding sheep and goats than cattle, as the wild ancestor of the cattle, the aurochs (*Bos primigenius*), used to live here in large herds. Some researchers have argued that there was local domestication of cattle and pigs, but faunal data are equivocal at best on this point. An alternative pattern of animal use was identified in the Danube gorges sites and on Transylvanian sites. There, a small variety of cattle predominated among the domesticated animals, whereas sheep and goats seemed less important. Pigs were almost entirely absent. At Körös sites in the levee and back swamp habitats of southern Hungary, fish bones are especially common, indicating a substantial aquatic component in the diet.

The burials were dispersed in habitation areas across the region. Skeletons are found in a crouched position, with almost no grave offerings. An auroch's head with horn cores is associated with some burials, and various animal bones were placed in others. A large pit dug between the two buried people, with no grave goods and filled with a large amount of bones of dogs and wild horses, may provide indirect evidence of ritual or competitive feasting.

CONCLUSION

The transition from hunting and gathering to agriculture in the Balkans cannot be explained simply in terms of Neolithic immigrants originating in Anatolia and pushing steadily northward and westward, displacing indigenous foragers. Instead, it appears that there was an initial period during which pottery production and incipient agriculture were broadly and rapidly disseminated among pre-Neolithic communities during the second half of the seventh millennium B.C. Subsequently, Early Neolithic communities with strong local roots appeared in the final centuries of the seventh millennium B.C. In the southern Balkans, substantial settlements, such as Chevdar and Karanovo I, showed signs of long-term occupation and a strong commitment to agriculture, whereas in the central and northern Balkans, settlements of the Starčevo-Körös-Criş complex appear to have been shorter-term habitations with a broader spectrum of subsistence resources.

See also **Iron Gates Mesolithic** (*vol. 1, part 2*); **Crops of the Early Farmers** (*vol. 1, part 3*); **Obre** (*vol. 1, part 3*); **The Farming Frontier on the Southern Steppes** (*vol. 1, part 3*).

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OBRE

Two stratified Neolithic and Chalcolithic sites at Obre, 65 kilometers northwest of Sarajevo in Bosnia, are located on the bank of the Trstionica tributary a few kilometers from the Bosna River, the main prehistoric highway in the western Balkans. Twenty-two radiocarbon dates have established that the sites were occupied between 6230 and 4780 B.C. Obre's position between the Adriatic Sea and the central and eastern Balkans placed it at the center of a long-distance exchange dynamic encompassing the entire Balkan Peninsula and the central Mediterranean.

Two seasons of archaeological research at Obre in the 1960s resulted in excavations totaling 928 square meters at two locations (Obre I and Obre II). The first small-scale excavations took place in 1963–1965; more excavations were completed in 1967–1968 by a joint project of the National Museum of Sarajevo and the University of California at Los Angeles. The principal investigators were Alojz Benac and Marija Gimbutas. The main objective of the research was to establish the genesis and the chronology of the Late Neolithic Butmir culture, and Obre was chosen because of its ideal vertical stratigraphy. Although the first-year fieldwork was intended as a search for the Butmir village cemetery, Early and Middle Neolithic settlements were found instead. As the well-preserved stratified sequence, including the remains of houses, burials, artifacts, and organic materials, was revealed, the importance of Obre as a key site in interpreting the Neolithic and Chalcolithic cultural continuum in western Balkans became apparent.

Obre I (dated 6230–5990 to 5300–4900 B.C.) represents the Early and Middle Neolithic chronological sequence and the succession of Starčevo-Impresso and Kakanj cultures. Obre II (dated 5310–4910 to 4780–4440 B.C.), about 250 meters upriver, opened a wider perspective for the study of the genesis of Butmir culture. At its earlier level, Obre II consists of a continuum of Kakanj culture followed by a clear typological break in pottery production and in the pattern of domestic animal exploitation. The pig replaces transhumant animals (sheep and goats) in popularity. Cattle, however, are the primary domesticate throughout each level. The change from seasonal transhumance to more settled patterns of animal husbandry perhaps indicates a shift toward a more intensive economy involving more localized site catchments utilization for general resources. The later levels at Obre II showed no signs of depositional hiatus and represent the sequential phases of Late Neolithic Butmir culture.

The earliest occupation at Obre is believed to have been by populations that paralleled each other's arrival into the microregion: one population came from the Pannonian Plain on the north, the territory of Starčevo culture, and the other population entered from the Adriatic coast on the south, the territory of Cardium-Impresso culture. Migrations have been traced in overlapping distributions of specific pottery shapes. Starčevo culture was characterized by the altars, three- or four-footed vessels and pottery with incised and painted ornaments and barbotine surface treatment, whereas the pottery of Impresso-Cardium culture was monochrome and had impressed ornaments shaped by the edges of marine shells. In the earliest settlement the complete Neolithic package of domesticated animals (cattle, sheep, goats, and pigs) and the main cultivated cereal crops (emmer and einkorn wheat, field peas, and lentils) was recorded. The earliest radiocarbon date from the site shows the existence of a farming settlement in central Bosnia in about 6230–5990 B.C. (the earliest level at Obre I).

The Middle Neolithic village at Obre I is hypothesized to correlate with the genesis of local Kakanj culture, marked by stylistic changes in pottery: the painted and Cardium-Impresso pottery found at earlier levels disappears, barbotine surface treatment continues, and the use of monochrome ceramic becomes dominant. Rhytons, vessels with four zoomorphic legs supporting a red-painted oval recipient with a large handle fixed to the top of the bowl, replace the altars found at previous levels. Almost identical vessels were found on the Adriatic and Ionian coast, in the Dinaric Alps, and in Thessaly, supporting the idea that rhytons may have been prestige items connected with salt distribution in the Balkans. Evidence indicates that copper was known at this stage of settlement, and the presence of obsidian, probably from Lipari Island, indicates contacts with the central Mediterranean.

The sequential settlement deposit at Obre II was attributed to Late Neolithic Butmir culture. The continuity in the carbon-14 dating sequence and in cultural tradition at Obre has suggested to some researchers that there was a hiatus between Obre I and Obre II. Obre II exhibits a complete disappearance of highly popular pottery forms from the phases represented at Obre I, and the second location offers the sudden appearance of a fine black burnished pottery completely devoid of tempering as well as pottery having a thin red design on black or gray painted ceramics. The sand tempering of the previous period (Obre I) was replaced by the use in the coarser ceramics and for certain polished ware of an intentionally crushed limestone temper. However, the Butmir pottery is characterized by spiral and band-painted and incised ornamental motifs. The most exquisite are globular vases painted with red or black bands and decorated with interconnected spirals, in relief or incised, which are white or red incrusted. Particularly characteristic is the combination of different spiral patterns at Obre II. The heterogeneous stylistic elements and the presence of imports among Obre II artifacts implies intra-Balkan and trans-Adriatic exchange networks and long-distance connections, evidence that may be connected to the change in economy marked by the shift in the composition of the domestic herd toward the less-transhumant animals.

Obre II comprises eight habitation horizons of the Butmir culture embedded in the time span 5310–4910 to 4780–4440 B.C. Architectural remains consisted of solid rectangular aboveground houses; several had apsidal (semicircular) ends and sacrificial structures. Houses were built of massive vertical posts supporting heavy walls of wattle and daub. They were up to 15 meters long, and some were subdivided by an internal clay wall into two rooms. A domed beehive-shaped oven with a clay platform in front and an ash pit, including a pot for collection of ashes, stood by the wall in the middle of the large room. Clusters of clay and wooden containers for storage of grain, together with a variety of pots and loom weights, were also found in the rooms.

Twenty-five human burials were identified within the habitation area at Obre I and II; only two of those were adults. Most of the infant burials were of stillbirths. Infants and children were buried in front of houses in a contracted position; none of their burials showed any remains of a pit, and there were no grave goods found at children's burial places. The adults, by contrast, were buried in a contracted position (crouched body rests on the left [most commonly] or right side) and were accompanied by grave goods such as painted pottery, an altar, and personal ornaments. A small stone mound marked one of the adult burials.

See also **The Farming Frontier on the Southern Steppes** (*vol. 1, part 3*).

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THE FARMING FRONTIER ON THE SOUTHERN STEPPES

North of the Black and Caspian Seas lies the Pontic-Caspian grassland, the western tongue of the vast steppe that covers the center of the Eurasian continent. North of the grassland was, eight thousand years ago, an equally vast forest. The precise location of the border between the forest and the steppe has shifted with changes in the world's climate, but since the end of the last Ice Age the lowland basins of the Black and Caspian Seas have been arid grasslands or deserts fringed on the north by upland forests. The transition zone, the forest-steppe, has always been among the most productive and pleasant environments in Europe because of its mixture of forest and meadow, sufficient rain but not too much. Both hunter-gatherers and early farmers were attracted to the forest-steppe. They came face to face in the forest-steppe of the East Carpathian piedmont, northwest of the Black Sea, about 5800–5600 B.C.

It was a meeting that utterly changed both ways of life because it provided the means for humanity to profit from the Eurasian grasslands: domesticated cattle and sheep. Cattle and sheep were grass processors. They soon spread into plains that formerly were grazed only by wild horses and antelope, and they converted grass into leather, milk, yogurt, cheese, meat, marrow, and bone—the foundation for life and wealth. The steppe region began to witness the emergence of societies committed to stockbreeding while the forest-steppe northwest of the Black Sea remained the home of increasingly prosperous and productive mixed farmers. An economic-cultural frontier formed between them. It remained the most clearly defined and contrastive cultural frontier in prehistoric Europe for about twenty-three hundred years, 5600–3300 B.C.

FIRST FARMERS: THE CRIŞ CULTURE

The people who brought the first domesticated cattle and sheep into the Pontic-Caspian region were immigrants who belonged to the Criş culture. They were the leading edge of a broad movement that had snaked northward out of Greece and Macedonia into the temperate forests of the Balkans and the Carpathian Basin beginning around 6300 B.C. Small groups of Criş farmers moved into the mountains of Transylvania and spilled over the eastern Carpathian ridges into the steep valleys of the Seret and Prut Rivers about 5800 B.C. Others moved up the Seret and Prut from the Lower Danube Valley, avoiding the arid steppe lowlands near the Black Sea, where rainfall agriculture was impossible. In the East Carpathian piedmont these groups created a northern and a southern variant of the East Carpathian Criş culture, which survived until about 5300–5100 B.C.

Archaeologists have found at least thirty Criş settlement sites in the East Carpathian piedmont. Most were built on the second terrace of a river, overlooking the floodplain; some were on steep-sided promontories (Suceava) or high ridges (Sakarova I). The more substantial homes had sunken floors and contained a kitchen area with a domed clay oven; lighter structures were built on the surface and had an open fire in the center of the single room. Settlements consisted of a few families living in perhaps three to ten simple dwellings, surrounded by agricultural fields, gardens, plum orchards and pastures for the animals. Ceramic vessels were handmade by the coiling method, and included a variety of fine wares with polished red-brown surfaces—tureens, round-bodied jars, bowls with carinated sides, and cups on pedestals. Two copper beads were found at the Criş site of Selishte, dated 5700–5500 B.C. (6830±100 B.P.), among the oldest metal artifacts in Europe. No Criş cemeteries are known nor is it known what the Criş ordinarily did to commemorate their dead.

The clay used to make Criş wall plaster and pottery contains impressions of seeds and chaff from cultivated wheat (emmer, einkorn, and spelt varieties), barley, and peas. Emmer and einkorn made up 70 percent of the identified wheats from the Criş site of Sakarovka I, and wheat composed two thirds of the identified grains. Wheat and peas were not native to southeastern Europe—like sheep, they were exotics, domesticated in the Near East, carried to Greece by immigrant farmers, and propagated through Europe from Greece. Flints included many blades 5 to 10 centimeters in length with edges showing "sickle gloss" from cutting grain; the blades were slotted into curved antler sickle handles. Most of the meat in the diet was from cattle and pigs, with red deer a close third, followed by some domesticated sheep—a distribution of species that suggests a largely forested environment.

The Criş people were different from the local foragers in many ways: they made different kinds of flint tools (large blade tools versus the foragers' microlithic tools); they lived in different places (on the better-drained soils of the second terrace, convenient for farming, while foragers preferred the floodplain, convenient for fishing); their polished stone axes were different; their economy was different; their pottery was quite different; and their tastes were different. Criş pioneers ate mutton, the meat of an animal (*Ovis aries*), foreign to southeastern Europe. The local foragers never acquired that taste. Some archaeologists have speculated that the East Carpathian Criş culture might have been an acculturated population of local foragers who had adopted a farming economy, rather than immigrant pioneers from the Danube Valley. This is unlikely given the numerous similarities in material culture to the Danubian Criş culture and the differences from the local foragers. But in any case, no one believes that the Criş people were genetically "pure," whatever that means. The important point is that the people who lived in Criş villages were *culturally* Criş in the material signs of their identity, and therefore almost certainly in nonmaterial signs like language as well. And the Criş *culture* came, without any doubt, from the Danube Valley. Territorially, Criş farmers never penetrated east of the Prut-Dniester watershed. East of the Prut a substantial population of foragers became the filter through which stockbreeding economies were introduced to Pontic-Caspian societies farther to the east.

FORAGERS BECOME FARMERS: THE BUG-DNIESTER CULTURE

At the Soroki II site in the forest-steppe zone of the Dniester Valley, a camp of Mesolithic foragers, without pottery, was covered by a Neolithic level, with pottery. The Mesolithic level (2) was dated about 6500–6200 B.C., and the Neolithic level (1) about 5700–5500 B.C. Some of the ceramic vessels in the top layer looked very much like Criş pots—round-bodied, narrow-mouthed pots on a ring base. But they were made locally, using clay tempered with sand and chopped vegetal matter, and most of the pots in this level were quite different from Criş in shape and decoration. The clay contained seed imprints of cultivated cereals—emmer and einkorn, the same suite of cereals cultivated by the Criş culture. Level 1 also yielded bones of domesticated cattle and pigs, apparently borrowed like the imported wheat from the Criş culture. In the time interval between levels 2 and 1 Criş farmers appeared in the hills to the west, and the foragers of the Dniester Valley began to emulate them, making pottery, cultivating domesticated cereals, and keeping domesticated cattle and pigs. In the South Bug Valley, east of the Dniester, there are many sites with similar flint tools and ceramics. Together, the Dniester and South Bug sites define the Bug-Dniester culture, the earliest native Neolithic culture northwest of the Black Sea. It began around 5700–5600 B.C. and survived until about 5100–4900 B.C.

The Bug-Dniester foragers borrowed domesticated cattle and pigs and cultivated cereals almost as soon as Criş farmers made them available. Criş ceramic vessel shapes, if not potters' methods, were copied as well. Why? What was so attractive about the Criş diet and even the pottery vessels in which it was served? There are three possibilities. One is that the pre-Neolithic Bug-Dniester foragers were running out of good hunting and fishing grounds and were already looking for ways to increase the amount of food that could be harvested within their hunting territories—an economic explanation. But forager population densities do not seem to have been so high, and the abundant tree pollen in Criş-period soils indicates that the Criş pioneers had little impact on the forest around them, so their arrival did not greatly reduce deer populations. The second possibility is that the foragers were impressed by the continuous abundance of food available for feasting and festivals among Criş farmers. Socially ambitious foragers might have begun to cultivate gardens and raise cattle to sponsor similar public feasts among their own people, even making serving bowls like those used in Criş villages—a political and ideological explanation, and one that also explains why Criş pots were copied. The third possibility is that there was some kind of natural disaster in or near the Bug-Dniester region that suddenly created a crisis in both the ecological and political arenas, pushing the old foraging system to its limits at just the moment when Criş farmers arrived. That sounds highly improbable, but curiously enough, an enormous natural disaster might have shocked the region, possibly at about the right time.

The geologists William Ryan and Walter Pitman have argued that the Black Sea was just a large brackish lake with a surface level about 100 meters beneath that of the Aegean Sea until sometime between about 6300–5600 B.C. At some point between those dates the saltwater of the Aegean Sea broke through the Bosporus Strait, previously just a long bay open to the Aegean, and poured into the Black Sea basin. If the breakthrough was sudden it would have created a fifty-year-long waterfall twelve times bigger at its peak than Niagara, until the Black Sea rose to the level of the Aegean. Some geologists think the breakthrough might have happened earlier or developed more gradually, although radiocarbon dates from the bottom of the Black Sea do suggest that its salinity and shell species changed between about 6300 B.C. (with Caspian-type shells) and 5600 B.C. (with Aegean-type shells). Before the breakthrough, what is now the northern part of the Black Sea would have been a broad grassy plain bisected by the Crimean Mountains and crossed by large rivers. If this plain was submerged suddenly about 5800–5600 B.C., the foragers who lived there would have retreated into the hills, creating a crisis that perhaps led to the adoption of a new economy.

The Bug-Dniester people adopted only selected parts of the Criş cultural pattern. In Criş settlements domesticated animals contributed 70 to 80 percent of the bones in kitchen middens. In Bug-Dniester settlements in the Dniester Valley, the earliest Neolithic levels contained about 24 percent domesticated animal bones, while middle-phase sites had about 44 percent and late sites 55 percent domesticated animals. Domesticated animals exceeded hunted wild game only in the latest phase. Bug-Dniester cooks did not offer mutton, and Bug-Dniester bakers initially did not use Criş-style saddle querns to grind their grain; instead they used small, rhomboidal stone mortars of a local Late Mesolithic style. They preferred their own chipped flint ax types to the smaller polished stone Criş axes. Their smaller chipped flint tools were also different. Their pottery was quite distinctive. The "local" look of most Bug-Dniester pottery might reflect the influence of indigenous Pontic-Caspian forager ceramic traditions of Dnieper-Donets I type that had developed about 6000–5800 B.C. in the Dnieper Valley, to the east.

THE LINEAR POTTERY AND CUCUTENI-TRIPOLYE CULTURES

During 5300–5200 B.C. a new farming culture, the Linear Pottery culture, moved into the East Carpathian piedmont from southern Poland, gradually replacing the Criş culture. The cultural frontier between Linear Pottery and late Bug-Dniester did not disappear—it just moved a little to the east, from the Prut to the Dniester. Linear Pottery sherds were found in late Bug-Dniester sites (Soroki V in the Dniester, Basikov Ostrov in the South Bug Valley) and Bug-Dniester sherds at the Linear Pottery site of Novi Ruseşti. The frontier was porous to people—no fortifications or other signs of conflict are known, and the sherd exchanges imply direct contact—but the cultures on either side remained quite different.

Around 5100–4900 B.C. a new kind of material-culture complex appeared in the East Carpathian piedmont: the Cucuteni-Tripolye culture (called Cucuteni in Soviet Romania and Tripolye in Ukraine, but a single prehistoric complex). Most of the new customs that defined the Cucuteni-Tripolye culture (house styles, pottery styles, and domestic rituals centered on female figurines) were copied from the Boian culture of the Lower Danube Valley, and indicate a strong new connection with that region. One result was a growing trade in copper bracelets, rings, and beads made from Balkan copper. In the Prut Valley, where Criş and Linear Pottery farmers had lived the longest, elm and lime trees, desirable for timber house construction, declined while open fields and meadows expanded. A stable form of village-based intensive farming developed in an increasingly open and cultivated landscape. Tripolye villages spread eastward into the Dniester and South Bug Valleys in today's Ukraine. The Tripolye A town of Mogil'noe IV near Gaivoron, among the first established in the South Bug Valley, had more than one hundred buildings and covered 15 to 20 hectares, with a population of perhaps four hundred to seven hundred. The Bug-Dniester culture finally disappeared. Late Bug-Dniester traditions had little or no visible influence on early Tripolye house types, rituals, or tools—although some of the earliest Tripolye sites in the South Bug Valley (Lugach, Gard 3) display some Bug-Dniester decorative motifs on their ceramics. The frontier between Cucuteni-Tripolye societies and those visibly derived from local Mesolithic forager cultures shifted eastward to the watershed between the South Bug and the Dnieper.

THE DNIEPER-DONETS CULTURE

Many sites in the Dnieper Valley were excavated in the 1950s during dam construction below the Dnieper Rapids. Sites around the rapids such as Igren 8, Pokhili, and Vovchok showed the same sequence of cultures: Mesolithic at the bottom; then an Early Neolithic culture called Surskii with shell-tempered pottery and microlithic flint tools (beginning perhaps around 6200 B.C.); then Dnieper-

Donets phase I (DDI) with comb-impressed and vegetal-tempered pottery (dated perhaps 6000–5400 B.C.); and on top, Dnieper-Donets II (DDII) with sand-tempered pottery with "pricked" or "stabbed" designs and large flint blade tools (dated 5400–4300 B.C.). The shift from hunting and fishing to herding economies occurred in the Dnieper Valley during the DDII period.

DDII is recognized by changes in pottery (larger, more decorated flat-based pots), flint tools (more large blades), cemeteries (the appearance of communal ossuary pits containing up to fifty skulls and fragmentary skeletons, with up to 170 individuals in a cemetery), the first use of metal ornaments (copper and even gold beads, imported through the Tripolye A culture), and the adoption of a new food-production economy. Domesticated cattle, pigs, and now even sheep were raised and eaten. Some DDII flint blades show "sickle gloss," and one impression of a barley seed was found in a DDII clay pot, so there is a little evidence that might suggest cereal cultivation, but the evidence for agriculture is much less convincing than the evidence for stockbreeding. Domesticated cattle (averaging 25.7 percent of bones), imported sheep and goats (averaging 20.2 percent), and (wild?) horses (averaging 12.1 percent) were the dominant food animals at three DDII occupation sites in the Dnieper Valley.

Social hierarchy seems to have emerged at the same time. A few individuals now were buried with rare prestige objects: gold rings, copper ornaments, polished stone maces, and burnished plaques made of boar's tusk. At the cemetery of Mariupol, one male was buried wearing forty tusk plaques sewn to his thighs and shirt, and numerous strings of shell and mother-of-pearl beads. He also had a polished porphyry four-knobbed mace-head, a bull figurine carved from bone, and seven bird-bone tubes. A child, one of the few buried at Mariupol, wore forty-one boar's-tusk plaques and a cap armored with eleven whole boar's tusks. The exceptional wealth of this child, and of others, hints at the inheritance of status. An elite seems to have emerged in the Dnieper-Azov steppes during DDII. It was defined partly by its access to exotic ornaments, including copper; partly by the display of indigenous signals of status (boar's-tusk plaques, polished stone maces); perhaps partly by differences in the treatment of the body after death (exposed, or with burial of only the skull, versus not exposed, with burial of the whole body); and perhaps partly by the possession and public sacrifice of domesticated animals.

THE SPREAD OF STOCKBREEDING

Stockbreeding spread very rapidly across the European steppes, sweeping from the Dnieper-Azov steppes eastward to the Volga-Ural region in one hundred to two hundred years. But then the diffusion came to an equally rapid halt. The cultures to the north, in the forest zone, remained foragers for another 2,500 years. The steppe cultures east of the Urals in northern Kazakhstan also stubbornly rejected stockbreeding for equally as long, until about 2500 B.C. An economic-cultural frontier emerged around 5000 B.C. at the forest-steppe boundary in the north and along the Ural River in the east, separating societies that owned animals from those that hunted them.

Domesticated animals were a new kind of wealth. They could be owned, stolen, traded, and offered as gifts or sacrifices. But the adoption of stockbreeding—and perhaps of some cereal cultivation, in the Dnieper Valley if not in the Volga—had different effects in different places. The region between the Dnieper Rapids and the Sea of Azov, the heart of DDII territory, had funeral rituals and pottery types different from those found on the middle Volga River between Saratov and Samara, the heart of the Khvalynsk culture. There was another kind of response in the drier southeastern steppes between the lower Don and the lower Volga, where the Orlovka culture used copper and kept some domesticated animals but did not have elaborate funerals or even cemeteries. And yet another response developed at the moister northern edge of the steppes, in the Samara River valley, where the Samara culture had its own distinct ceramic styles, cemeteries, and burial posture. One of the interesting things about the period from 5000 to 4500 B.C. is the variety of local adaptations to stockbreeding across the different river valleys of the Pontic-Caspian steppes.

Still, a few things were shared across large distances. The veneer of community appeared most clearly in a shared set of markers among local elites: copper beads and bracelets, boar's-tusk ornaments, polished stone maces, and, curiously, bird-bone tubes (found in rich graves at both Mariupol and Khvalynsk). Boar's-tusk plaques of exactly the same type were found at the DDII cemetery of Yasinovatka and at S'yezzhe in the Samara Valley, about 400 kilometers to the east—as far as Rome is from Paris. Copper was widespread. The Khvalynsk I cemetery on the Volga, dated 5000–4500 B.C., contained 34 copper ornaments concentrated in 11 of 158 graves: copper wire rings, small copper beads, and round-sectioned spiral hoops. At least some of the copper came from Balkan Mountain ores, mined in the region of modern Bulgaria, probably traded through the Tripolye A culture. The polished stone mace was made in different forms in the Dnieper Valley (Nikol'skoye), the middle Volga (Khvalynsk), and the North Caspian region (Varfolomievka). But a mace is a weapon, and its wide adoption as a symbol of status suggests a change in the politics of power. Between 5000–4500 B.C. a new kind of social hierarchy based on the ownership of cattle and sheep (and possibly horses) became established in the Pontic-Caspian steppes.

Some have speculated that the first domesticated animals and copper in the western steppes could have been acquired from the cultures of the Caucasus Mountains or from Central Asia, rather than from the west as described here. These theories date from the 1950s, when a Central Asian source was popular, or the 1970s, when a Caucasian source was considered. But radiocarbon dates from the 1980s and 1990s show that the Eneolithic of the European steppes began much earlier than was previously thought, around 5400–5200 B.C. Although there were Neolithic and Eneolithic cultures in southern Central Asia (Djeitun) and in the southern Caucasus valleys (Shulaveri) at this date, no bridge or cultural connection linked these distant farming communities to the European steppes. Yet contact between Criş–Linear Pottery farmers and foragers of the Dnieper-Dniester zone is well documented archaeologically between 5800–5200 B.C., and trace elements in the copper from Khvalynsk suggest a Balkan source. Also, the cultivated cereals that appeared in Bug-Dniester sites and later in the Pontic-Caspian steppe river valleys composed a Balkan-Danubian crop suite (emphasizing emmer wheat and naked barley), not a Caucasian crop suite (emphasizing bread wheat, *T. aestivum*). A western source seemed therefore more likely based on data from the late twentieth century.

Wool sheep were introduced to the Eurasian steppes well after the period described here. Sheep covered with wool were mutants, bred for that trait, and it seems likely that they first appeared in Mesopotamia about 4000 B.C. The earliest direct evidence for woolen fabrics in the steppes or steppe borderlands is from about 3000 B.C., although wool sheep may have been present earlier. So the stockbreeding system described here was pre-wool—the only textiles were linens, made from flax. Wool sheep gave the steppe people textiles that shed water, took dyes very well, and could be used for tents, clothing, and trade goods. The age of wool quickly also became the age of bronze weapons, wagons, and copper mines in the steppes, a combination of commodities and technologies that would make steppe societies truly wealthy for the first time after about 3000 B.C. The social and economic foundation for this later wealth was established when Criş farmers appeared in the East Carpathian piedmont about 5800 B.C.

See also **Transition to Farming in the Balkans** (*vol. 1, part 3*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Domestication of the Horse** (*vol. 1, part 4*).

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DAVID W. ANTHONY

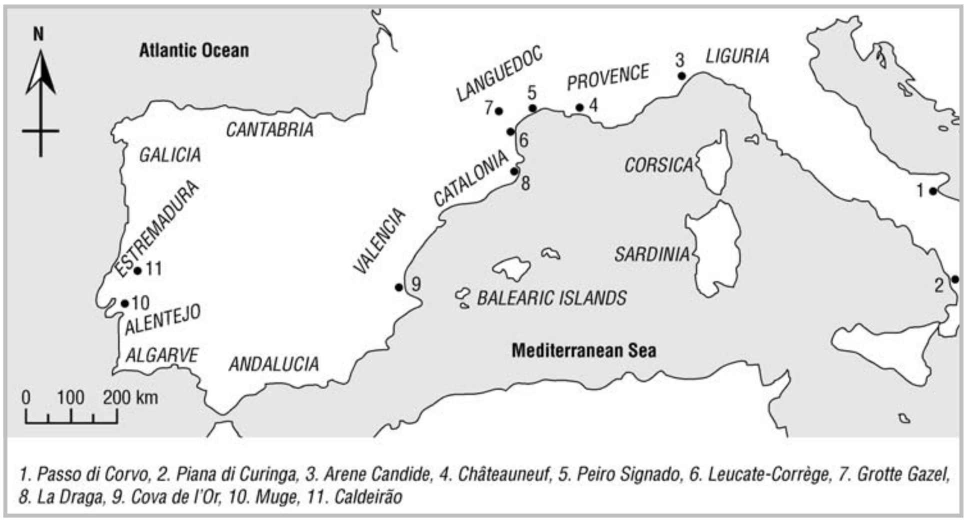
SPREAD OF AGRICULTURE WESTWARD ACROSS THE MEDITERRANEAN

FOLLOWED BY FEATURE ESSAYS ON:

The beginnings of agriculture in the western part of the Mediterranean basin (which includes Italy, southern France, and Spain as well as major islands, such as Sardinia, Corsica, the Balearics, and, traditionally, Portugal) are associated archaeologically with the start of the Neolithic period. The earliest agricultural sites are known to have appeared across the western Mediterranean around 5500 B.C. The environment at this time was not significantly different from today's, the Ice Age having ended c. 12,000 B.C., and the climate having gradually warmed to roughly its present state. It was a typical Mediterranean climate, characterized by hot, dry summers and wet winters. The western Mediterranean was populated largely by mixed forests of oak, lime, and elm in the lower altitudes, changing to fir at higher elevations. The current open, brushy landscape characteristic of the modern Mediterranean is the result of erosion from millennia of agriculture, which did not really take hold for a thousand years after its initial appearance. Deer, ibex, and boar roamed the region and were hunted widely.

The western Mediterranean is replete with limestone caves, as a result of the uplift of Jurassic and Cretaceous geological beds. It also has an abundance of clay deposits (important for making pottery), with rich alluvial plains good for raising crops, separated by relatively dry uplands for hunting. With the melting of the Pleistocene glaciers, the sea levels in the western Mediterranean gradually began to rise. Flooded river valleys became rich coastal estuaries brimming with shellfish, fish, and waterfowl. Many Mesolithic (the last prehistoric period before the arrival of agriculture) archaeological sites are from estuarine shell middens. Middens are large piles of shells that sometimes contain artifacts and even burials left by prehistoric populations. Some of the largest in Europe are the Portuguese middens near the town of Muge in the Tagus valley. The rise in sea level had one additional consequence—it submerged sites. The sea level during the Early Neolithic was about 10 meters lower than it is now. A very few early coastal agricultural sites, such as Leucate-Corrège, just north of Perpignan in France, were discovered by dredging operations, but most undoubtedly have been lost.

After a century of excavation and study, we have a basic framework of knowledge regarding the spread of agriculture in the western Mediterranean. Identified sites tend to be primarily caves, although that probably stems from the fact that caves are visible features in the landscape (unlike open sites,



Selected sites in the western Mediterranean. ADAPTED FROM BARNETT IN PRICE 2000.

which are evident mostly by their artifact scatters). Pre-agricultural Mesolithic sites other than middens are mainly caves or rock shelters, where flaked stone tools typically are found with butchered remains of deer and boar. The tools are quite small, sometimes less than a centimeter in length, and geometrically shaped, with transverse arrowheads (the business end being a blade edge that cuts into the target). It is thought that the Mesolithic people who created these sites lived in nuclear family units. They tended to disperse to the highlands to hunt in the summer and then aggregate along the coasts for the winter.

These flaked stone tool forms did not disappear during the Neolithic, and it seems that many Mesolithic sites continued to be inhabited into the Early Neolithic at this critical transition phase. The Early Neolithic material complex most notably contains pottery, along with the earliest groundstone axes and other groundstone objects, such as bracelets. There is direct evidence of domesticated forms of wheat and barley as well as domesticated sheep. The appearance of sheep is confirmed by the presence in site deposits of their bones, which can be distinguished from remains of wild species, such as ibex. Evidence of domesticated cereals has been recovered as carbonized remains in ancient fire pits as well as the occasional grain impression in the wall of an Early Neolithic pot.

Excavation of numerous classic cave sites has helped archaeologists date and define the material culture of these first agricultural populations. The ceramics are the most distinctive and informative. They were fired at low temperatures, without a kiln, and have distinct patterns of manufacture and decoration. A particular type of stamp-impressed early pottery, termed Impresso, was first identified from Arene Candide (5800–5300 B.C.) in Ligurian Italy. Other key cave sites with the more classic Cardial pottery are in the west, at Châteauneuf-les-Martigues near Marseilles (5750–5500 B.C.), La Grotte Gazel on the southern flank of the French Montagne Noir (4900–4830 B.C.), Cova de l'Or in Valencian Spain (5900–5300 B.C.), and Caldeirão in central Portugal (5900–5600 B.C.).

The earliest of early pottery, sometimes termed Le Vrai Cardial (true Cardial) is well made and highly burnished, and it is distributed broadly across the western Mediterranean; it may have been a trade good. Although only simple pyrotechnic methods were available to fire this pottery, which would have affected its hardness and durability, a great deal of labor went into manufacturing and decorating each vessel. The decorative style of these vessels is uniform, with a standard technological "recipe" of manufacture, showing a shared manufacturing tradition. Most important, many of these vessels have been carried over long distances. Later Cardial vessels have more regional styles, are less well made and decorated, and appear not to have been carried over short distances or used locally.

In addition to cave sites, some open-air sites have been excavated, indicating a diversity of settle-

Fig. 1. Example of Cardial-impressed pottery from eastern Spain, made by pressing the edge of the shell of the mussel *Cardium edule* into the wet clay. MUSEU ARQUEOLOGIC MUNICIPAL CAMIL VISEDO MOLTO (ALCOI, ALICANTE/ESPANA). REPRODUCED BY PERMISSION.

ment, typically in small villages. In Italy, Passo di Corvo, a walled settlement, and Piana di Curinga, a village of wattle-and-daub huts, represent two such sites. In France the site of Peiro Signado sits on a hilltop near the coast, and Leucate-Corrège was a coastal site now submerged. The site of La Draga in Spain has evidence of wooden walkways similar to the classic Neolithic lake dwellings of Switzerland.

WHY DID AGRICULTURE SPREAD?

Agriculture appears to have spread through this area fairly quickly during the sixth millennium B.C. With the help of radiocarbon dating, it is possible to trace the rate of agricultural dispersal in the western Mediterranean. In 1971 Albert Ammerman and Luigi Cavalli-Sforza proposed a "wave of advance" of early agriculture of approximately 5 kilometers a year for this area, much faster than the rate for other parts of Europe. João Zilhão, a Portuguese prehistorian, later reexamined the dates for the western Mediterranean area and proposed that the rate was closer to 10 kilometers a year. This would mean that agricultural societies spread from Italy to Portugal in just one hundred years.

There is good information about the possible mechanisms for the spread of agriculture in the Mediterranean basin. Boats have been discovered at Mesolithic sites, so people at this time could have traveled faster and over longer distances than by foot on land. Moreover, the landscape was not empty. The spread of agriculture could have been either helped or hindered by the existence of the pre-agricultural populations that already inhabited the Mediterranean estuaries and caves. Finally, the earliest agricultural communities in this area may not have been sedentary farming villages but rather communities using a combination of domesticated and wild foods. The arrival of agriculture in the western Mediterranean area certainly was accompanied by a period of rapid cultural and economic change that formed the foundation for subsequent prehistoric developments.

Theories of the spread of agriculture across the western Mediterranean have evolved from "ages" to "revolutions" and then to models of human economic and social behavior. For the most part, pre-agriculturalists are thought to have had an economy based on the hunting of animals and fishes and the gathering of shellfish, berries, seeds, roots, and other edible plants. This lifestyle is the basis for the term "hunter-gatherers." Also known as "foragers," they depended on the collection of foods from the natural environment. Early agriculturalists are seen as subsistence farmers or pastoralists, not highly productive but able to guard against difficult times by storing surplus or keeping herds. Still, the basic question concerning the adoption of farming by gathering societies or the migration of agricultural villagers persists.

The most promising of the models of the transition to agriculture build upon the concept of frontiers—zones that lie between groups with different economies or ethnic territories, across which people, goods, ideas, innovations, and conflicts pass. Frontiers where the economic strategies are mismatched, for example, between agriculturalists and hunter-gatherers, are the ones likely to move as one strategy replaces the other. Thus, frontier models seem to explain the agricultural transition in the western Mediterranean and elsewhere.

The Ammerman and Cavalli-Sforza "wave of advance" model mentioned earlier was one of the first frontier models, and the most basic. As a population-diffusion (migration) model, it proposed that agricultural settlements spread outward at a regular rate in a wave, similarly to a ripple moving across the surface of water. It was easy to model mathematically, yet could not accommodate important variables. The types of agriculture or hunting and gathering being practiced on either side of the agricultural frontier could easily affect the rate of agricultural spread as well as possible cultural resistance or receptivity. Social factors would have determined whether these groups interacted peacefully or through conflict. Geography, environment, climate, and transportation (such as boats) also could have influenced the rate of spread. Obviously, some of these factors contributed to the five- to tenfold inaccuracy of this model's proposed dispersal rate in the Mediterranean.

Given the few data we have about these transitional agricultural societies, it is unlikely that any mathematical model, no matter how complex, can ever be tested. Archaeologists may never excavate even 1 percent of all the sites inhabited during this period. Most of the materials made and used were organic and have long since decayed and disappeared. Moreover, it is difficult to reconstruct the ways in which they might have been used by prehistoric peoples. Radiocarbon dating, the best technique we have for identifying contemporaneous sites, provides a statistical estimation accurate to about one hundred years at 64 percent likelihood. That time span represents roughly five generations of habitation, which makes it very difficult to relate to real people and the activities that produced particular sites.

There are alternate ways to improve our understanding of these sites. Researchers have used frontier descriptions as models to understand how agriculture might have spread across the western Mediterranean. This method has allowed archaeologists to incorporate more variables or even to lay predictive patterns over an actual rather than a theoretical landscape. By looking at real situations and the large-scale impacts of small-scale societies, we can gain a better idea of the potential underlying forces.

These ethnographic models derive mostly from studies of present-day small scale societies (band- or village-level societies), where it is assumed that such societies are more traditional and therefore somewhat like our prehistoric ancestors. These models have been used extensively to better understand how foragers and farmers might have interacted in the past, as agricultural economies were established. Exemplars of prestige exchange are based on studies of potlatching among populations along the northwest coast of America or on Polynesian prestige trade rings. Ideas about simple hunting-and-gathering groups come from studies of migratory groups in the Kalahari Desert of southern Africa and from interior Australia. Examples of aggressive agricultural populations similarly come from the study of twentieth-century Pacific societies or village agriculturalists of South America and Africa, whereas notions of simple farmers are taken from studies of "subsistence" farmers of Africa and elsewhere.

The nature of the societies on either side of the agricultural frontier greatly influenced the rapid transition in the western Mediterranean. Some scholars have viewed pre-agricultural populations as relatively simple family-sized groups, whereas others have seen them as more complex societies with exchange networks, driven by competition for prestige. Similarly, on the agricultural side, cultures can be viewed either as very simple farmers not much better off than their forager neighbors or as true village agriculturalists. None of these four options ideally captures what it must have been like in the western Mediterranean six thousand years ago, but it is a good start and one based on ethnographic studies of real peoples.

The notion that simple subsistence farmers made contact with simple gathering groups cannot account for the rapid agricultural spread across the Mediterranean, as there is no predominant inequality, such as prestige or settled agriculture, to move the frontier. Complex foragers or complex agriculturalists could have effected this change. Brian Hayden has developed a model for the emergence of agriculture through prestige competition. His theory is that among some foraging societies there was competition for status. Agricultural products represent storable wealth as well as a potentially greater food supply. With prestige competition among foragers, power was accumulated through prestigious objects or through obligations. Agricultural items, such as domesticated animals, would have been an innovative and therefore prestigious object in such a setting. They could have been rapidly dispersed through such a culture, with agricultural dependence as an unintended consequence of the desire to accumulate prestige.

In 1986 Marek Zvelebil, an archaeologist at the University of Sheffield, presented the concept of adoption as the *availability* model for the transition from foraging to farming. In this model there are three zones across a frontier between agriculturalists and foragers. First, in an availability zone, where domestic plants and animals as well as pottery and other new items became available to foragers by trade, but these items did not really affect the overall economy of the group. A desire for prestige or power would have driven individuals to invest in these innovations. In subsequent phases, farming developed as an alternative economic strategy alongside foraging. Last, settled farming consolidated as the principal economic strategy.

How does the evidence in the western Mediterranean support this theory? The availability model proposes stratified Mesolithic populations with a network of trade in prestige goods. It predicts the initial appearance of domesticated plants and animals within a predominantly foraging economy. It does not require early settled agricultural villages.

Evidence of pre-agricultural trade is slim. There are few signs of the movement of material goods during the Mesolithic, but there also is little recoverable and traceable material. The stone sources used to make flaked tools in the latest Mesolithic times come from more local regions than in earlier periods, so they probably were not exchanged. It is possible that there were valued exchange items made of organic materials that do not survive. From the earliest Neolithic period, however, there is evidence of trade. It has been shown that the earliest pottery, Cardial, was transported long distances, as were the earliest groundstone axes. The exchange of obsidian, a volcanic glass used to make very distinct flaked tools, also began across the Mediterranean at this time.

In terms of economy, there is evidence from many Early Neolithic sites that wild species initially predominated among the deposits. Bones of wild deer and boar at first outnumbered those of domesticated sheep at many Early Neolithic cave sites. The proportions of wild to domesticated animals gradually changed over a period of hundreds of years, until domesticated animals came to dominate the archaeological assemblages. The animal bones recovered from Early Neolithic coastal sites, such as Leucate-Corrège, include the remains of species hunted at different times of the year, indicating that there were permanent settlements at this time that were not necessarily agricultural villages.

The results are mixed in terms of making the case for adoption. There is no good evidence of trade before the first agricultural sites, but trade of objects clearly is present at these Early Neolithic sites and is quite uniform across the western Mediterranean. Still, there might have been trade in organic materials, such as furs or meat, or in social obligations, such as labor. The availability model for agricultural adoption correctly predicts the proportions of wild to domesticated animals. With boats, it would have been possible for these innovations to spread rapidly enough to get from Italy to Portugal in one hundred years.

Equally, village agriculturalists also might have migrated rapidly across the Mediterranean, even in a landscape already occupied by Mesolithic foragers. Zilhão has proposed a model of *enclave colonization*. Enclave colonization involves resettlement by small seafaring groups of agriculturalists across the western Mediterranean. It is described as the budding off of small groups to found new agricultural colonies. This budding off might have been driven by offspring required to homestead enclaves as part of their entry into adulthood or through inheritance or as part of planned enterprises. Upon arrival, they would have assimilated or displaced local foragers, despite their smaller numbers, due to the inherent superiority of a production economy. This agricultural economy would have provided a stable surplus of food that would have allowed their populations to grow and to trade successfully with local foragers.

How do the data support enclave colonization? This model predicts rapid spread through the establishment of far-flung settled villages. Because these societies initially were smaller and more isolated than the resident Mesolithic societies, they might have had to settle in areas that were undesirable or relatively unused by resident foragers or to have been readily adopted by the foraging groups. This theory also requires that a "package" of domesticated plants and animals and new technologies, such as pottery and groundstone axes, spread as a uniform and interdependent economic strategy.

Certainly, it seems as if agricultural items spread across the western Mediterranean at almost the same time, insofar as the relative inaccuracies of radiocarbon dating permit us to say. This is in contrast to a more piecemeal adoption of innovations that might have taken place had they been brought across the Mediterranean as unlinked prestige trade items. Zilhão also has identified upland areas in regions of the western Mediterranean, particularly in the Estremadura of central Portugal, where there appears to have been little or no Mesolithic habitation, yet a strong Early Neolithic occupation. Just to the south, in the Tagus estuary, are the remains of some of the largest Mesolithic shell middens in Europe. This area could have been a region leaped over and not colonized by agricultural enclaves.

In terms of economy, there is no strong evidence of a dramatic shift to full-scale agriculture. As mentioned earlier, most Early Neolithic sites are dominated by the bones of wild, not domesticated, animals. It is possible, of course, that these initial agriculturalists ate mostly wild animals because they traded locally with foragers or that they added to their food supplies with regular hunting, as do many modern peoples.

CONCLUSION

How can we distinguish what really went on when agriculture first spread across the western Mediterranean? Neither adoption nor migration models seem to single-handedly match up with the thin amount of information we have collected. Mesolithic foragers could not have traded for agricultural goods without moving, and early agriculturalists could not have moved without coming in contact with whomever was there already. There are tantalizing bits of evidence, such as the rapid spread of domesticated plants and animals and new technologies like pottery. There also is evidence of the birth or rapid expansion of trade routes at this time. Still, there is the persistence of flaked stone tool traditions, habitation, and economy across the transition. The models we are using, based on modern examples, will have to expand beyond the simple one of migration versus adoption.

Zvelebil has described more flexible options that will provide a good testing ground. These include individual frontier mobility (spread through kinship-based exchanges of individuals or small groups), leapfrog colonization (highly selective colonization by seafaring peoples), and infiltration (gradual penetration by groups that assume a subordinate political position and perform specialized tasks). As we broaden our perspectives and find ways to evaluate these models, we will come closer to understanding what it was like at the moment when the first inklings of the foundations of European civilization spread across the western Mediterranean.

See also **Muge Shell Middens** (*vol. 1, part 2*). **Caldeirão Cave** (*vol. 1, part 3*).

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ARENE CANDIDE

Arene Candide is a spacious and pleasant cave in Liguria in northwestern Italy directly overlooking the Mediterranean, midway between Genoa and the

French border. The opening is in a cliff face 90 meters above sea level. Arene Candide means "white sands," referring to a sand dune that once lay against the cliff (which was quarried during the twentieth century). The dune probably never provided access to the cave, however, which could be approached only by a path from above. The topography is steep; even at the height of the last glacial period, when sea level was more than 100 meters lower than it is now, the cave was only a few kilometers from the sea.

The cave has seen excavation since the nineteenth century, but most information comes from two twentieth-century campaigns. Luigi Bernabò Brea and Luigi Cardini carried out a classic excavation in 1940–1942, continuing in 1948–1950. Unusually for their time, they excavated by stratigraphic layers rather than by arbitrary levels, and they used screening to recover small objects. Many samples of various types of material (among them charcoal and shells) also were taken. The findings of these excavations were published in part by the excavators. Full publication of the material by a team of specialists was led by Roberto Maggi. A second major excavation was undertaken by Santo Tinè in 1972–1977, which also has been published.

The excavations revealed many stratigraphic layers extending into the Pleistocene. Most of the available material is Neolithic, although Cardini excavated terminal Pleistocene deposits. In 1942 a sondage, a narrow test pit into the deeper layers, was excavated into the lower layers. The bottom of the cave was never reached, but on 1 May 1942 a spectacular find was made: an Upper Palaeolithic burial belonging to the Gravettian culture. The skeleton was of a young male adult, nicknamed *il Principe* (the prince) because of his rich grave goods. These items comprised three decorated objects made of moose antler, a long flint blade, and hundreds of snail shells that probably were used to decorate a hat (which has decayed). The skeleton has been radiocarbon dated to c. 24,000–23,000 B.P. (c. 22,000–21,000 B.C.). Even more significant, analysis of carbon isotopes in his bones (which reveal diet because seafood contains more carbon 13 than other foods) shows that 20 to 25 percent of his diet was marine foods—a reflection of the short distance to the seashore in his day.

Later in the Pleistocene there was substantial Epigravettian occupation in the period 13,000–11,000 B.P. (11,000–9000 B.C.). At the start of this period the cave was used for burials. Some eighteen individuals were excavated, making this Europe's largest Pleistocene cemetery. The grave goods were rich. There was much red ochre (and several ochre grinders) as well as red deer canines, perforated pebbles and shells, beaver mandibles, and skeletons of corncrakes and choughs (small birds in the crane and crow families, respectively). Most common were tail vertebrae from red squirrels; perhaps squirrel tails were stitched onto clothing.

At the start of the Holocene the site was abandoned. There are few traces of Mesolithic settlement anywhere in Liguria. As a result, when the cave was reoccupied at the start of the Neolithic, one can be sure that the population had immigrated—perhaps from somewhere along the Italian coast to the southeast. The earliest agricultural immigrants arrived around 5700–5600 B.C., based on a direct date from a grain of barley. These people were makers of Impresso pottery, so-called because of its impressed decoration; over about the next two centuries this style evolved into the classic Cardial style, decorated with impressions of the edges of cockle (or *Cardium*) shells. In addition to cereals and perhaps pulses, the farmers kept domestic cattle and sheep; the latter may have been milked, which would be a very early example of dairying. Goats were apparently absent until the Middle Neolithic. There may have been wild pigs, but most of the meat came from domestic stock.

Cardial pottery and agriculture spread very rapidly along the coasts of France, Spain, and southern Portugal. How this was accomplished is debated. Some researchers argue that local Mesolithic hunter-fishers played a crucial role and others that Neolithic immigrants were responsible. Arene Candide lies near the start of the Cardial expansion, and as already seen, agriculture must have reached the site via an immigration; this may support the immigrant Neolithic argument elsewhere in the western Mediterranean.

The Early Neolithic at Arene Candide continued until about 4900–4700 B.C. Occupation during this period was not particularly intensive and may have been intermittent or seasonal. Contacts with coastal communities to the west are suggested by small amounts of flint from southern France and also by the importation of large pottery vessels made elsewhere and imported as finished objects. These vessels probably were too large to carry overland, given the steep topography, and might have been carried by boat.

The start of the Middle Neolithic is marked by an abrupt transition to *bocca quadrata* (square-mouth) pottery. Much more archaeological material is found for this time period, and the cave by then probably was a permanently occupied base. For the first time, there was contact across the Ligurian Mountains with the interior of northern Italy: some 12 percent of the flint was imported from an Alpine source. There is evidence of many domestic activities. Cereal pollen is common, and the numerous querns suggest that it was ground inside the cave. Animals were stalled inside the cave, too; soil micromorphology (the microscopic analysis of soil particles) shows that the animals' bedding was burned from time to time. This bedding was made of plant material, including a species of heather, represented by its pollen and charcoal.

The Late Neolithic started just before 4000 B.C., and during this period there was a diminution of occupational intensity. The cultural transition again is rapid, with the appearance of the Chassey type of pottery (reddish in color, fine walled, undecorated but polished, and well made), similar to that in southern France. A French connection also is revealed by the fact that over half of all the flint was imported from the Rhône delta. After the Late Neolithic, occupation declined further. Intermittent occupation took place through the Bronze Age, with later traces of a little Iron Age and Roman occupation at the top.

Arene Candide is one of the key sequences of the western Mediterranean, thanks partly to its well-preserved stratigraphy and partly to the quality of the excavations by Bernabò Brea and Cardini. New information continues to come from the site and doubtless will do so for many years to come.

See also **Caldeirão Cave** (*vol. 1, part 3*).

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PETER ROWLEY-CONWY

CALDEIRÃO CAVE

The site of Gruta do Caldeirão is near the city of Tomar, Portugal, about 150 kilometers northeast of Lisbon. The entrance opens about 120 meters above sea level and dominates a small valley at the bottom of which a temporary stream flows into the Nabão River, the subtributary of the Tagus River that cuts (from north to south) the small limestone plateau where the cave is located. The stratigraphic succession defined in the cave's "back chamber" is about 6 meters thick and features three major discontinuities that divide it into four major blocks. At the bottom are Middle Palaeolithic levels K through P, dated to more than 28,000 B.P. (beyond 30,000 B.C.); these are followed by early Upper Palaeolithic and Solutrean levels Fa through Jb, dated to more

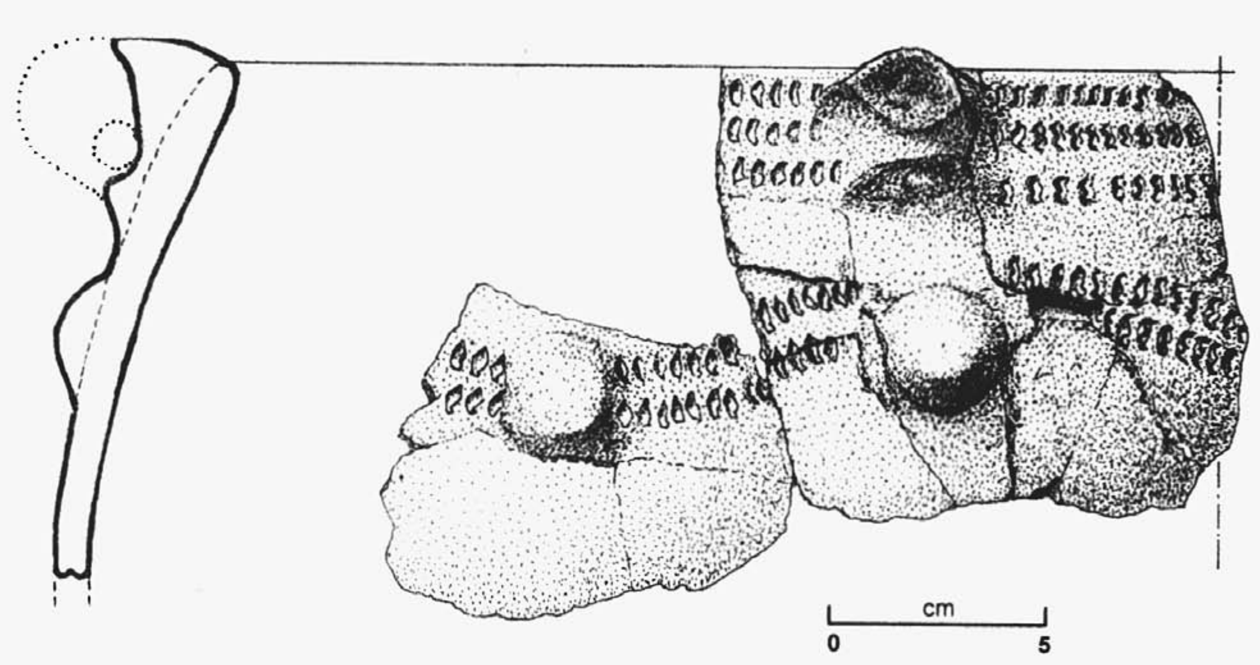

Fig. 1. Fragments of decorated Cardial-impressed vessel from Caldeirão Cave. COURTESY OF JOÃO ZILHÃO. REPRODUCED BY PERMISSION.

than 18,000 B.P. (beyond 20,000 B.C.), and by Magdalenian level Eb, dated to between c. 16,000 and c. 10,000 B.P. (between c. 17,500 B.C. and c. 9500 B.C.). The accumulation of the overlying Neolithic and post-Neolithic deposits began with level Ea, c. 6000 B.C.

The Early Neolithic remains form two different archaeological horizons, NA2 and NA1. The earliest, NA2, is a funerary context defined by an assemblage of human bones and associated pottery, ornaments, lithics, and animal bones. Most of this material was recovered as discrete concentrations inside level Eb. The hiatus in sediment deposition after the end of the last glacial explains the intrusion, because it implies that the floor of the cave at the time of the first Neolithic human activities was still the same that existed at the end of the Magdalenian era. As a result of those activities, as well as of the contemporary disturbance caused by burrowing animals, the remains of the Early Neolithic burials became incorporated in the immediately underlying deposits. The contents of the latter, therefore, were a mix and for the most part accumulated in the cave much earlier—a common phenomenon in Mediterranean caves but one that often goes unnoticed and is responsible for much of the controversy regarding the exact timing of the appearance of farming in the region.

Horizon NA2 contains the remains of at least four adult individuals and a child, and estimates based on the dental material suggest that a fifth adult is also present. The spatial distribution of the bones and associated artifacts suggests that a female was buried against the north wall and that a cardial-decorated ceramic vessel was emplaced with her. A male buried against the south wall has been associated with three microliths (one trapeze and two segments), and a second nearby male has been associated with a cluster of 120 shell beads made of the species *Theodoxus fluviatilis* (freshwater snail), *Hinia pfeifferi* (netted dog whelk), and *Glycymeris glycymeris* (dog cockle). The postdepositional scattering of these inferred contexts further suggests that the bodies were not placed inside protective burial features but simply laid down on the cave floor. The location of the clusters of cranial material suggests that the heads were probably leaning against the side walls.

The human bone material ascribed to horizon NA1 represents a minimum of thirteen individuals: six were less than fifteen years old; two were between fifteen and twenty; and five were adults, two of whom (one male and one female) were still young (twenty to twenty-five), and the other three of whom (two males and one female) were of an older age. The postdepositional disturbance, or the scattering and breakage of the human skeletons by such animal cave dwellers as foxes and badgers, was in this case too severe to identify patterning in the spatial distribution of the different people. Burial gifts in horizon NA1 include polished stone axes and impressed (epicardial) ceramic vessels.

The animal bones indicate that this burial site was also episodically used as a warm-season shelter for the hunting of wild boar and the herding of sheep. Permanent villages in the region of this site are still archaeologically unknown but must have been located farther south, in the good soils of the alluvial plain of the Nabão. The absence of cereal grains or other direct proof of the existence of domesticated plants in the cave deposits must be related to the specialized use of the site; it does not mean that agriculture was not part of the economic system. Stable isotope analysis of the human bone shows a diet where aquatic resources were absent, in sharp contrast with the evidence for regional late Mesolithic people; the latter, moreover, do not seem to have settled inland areas devoid of close access to the sea or the major estuaries. The fact that such a settlement was achieved by Early Neolithic people strongly indicates that cereal agriculture was introduced at the same time as domesticated animals. The Cardial ceramics in horizon NA2 can therefore be taken as a proxy for the complete Neolithic package, which means that the presence of ceramics presumes the presence also of other things that accompany it in western Mediterranean Europe: cereal agriculture, plus sheep and goats, as the basis of the economy and the diet, as well as sedentary village life, and, where technology is concerned, polished stone axes.

Stylistically, this pottery is relatively evolved; the decoration is restricted to a band below the rim, occupying the space between small, horizontally perforated handles, from which garlands of impressions descend to the body, bridging the space between regularly placed buttons. Similar vessel types associated with identical radiocarbon ages are also known from nearby sites in the northern half of the Central Limestone Massif of Estremadura such as Buraca Grande (Pombal) and Pena d'Água (Torres Novas). Stylistically earlier, baroquely decorated Cardial vessels have been recovered in the cave burial site of Galeria da Cisterna (Almonda karstic system, Torres Novas), located about 40 kilometers to the southwest of Caldeirão; they are associated with characteristic ornaments (pierced red deer canine teeth and bone beads imitating their shape) directly dated by AMS radiocarbon dating to c. 5423 B.C.

The contemporaneity and the close similarity in vessel decoration and personal ornamentation between Cisterna and such sites as Cova de l'Or on the Mediterranean coast of Valencia, Spain, support the hypothesis that the spread of farmer-herders along the shores of Mediterranean and south-Atlantic Iberia was effected through a process of maritime pioneer colonization. The sourcing of raw materials—shells and clay—used for the manufacture of artifacts recovered in such inland sites as Caldeirão is consistent with this hypothesis, since it indicates exchange systems oriented toward the estuaries and the sea. Given the dating evidence, it would seem that it took some six generations before the descendants of the Neolithic people who first arrived in coastal Portugal started to settle in the Nabão Valley. Since the physical anthropological analysis of the Caldeirão human remains reveals no signs of stress, it must be inferred that the new economic system they brought with them was successful right from the beginning.

See also **Spread of Agriculture Westward across the Mediterranean** (*vol. 1, part 3*); **Arene Candide** (*vol. 1, part 3*).

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João Zilhão

FIRST FARMERS OF CENTRAL EUROPE

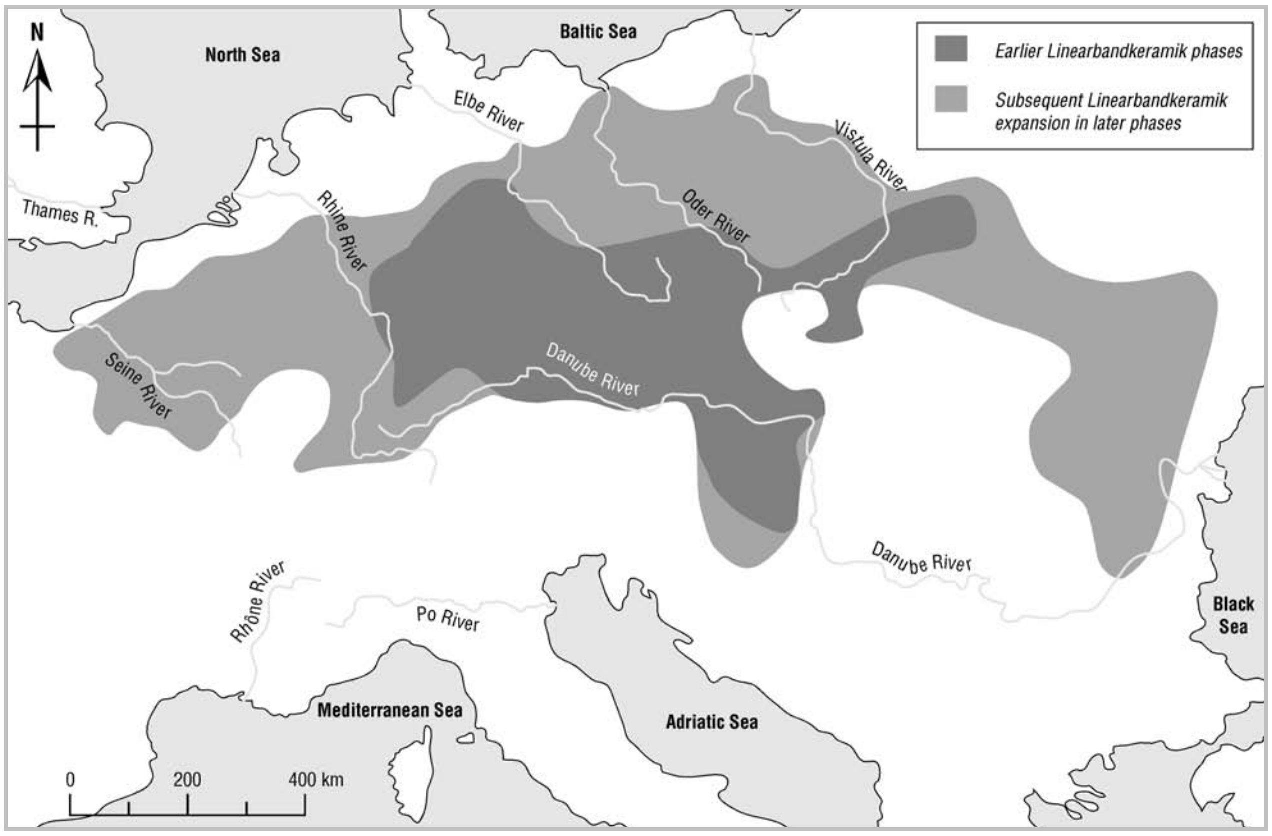
FOLLOWED BY FEATURE ESSAYS ON:

A millennium after agriculture was first introduced to Greece and the southern Balkans (the Sesklo and Karanovo/Kremikovci cultures) and half a millennium after its introduction to the northern Balkans (the Starčevo, Körös, and Criş cultures), peoples of the *Linearbandkeramik* (LBK) culture first farmed on the Hungarian Plain near Budapest. Within a period of seven to eight hundred years, these peoples had spread through most of central Europe, to the boundary of the North European Plain. They brought with them new practices not seen earlier in these areas, including agriculture and stock rearing; construction of large, permanent houses and settlements; and the production of pottery. While traditional views of the LBK culture saw these peoples as peaceful, self-sufficient migrants who largely replaced the indigenous hunting-gathering peoples of central Europe, new research has established that the expansion of the LBK involved more complex social interactions, at times including extreme violence.

THE *LINEARBANDKERAMIK* CULTURE

The LBK culture (named after its linear style of incised pottery decoration) first appeared on the Hungarian Plain, near Budapest, and subsequently spread into Bohemia, Moravia, Slovakia, southern Poland, parts of the Ukraine, Moldavia, northern Romania, Lower Austria, Germany, Alsace, the Dutch Limburg, Belgium, the Aisne Valley, and the Paris basin. This culture was identified by the German archaeologist Friedrich Klopfleisch (1831–1898) at the end of the nineteenth century, and many archaeologists continue to use the German name *Linearbandkeramik* or *Linienbandkeramik* or sometimes simply *Bandkeramik*. The English translation, also frequently seen in archaeological literature, is Linear Pottery culture, while the French name is *Céramique Rubanée*. An older usage, introduced by V. Gordon Childe in the 1920s as the foundation of his Danubian sequence of cultures in prehistoric central Europe, but no longer in common use, is Danubian I.

Although a large body of radiocarbon dates is available from LBK sites throughout Europe, difficulties with calibration and resolution make it virtually impossible to construct a chronology relying on carbon-14 dating alone. The LBK period typically is divided into four chronological phases based on the evolution of ceramic decoration: Oldest, Older, Younger, and Youngest. More precise regional chronologies have been developed for



Extent of *Linearbandkeramik* settlement. ADAPTED FROM LÜNING, KLOOS, AND ALBERT 1989.

most areas of the LBK distribution, however. Similarities with Early Neolithic material culture from the northern Balkans (Körös), in conjunction with radiocarbon dates, place the origin of the LBK culture at c. 5700 B.C. Oldest-phase LBK sites appear over a large area, comprising the Hungarian Plain, Lower Austria, southern Bohemia and Moravia, eastern Germany, the Danube Valley in southern Germany, and as far west as the Main Valley near Frankfurt. Dates for these sites are virtually indistinguishable from one another, indicating rapid dispersal. The Older phase of the LBK culture began c. 5500–5300 B.C. and saw the first settlement of the Rhine Valley (as far north as Belgium and the Netherlands) and southern Poland. During the Younger and Youngest phases there was further expansion into the Ukraine, Moldavia, northern Romania, and the Paris basin in the west. The sites that are farthest west did not appear until c. 4900 B.C., which would indicate that, on average, the LBK culture spread into Europe at a rate of 3.5–5 kilometers per year.

HISTORY OF RESEARCH

Finds of LBK ceramics have been noted in central Europe since the 1700s, and pits containing LBK material were first excavated during the 1800s. These sites were referred to as "pit houses" and were thought to represent the dwellings of the first farmers. It was not until Werner Buttler and Waldemar Haberey's excavations at Köln-Lindenthal in the 1920s, however, that a full settlement was recovered and the LBK longhouse first recognized.

Since then, hundreds of LBK sites have been fully or partially excavated, making the LBK one of the most extensively researched cultures in European prehistory. LBK sites have been excavated in Hungary, the Czech Republic, Slovakia, the Ukraine, Moldavia, Romania, Poland, Austria, Germany, Luxembourg, the Netherlands, Belgium, and France. Some of the most extensive work was carried out during the 1970s on the Aldenhovener Platte (near Cologne) and the Helmstedt coal seam near Braunschweig, where strip mining allowed for salvage excavation of all LBK sites along entire stream courses. Additional large-scale excavations have been carried out in southern Poland, including settlement survey on a regional level. The Hungarian Plain and the southern Czech Republic also have been intensively investigated. In the west the Dutch Limburg, the Belgian Hesbaye, the Aisne Valley, and the Paris basin all have been surveyed and excavated extensively. A newer University of Frankfurt project has focused on the excavation of Oldest LBK settlements throughout Germany and Austria.

LINEARBANDKERAMIK MATERIAL CULTURE

LBK farmers preferred to found their villages on soils formed from loess or redeposited loess (although in some areas fewer than 50 percent are situated on such soils) in close proximity (500 meters or less) to second- or third-order streams. In many cases, sites (Köln-Lindenthal, Elsloo, and Olszanica, for instance) clearly were large, permanent settlements with numerous contemporaneous longhouses and, sometimes, associated cemeteries. Excavations on the Aldenhovener Platte indicate, however, that in other instances, LBK "villages" actually were isolated farmsteads separated by several hundred meters. Little remains of LBK sites other than the bottoms of post holes and pits, owing to post-Neolithic erosion; it nonetheless is clear that certain sites were fortified with ditches, and such features as wells and ovens also have been discovered. Sites typically are situated in "clusters" (*Siedlungskammern*) of as many as forty sites each, often within a single stream valley.

LBK peoples built massive timber longhouses, usually several meters wide, with the longest being tens of meters in length. Longhouses (recognizable only as post molds) typically consist of two or four outer post rows (the walls) and three rows of inner support posts that held up the roof. Earlier longhouses in western Europe have a characteristic pattern of central post rows in a Y or 7 formation; this pattern is replaced by a single straight row in later houses. Longhouses were modular, with a middle section often interpreted as living quarters; a northwestern section with full surrounding wall trench, generally taken to be a winter stall for animals; and a southeastern section with heavy double posts, usually seen as a raised grain loft. Longhouses always have a central section but may or may not have northwestern and southwestern sections. At many sites, however, the majority of houses have all three segments, arguing against a correlation between house size and the social status of its occupants. No original occupation surface has ever been recovered, but analysis of soil phosphate content has shown no functional difference among the three sections.

LBK stone tools typically are made from broad, long blades with flat platforms struck from unidirectional cores or from flakes. Oldest-phase LBK stone tools more commonly (40 percent as opposed to 20 percent in the later LBK culture) are composed of smaller, narrower blades, in some cases with faceted platforms. Typical tools include end scrapers, sickle blades and armatures (with heavy "sickle gloss," indicating use), and borers. Except for rare examples, burins are virtually absent. Projectile points are present in small numbers (less than 1 percent of a total assemblage) at eastern sites but are much more common (as much as 20 percent of total finds) in the west. At Oldest LBK sites, many of these points are geometric microliths, often trapezes—this trend continued into later phases of the eastern LBK. At western sites the classic "Danubian" triangular point type is more prevalent. Groundstone adzes (of the D-section "shoe last" type) and axes (the *Flachhacke*) are ubiquitous at LBK sites, as are saddle querns (grinding stones).

LBK ceramics (fig. 1a–e) usually are divided into two types, well-made and elaborately decorated fine ware and a plain coarse ware. While coarse ware almost certainly was used for storage and cooking, the function of fine-ware pots is understood less well. They may have been serving vessels. Oldest LBK pots generally were organically tempered and flat-bottomed, and the decorated examples almost always have a spiral or meander pattern of two or three bands. During later LBK culture phases, round bottoms and inorganic temper were employed almost universally. The three-quarter spherical bowl (*Kümpf*) replaced the low bowl as the most common vessel type, and decorative motifs became ever more elaborate. During the Younger phase, a distinct east/west stylistic division was evident, with eastern ceramics being characterized by relative stylistic uniformity. Youngest western ceramics show the development of local style zones, roughly corresponding to separate river systems. In addition to pots, ceramic figurines, clay "altars,"

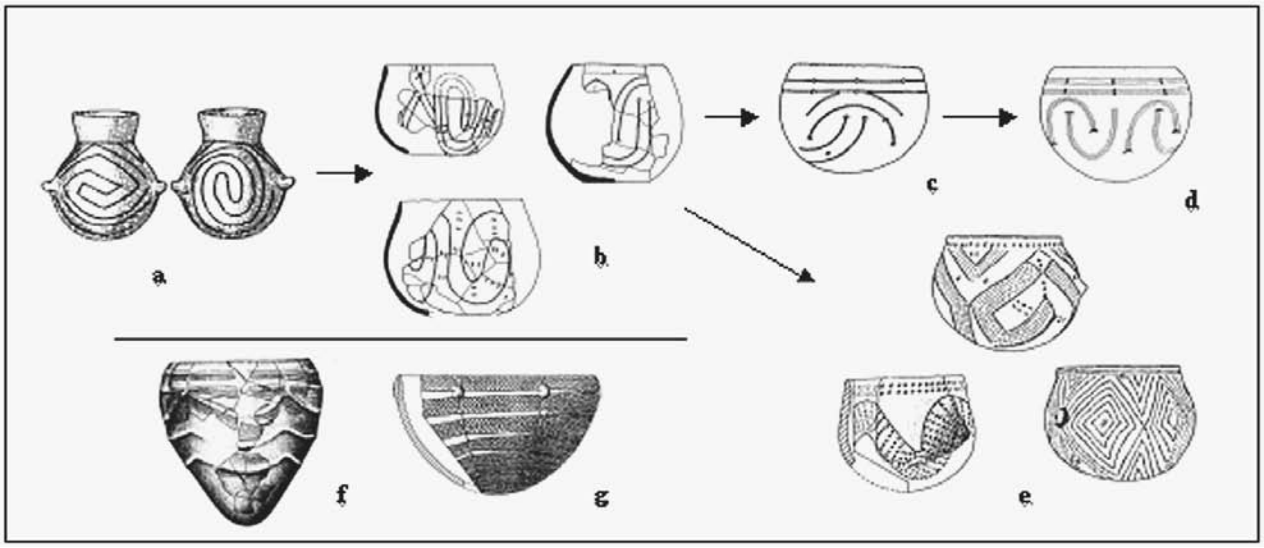


Fig. 1. Early Neolithic ceramics: (a) oldest LBK; (b) Flomborn/Ačkovy/Zofipole; (c) Notenkipf; (d) Želiecovce; (e) youngest Western styles; (f) La Hoguette; (g) Limburg (redrawn after Bogucki 1995, Constantin 1985, Lüning, Kloos, and Albert 1989, Müller-Karpe 1968, Preuß 1998). COURTESY OF LAWRENCE KEELEY. REPRODUCED BY PERMISSION.

and anthropomorphic and zoomorphic vessels are found at earlier LBK sites (particularly eastern ones) and clearly are related to similar objects discovered at Balkan Neolithic sites. Objects of this type became considerably less common in later LBK contexts.

SUBSISTENCE ECONOMY

The introduction of agriculture to central Europe coincided with the beginning of the Atlantic climatic phase, a period of warmer temperature (by about 2 degrees Celsius), more humidity (8–22 percent wetter), and milder winters than today's. Atlantic Europe was covered almost entirely by mixed broadleaf forest (elm, oak, and linden/lime), but pollen cores suggest that LBK communities cleared a substantial amount of this forest upon first settlement.

The faunal and floral assemblages at Oldest LBK sites typically contain about 20 percent wild species and 80 percent domesticated species. These domesticates include cattle; sheep and goats; pigs; dogs; emmer, einkorn, and spelt wheat; legumes (peas and vetch); and flax. Oldest sites display a degree of diversity in their assemblages, with southern sites (such as Schwanfeld, Strögen, and Neckenmarkt) having a majority of sheep and goats, northern sites (such as Eitzum and Eilsleben) having cattle, and western sites (Bruchenbrücken and Goddelau) having pigs. Emmer and einkorn forms of wheat were the most common domesticated plants, but the small number of sickle blades has led some researchers to argue that agriculture was practiced less intensively at Oldest LBK villages than at later ones.

After the Oldest LBK phase, domesticates composed as much as 95 percent of all faunal and floral remains, with cattle the most important species in terms of total calories. Emmer wheat remained the most abundant cereal, with einkorn taking second place and spelt wheat third. Small amounts of barley and rye also are known. Wild resources continued to be exploited in small amounts and numbers, including aurochs, wild pigs, red deer, horse, fish, wild fruits (apples and pears), and berries (blackberries and raspberries). There was some regional variation; for example, non-domesticates make up between 20 percent and 50 percent of assemblages at some southern and extreme eastern LBK sites.

Initially, it was believed that LBK communities practiced slash-and-burn cultivation and that the constant need for new land fueled the rapid dispersal of LBK peoples into central Europe. It has since become clear that many LBK sites were settled continuously for several hundred years. Experimental agricultural studies have established that Neolithic farming practices would have been sustainable for hundreds of years on heavy, loess-derived soils, such as those settled by LBK peoples. LBK peoples probably cleared small fields within about a kilometer of villages for both farming and grazing, with one person estimated to require approximately 0.4 hectare of land per year.

LINEARBANDKERAMIK SOCIETY

It was long held that LBK villages were largely self-sufficient farmsteads with limited long-distance contact and that little social organization existed beyond the village level. It has now become apparent that LBK communities were socially integrated with their close neighbors and had such ties over distances of hundreds of kilometers. For instance, such goods as *Spondylus* shell were traded into central Europe from the Black Sea and Aegean Sea. In some cases, villages obtained almost their entire supply of flint from distant sources, for instance, Bylany (in the present-day Czech Republic), which obtained flint from Olszanica, more than 200 kilometers distant. It has been suggested that periodic trade expeditions might have been sent out to obtain such materials.

At Langweiler 8 (Aldenhovener Platte), flint from the Netherlands probably was brought in and worked into finished tools before being redistributed to other LBK sites in the immediate vicinity. Evidence of such interdependence between neighboring villages is known in numerous cases. At Langweiler 2 an overabundance of a particular narrow pit feature (*Schlitzgrubbe*) may indicate that peoples at the site specialized in hide preparation and export. Production specialization is apparent at many LBK sites in the Hesbaye region of Belgium, with evidence of trade in utilitarian goods (pottery and lithics), a practice that may have helped cement social and military alliances.

Cooperation on a regional level also is evidenced by the amount of labor that periodically would have been required to build longhouses and, in particular, fortifications, which also would have necessitated the aid of the inhabitants of several sites to defend them. There is little indication, however, that any form of hereditary status inequality existed in LBK society. Status seems to have come with age, with older men (groundstone axes) and older women being the only ones buried with grave goods. Some researchers have posited a form of "big-man" status competition within LBK society. There is little concrete archaeological material to support such a hypothesis, however, other than evidence from a small number of sites at which houses with larger numbers of groundstone axes and other materials were found. It is only in the context of the late western LBK that there is support for status differentiation, for instance, at Rixheim (a cemetery in Alsace), where there were a few people with very elaborate personal ornamentation.

CONFLICT AND WARFARE

It once was believed that the LBK expansion essentially was a peaceful process of population replacement. A substantial body of evidence now concludes that LBK society was, at times, intensely violent. Fortification enclosures (taking the form of interrupted V- or U-profiled ditches with inner palisade lines or trenches, sometimes with baffled or screened gates) are known from well over a hundred LBK sites representing most regions and phases. They are most common in the later phases of the western LBK. LBK sites generally were not located in naturally defensible locations, however, and most ditches seem to have filled in rapidly shortly after construction. This would suggest that whatever threats necessitated the construction of fortifications, they were not foreseen at the time of initial settlement and tended to be short lived. Nonetheless, at some sites (Schletz-Asparn, Eilsleben, and Köln-Lindenthal, for instance), there were several phases of fortification.

One review of LBK burials has shown that approximately 2.2 percent of people at eastern LBK sites suffered traumatic injuries during their lifetimes, whereas in the west the rate of injury was nearly 19 percent. While both values are extremely high, they are consistent with other evidence supporting the notion that western LBK society was far more violent than was eastern LBK society. For instance, it is likely that this difference explains the much higher number of projectile points in western LBK assemblages.

Many theories have been advanced concerning the cause and nature of these conflicts. At Vaihingen/Enz (a fortified site near Stuttgart), numerous skeletons were found in two large garbage pits, and fragmented human remains were scattered throughout the site. Many of these remains show evidence of traumatic injury. Upon metrical analysis, the skeletal material from these atypical "burials" was found to be far more robust than that from typical semi-flexed LBK burials (lying on the side with slightly bent knees and arms) at the site's cemetery. These may well have been indigenous hunter-gatherers who were killed during conflict with incoming farmers. While fragmented bones (skulls, mandibles, and long bones) are known from other western LBK sites, they have not been subjected to a similar analysis. Nevertheless, a no-man's-land, 20–25 kilometers wide, between terminal Mesolithic sites and LBK sites in northeastern Belgium indicates that in at least some cases conflict occurred between incoming farmers and indigenous hunter-gatherers.

Evidence of violence between LBK communities is becoming increasingly well documented. The most extreme examples are found at massacre sites, of which two are known. At Talheim (the Middle Rhine Valley), an excavated pit contained thirty-four skeletons with many head wounds caused by blows with LBK axes or adzes as well as arrows. Most of the wounds were located on the back of the victim's skull, indicating that the person was attacked while fleeing. The demographics indicate that an entire village population was killed. At Schletz-Asparn (near Vienna), between sixty-six and three hundred people were killed and thrown into the site's fortification ditch, where they were left exposed for several months. Again, the victims were killed with LBK axes or adzes and arrows. The underrepresentation of young women in the burial population may indicate that the attackers carried them off.

Violence seems to have been so common and extreme at the later western LBK sites that some researchers have referred to this phase as a "crisis" period. In addition to high rates of burial trauma and large numbers of fortified sites, there is evidence of cannibalism (split long bones with charring) at such sites as Herxheim, where large caches of skulls were found, and Ober-Hörgern. There was an apparent concern with securing interior water supplies via wells or cisterns at several sites that were all located within a few hundred meters of running water. In the Kaiserstuhl region (the Upper Rhine Valley), some LBK communities appear to have relocated into more defensive hilly locations off loess soils. At the same time that fortifications were constructed, long-distance trade networks appear to have collapsed, with sites in the Rhine Valley, for instance, forced to rely on inferior local raw materials rather than ones they previously had obtained from the Dutch Limburg.

Lowered water tables and other signs of increasing aridity have been noted at many LBK sites during later phases. Population pressure also has been suggested as a potential source of conflict. Some researchers have related new cult practices evident in the late LBK to this "crisis" period. There is, for example, possible evidence of human sacrifices (of women, in particular) at so-called cult caves, such as the Jungfernhöhle, and numerous skeletons of children as young as five or six years old have been uncovered in the fortification ditch at Menneville (Aisne Valley). Nevertheless, declining environmental conditions alone cannot explain why the western LBK was so much more violent than the eastern LBK. While it is now clear that violence was a common occurrence in Early Neolithic central Europe, the causes of this violence are not yet entirely clear.

ORIGINS AND EXPANSION OF THE *LINEARBANDKERAMIK*

The first LBK communities were located on the Hungarian Plain, but the exact origins of the LBK culture remain mysterious. Much LBK material culture (pottery, lithics, groundstone, ceramic figurines) and economy has clear ties to the northern Balkan Early Neolithic. Other aspects, most notably the LBK longhouse, are novel. While there is overlap between the distribution of early LBK sites and Körös sites, no site has yet been excavated that would indicate a distinct transition from one material culture to the other. Oldest-phase LBK sites in Hungary (Budapest III, Becseheley, Bicske, and Medina, among others) already have the full "package" of LBK material culture and economy. It has been suggested that the LBK represents acculturation by Mesolithic hunter-gatherers after contact with farmers to the south, but the extremely low density of Late Mesolithic sites in Hungary makes this argument equally difficult to support.

LBK sites throughout the Oldest distribution area appeared simultaneously (within the resolution limits of radiocarbon dating), indicating an extremely rapid spread of LBK culture. The LBK typically has been viewed as a clear example of prehistoric migration, owing to the rapidity of expansion, the uniformity and novelty of material culture, and the foreign origins of plants and animals. Still, it has been argued that the Oldest LBK phase involved a considerable degree of indigenous incorporation.

Such arguments are based on the continuation of certain Mesolithic trade networks that brought material in from areas well outside the Oldest LBK region (Meuse Valley flints and Szentgál radiolarite from the Bakony Mountains, for instance), the overall greater diversity of resource usage and higher percentages of wild resources (compared to later phases), and certain aspects of the Oldest LBK lithic industry that show continuity with the preceding Mesolithic. For instance, faceted blade platforms are present at some LBK sites but not at others, mirroring their distribution during the Mesolithic. Likewise, projectile point styles show an east/west divide, again mirroring the Mesolithic pattern. These "Mesolithic" traits are present only in small numbers, however, and the majority of Oldest LBK culture sites have no continuity with the preceding Mesolithic. Indeed, one review of radiocarbon dates from central Europe has shown that the majority of Mesolithic sites had ceased to be occupied several hundred years before the appearance of the first LBK communities.

A study of the bone chemistry of bodies from cemeteries of the Older and Younger/Youngest LBK phases in southwestern Germany (Flomborn, Schwanfeld, and Dillingen) has determined that approximately 60 percent of people of the Older phase (the first settlement in the Rhine Valley) had "nonlocal" chemistry profiles. This percentage drops considerably at the Younger/Youngest cemeteries. "Nonlocal" people seem to have received different burial treatment—their burials lack stone axes, and their heads are oriented toward the northwest rather than the southeast. Strontium levels in these remains were found to be consistent with origins in sandy uplands contexts, which were not occupied by LBK groups or Mesolithic peoples, who preferred major river valleys. The possibility, not yet substantiated, exists that these people represent incorporated Mesolithic foragers.

It remains possible that there was a degree of interaction between LBK farmers and indigenous peoples in western central Europe. In addition to typical LBK ceramics, two somewhat enigmatic ceramic types, La Hoguette and Limburg (fig. 1f, g), have been discovered in small numbers at western LBK sites. Both La Hoguette and Limburg ceramics are clearly different from LBK ceramics in form, decoration, and technological methods (particularly the use of bone temper). La Hoguette ceramics are found primarily at Oldest and Older LBK sites in the Middle Rhine Valley, but they have been seen in "Mesolithic" contexts. For instance, at the Bavans rock shelter, La Hoguette ceramics were present in association with Mesolithic lithic remains and what is thought to be domesticated sheep or goat bones, with possible dates as early as 5800 B.C. Limburg ceramics are encountered almost exclusively at LBK sites of the Younger/Youngest phase in the Lower Rhine Valley, Belgium, and France. To date, Limburg ceramics have not been uncovered in any other secure context. The significance of these two wares has been much debated but never resolved. While it seems likely that La Hoguette ceramics were of Mesolithic manufacture, no strong evidence of Mesolithic origin has been uncovered for Limburg ceramics. Both types appear to be stylistically influenced by Epicardial wares from southern France, though they are not similar to each other.

Indigenous hunter-gatherer involvement in the formation of LBK communities has been argued most plausibly for the Oldest LBK period. Such a process might have taken place during later phases of expansion, but the evidence is at best speculative. The vast majority of material culture and cultural practice first seen in central Europe in the context of the LBK shows little or no connection to the preceding Mesolithic. At present, the archaeological record suggests that actual human migration was the primary mechanism by which agriculture was first introduced into central Europe. The reasons for this migration are not certain, but numerous theories have been put forth, including population pressure, favorable ecological conditions for the introduction of Middle Eastern crops to central Europe (the onset of Atlantic climatic conditions), and social pressures (conflict and movement as a means of relieving such tensions).

CENTRAL EUROPE AFTER THE *LINEARBANDKERAMIK*

The trend toward the development of regional styles and practices evident in the later phases of the LBK culture continued into the post-LBK period (after c. 4800 B.C.), when several related "daughter" cultures emerged. Among these cultures is the Rössen in western Germany and the Netherlands, the Villeneuve/Saint Germain in France, the Blicquy in Belgium, the Stichbandkeramik (Stroke-Ornamented Pottery culture) in eastern Germany, and the Lengyel in much of the eastern LBK region. These cultures are distinguished not only by differences in ceramic style but also by varying subsistence adaptations and cultural practices. In general, later Early Neolithic peoples were much less densely settled throughout central Europe, which sometimes is attributed to the late LBK "collapse."

The expansion of LBK peoples for the most part seems to have halted at the boundaries of the North European Plain (except in Poland), where for as long as a millennium they were in contact with complex hunter-gatherers to the north. It has been suggested that Lengyel communities gave rise to the earliest Funnel Beaker communities in the Polish lowlands, continuing the expansion of agriculture onto the North European Plain and into southern Scandinavia.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **Bruchenbrücken** (*vol. 1, part 3*); **Bylany** (*vol. 1, part 3*); **Beginnings of Farming in Northwestern Europe** (*vol. 1, part 3*); **Transition to Farming along the Lower Rhine and Meuse** (*vol. 1, part 3*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*); **Milk, Wool, and Traction: Secondary Animal Products** (*vol. 1, part 4*); **Brześć Kujawski** (*vol. 1, part 4*).

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LAWRENCE H. KEELEY, MARK GOLITKO

BRUCHENBRÜCKEN

The site of Bruchenbrücken lies about 5 kilometers south of Friedberg, Germany, in the Wetterau region, a loess plateau between the Taunus hills and the Vogelsberg and Spessart massifs. Excavations were conducted during the early to mid-1980s in the course of a research project based at the Johann Wolfgang Goethe University in Frankfurt, Germany. A new excavation campaign began in the spring of 2003 as housing development in the area continued. Bruchenbrücken is a multicomponent site with features dating to the earliest Linear Pottery culture (called *Linearbandkeramik,* or LBK, in German; LBK I c. 5400–5250 B.C.), younger LBK (LBK II c. 5250–5000 B.C.), Middle Neolithic (c. first half of the fifth millennium B.C.), and Bronze Age (unclear dates at this site).

The site became famous for its earliest LBK component, notably the association of classic earliest LBK material with that of another Early Neolithic tradition from western and west-central Europe

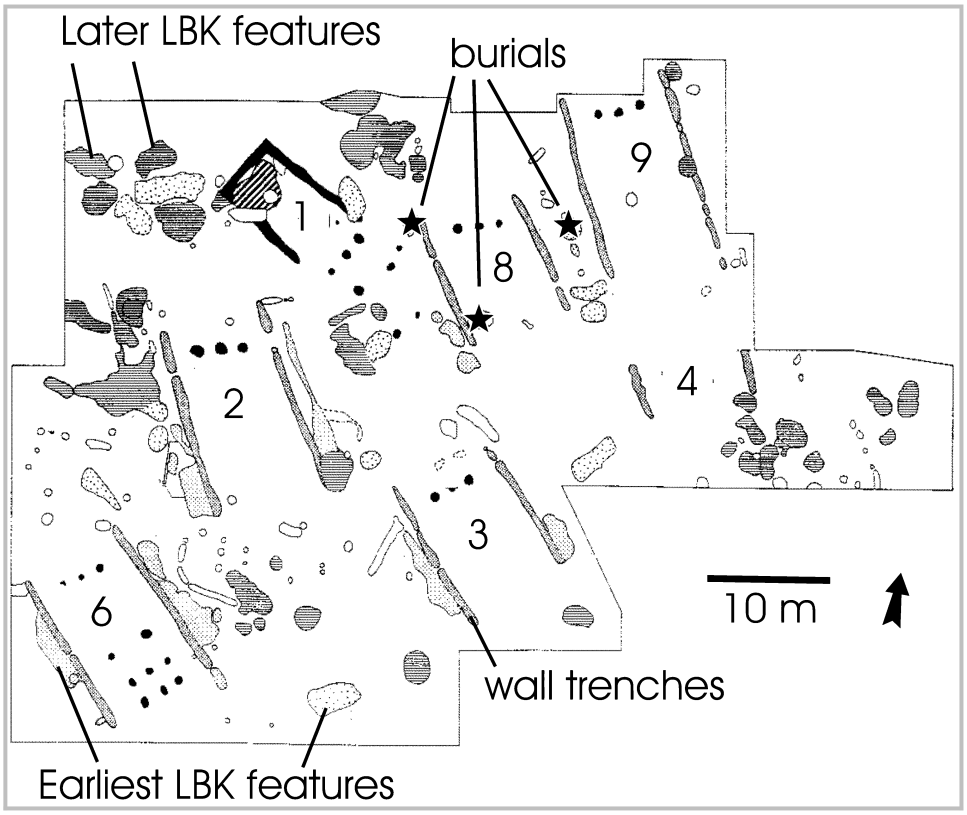

Fig. 1. Site plan of Bruchenbrücken. COURTESY OF DETLEF GRONENBORN. REPRODUCED BY PERMISSION.

known as "La Hoguette." This contemporaneous occupation would have taken place between 5350 and 5250 B.C. The site plan (fig. 1) shows the remains of six houses dating to the earliest LBK (2, 3, 4, 6, 8, and 9) and one (1) dating to the younger LBK. Earliest LBK houses are arranged in two rows and are oriented in a direction that is roughly NNW–SSE, the southern row showing a slight turn toward the west. Because of the close proximity of the house plans to one another, it can be ruled out that they were contemporaneous. It seems more likely that neighboring structures represent succeeding buildings, with the new structure erected close to its predecessor. Owing to continuous occupation of the site during the LBK period and resulting disturbances in the extraction pits alongside houses, it has not been possible to seriate archaeological material in more than a very rough order. Another problem has been the numerous vessel refittings (reconstruction of ceramic vessels with sherds to achieve a possible idea of the original vessel's shape and decoration), notably from houses 2, 3, and 6. As a result of these taphonomic problems, a stable internal earliest LBK chronology could not be established. At the end of the earliest LBK there seems have been a hiatus, and the site was resettled at an advanced stage of LBK II, after about 5200 B.C. At that point Bruchenbrücken became occupied continuously, until the end of the LBK in about 5000 B.C.

The archaeological material recovered from the site shows wide-ranging links to surrounding regions. About 80 percent of the lithic material from the earliest phase came from the Maas Valley, which lies at a distance of 250 kilometers. There are, however, no LBK sites dating to this period between the Wetterau and the Maas, so the large amount of "exotic" flint needs explanation. It may be linked with La Hoguette pottery (fig. 2). La Hoguette is a ware attributed to Late Mesolithic forager-horticulturalists (who had adapted small-scale agriculturalist practices) that is distributed across a wide area along the Rhine and its adjacent uplands and reaches as far as the English Channel in northern France. The ware can be distinguished from LBK pottery by shape, texture, and decoration tech-

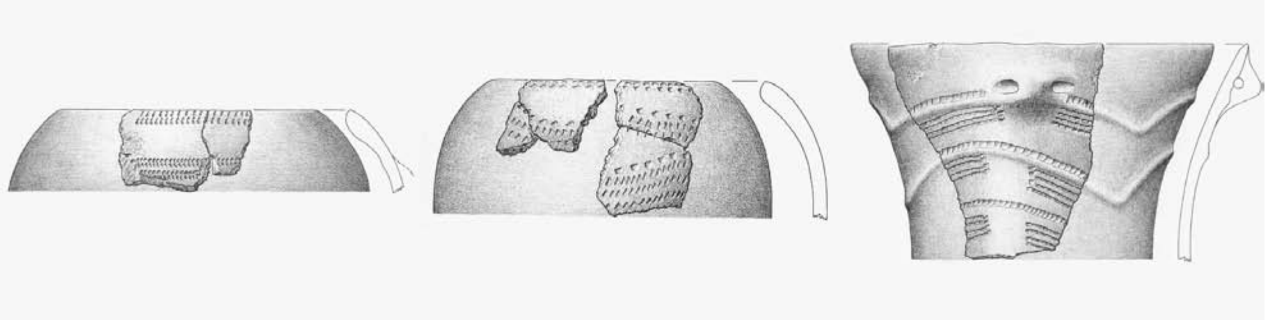

Fig. 2. Fragments of La Hoguette pottery from Bruchenbrücken, Friedberg, Germany. FROM LÜNING, KLOOS, AND ALBERT 1989. COURTESY OF K. F. RITTERSHOFER. REPRODUCED BY PERMISSION.

nique. In addition to La Hoguette ware, a triangular point was excavated from an earliest LBK pit. Formerly such items were mistakenly called "Danubian points" because of their abundant appearance on western LBK sites. It is now clear that they actually represent a central and western European Late Mesolithic tradition. Not unexpectedly, this point also was manufactured out of Maas Valley flint.

Apart from the typological differences, there are two different blade-manufacturing techniques. The shape of a few blades shows clear traces of a western European Late Mesolithic core-reduction tradition, while the majority of blades were produced in the technique of the central European Late Mesolithic and Early Neolithic. These lithic traditions are technologically exclusive of each other and result in differing end products; both are regionally exclusive as well.

Thus at Bruchenbrücken there are two differing pottery traditions, two distinct lithic traditions, and raw material imports in considerable quantity from an area that was not, at the time, settled by LBK villages. Considering the entirety of this evidence, one might justifiably think of two discrete yet contemporaneous ethnic groups that interacted economically and certainly also socially. One group, the manufacturers of La Hoguette pottery and triangular points, has local Late Mesolithic roots. These people had come under the influence of innovations ultimately going back to the southern French Mediterranean coast. New evidence from pollen profiles taken a little distance from Bruchenbrücken shows that the environment had been altered artificially as early as 5700–5000 B.C. Heliophytic (sun-loving) plants increase in number, and *Plantago lanceolata* (a weed associated with animal husbandry) indicates a human presence. Pollen from a poppy variety indigenous to southern France (*Papaver setigerum*) shows that the innovations would have come from this direction. There also were slight indications of cereal pollen of an undetermined variety. The changes in the composition of the natural vegetation can be attributed to an economy that was based on horticulture and some stockbreeding, notably sheep and goats.

There are numerous sites in central Europe where some remains of sheep and goats, and also cattle, have been found in Late Mesolithic layers. The most revealing site is Stuttgart–Bad Cannstatt, where a layer with La Hoguette pottery and evidence of a western European Late Mesolithic lithic tradition has been excavated, first in the 1960s and then during the early 1990s. The analysis of the newly available faunal and botanical material showed that the site was occupied briefly by a small band during the spring and fall seasons. The group had rested at the location for only a few days and then had continued with its yearly exploitation cycle (yearly or seasonal exploitation of the natural environment). Domestic animal remains belong to sheep and goats that were slaughtered on the spot and prepared for a meal, as is indicated by the presence of a spice weed (*Allium ursinum,* or wild garlic).

Other remains stem from the local, typical wild fauna, such as red or roe deer, aurochs, and many smaller animals. Wheat pollen shows that cereals were consumed at the site. It is likely that wheat was not grown at this location but was brought in from elsewhere, maybe from LBK farmsteads. Because the occupation dates to 5500–5300 B.C., it cannot be ruled out that the people of Bad Cannstatt had contact with the earliest LBK sites, some of which lie close together. It is thus not impossible that wheat was obtained through exchange with farmers, but no definite artifacts of LBK origin have been found.

Stuttgart–Bad Cannstatt is a site type complementary to the LBK settlement of Bruchenbrücken. It was not maintained by LBK farmers but by La Hoguette forager-horticulturalists. Both sites give insights into the complex interrelationship and coexistence of two different populations at the transition from the Mesolithic to the Neolithic in central Europe.

See also **First Farmers of Central Europe** (*vol. 1, part 3*); **Bylany** (*vol. 1, part 3*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*).

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DETLEF GRONENBORN

BYLANY

Bylany is one of the key sites of the *Linearbandkeramik* (Linear Pottery or LBK), which is probably the best-known culture of Neolithic Europe, a remarkably uniform phenomenon across a vast area from France to Hungary. Although many large LBK settlements have been excavated, the importance of the Bylany project resides in its pioneering nature, its scale and longevity (excavations and analysis spanning nearly fifty years), and the ideas it continues to generate.

Bylany is located near Kutná Hora in Bohemia (Czech Republic), some 70 kilometers east of Prague. A series of settlement "microareas" lie in the valley of the Bylanka stream. The soil is now, as in the Neolithic, a fertile brown chernozem on a loess base. The main settlement at Bylany 1, the focus of this article, lies on a gentle north-facing slope cut by smaller stream channels that were active during the Neolithic. Discovered in 1952, the site was excavated by Bohumil Soudský as the first major project of the Czech Archaeological Institute. Between 1953 and 1967, 7 hectares of the 30 hectare site were uncovered. The work set new standards in archaeological excavation and had an international impact. Only one excavation comparable in size had taken place previously, at Köln-Lindenthal in Germany. But Köln-Lindenthal was excavated at a time when Neolithic houses were thought to be pit dwellings, so the post-built structures were misinterpreted as granaries. Bylany therefore represents the first large-scale modern excavation of an LBK settlement. While Soudský later moved on to research the LBK of the Paris Basin, work continued at Bylany, led by Ivan Pavlů and others, to analyze and publish Soudský's data, and to explore the regional landscape.

Pavlů sees the work at Bylany in terms of several distinct phases of research, gradually expanding the area and periods represented. Since the 1970s a small LBK settlement, a *Stichbandkeramik* (Stroked Pottery, or SBK) cemetery, an SBK circular ditched enclosure (or "rondel"), and an Eneolithic (Copper Age) settlement have been excavated, all within 1.5 kilometers of Bylany 1. Much can now be said about two millennia of settlement and ritual activity at Bylany. No Mesolithic remains have been found, de-

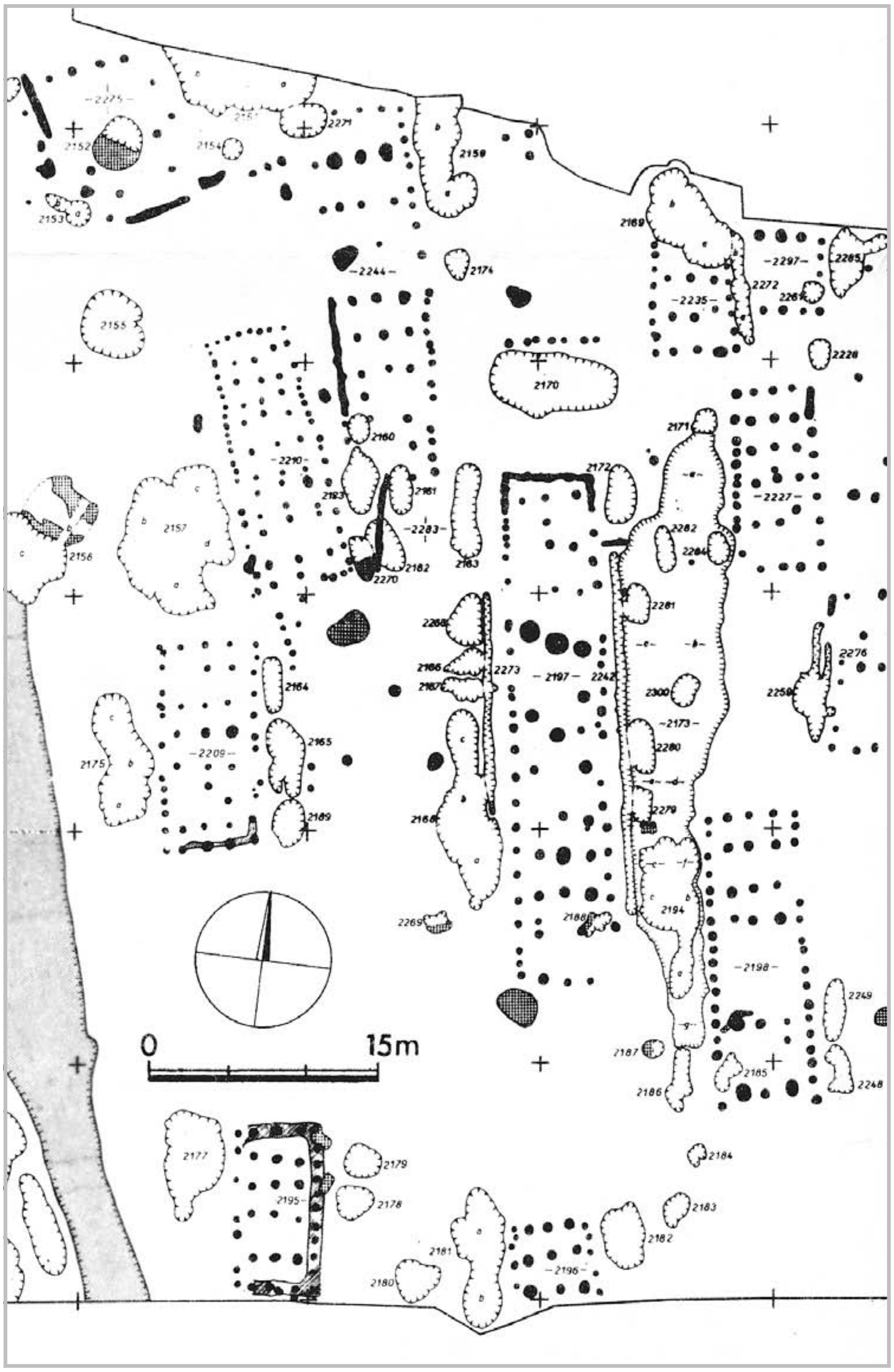

Fig. 1. Portion of site plan of Bylany showing LBK houses and borrow pits of various sizes and phases. COURTESY OF INSTITUTE OF ARCHAEOLOGY. REPRODUCED BY PERMISSION.

spite intensive fieldwalking; the LBK occupation begins in that culture's earliest phase, marked by organic-tempered pottery, and it spans the second half of the sixth millennium B.C. The succeeding SBK and Lengyel phases cover most of the fifth millennium B.C., while the Eneolithic settlement dates to around 3000 B.C.

At Bylany 1 some 130 house plans were uncovered, along with several hundred pits and other features. Only a few of these are the typically trapezoidal or apsidal SBK and Lengyel structures. The LBK houses conform to the standard pattern: rectangular timber longhouses averaging 20 meters in length, all uniformly oriented north-south (the entrance presumed to be at the southern end), with a tripartite, modular ground plan, the smaller buildings comprising just one or two of these modules. Some of the later houses had their external walls set in a continuous bedding trench rather than a row of discrete postholes. The largest houses (more than 45 meters long) were formerly interpreted as communal structures ("clubhouses"), but their associated finds are not qualitatively different.

Around most houses, usually flanking the long sides, are irregular pits containing large quantities of artifacts. They are assumed to be borrow pits, dug to provide clay for the walls and then left open to collect contemporary household rubbish (although the occurrence of intrusive SBK sherds may indicate more complex formation processes). Pavlů has defined a "building complex" as all features within an arbitrary 5 meters' distance of the house; farther away lay other groups of pits, perhaps marking areas of communal activity. Finds from the pits are dominated by pottery, but ground and chipped stone is also present. It is the latter assemblage, including flint imported from Poland, that hints at the networks of exchange and interaction that sustained the LBK as an entity.

Despite the great density of structures at Bylany they rarely intercut: like many, but not all, LBK settlements, old house sites were not built upon, whether for practical (if a mound remained) or symbolic reasons. Rather than stratigraphy, the basis of the site phasing is a quantitative analysis of the banded motifs on the pottery, based on the proportions of impressed (*Notenkopf,* or "music note") and incised decoration. Already in the 1950s Soudský was using a computerized system of finds recording, based on punched cards. More recently, discriminant analysis has tested and refined the sequence of occupation and by the 1980s some twenty-five settlement phases were recognized, with up to ten houses within the excavated area in any one phase.

The Bylany chronology has sparked much debate about the nature of LBK society and economy. Following earlier scholars, Soudský saw discontinuities in the ceramic phasing as evidence of "cyclical" agriculture, based on slash-and-burn cultivation: the community abandoned the site when the soil was exhausted and returned periodically when vegetation had regenerated. The economy was seen as primarily agricultural, supplemented by animal husbandry, although there is little direct evidence: bone rarely survives on the acid, loess soils favored by LBK communities. The cyclical model was heavily criticized in the 1970s; other sites, such as Elsloo in the Netherlands, did not show these breaks, and the analogy with tropical agriculture was inappropriate. The theory was replaced by a model of settled horticulture, with large settlements giving rise to "daughter" sites as population increased—the archetypal example being the vast Aldenhovener Platte excavations in the Rhineland.

Although the hiatuses at Bylany remain, Pavlů now argues, less dogmatically, for an irregular development of settlement, with breaks marked by the increased deposition of (nonportable) grindstones in the preceding phase and a planned layout of houses at each reoccupation—this layout became less ordered over time as houses went out of use and were replaced. The new understanding fits with Alasdair Whittle's critique of the sedentary horticulture model for the LBK: instead he sees "tethered" or "restrained" mobility (both seasonal and periodic) articulated through a "commitment to place" encapsulated in the formality of the longhouse. There remains the paradox, first expressed by Gordon Childe, that these "commodious and substantial" houses often lack evidence for prolonged occupation—but this now has to be understood in social and symbolic terms, not the perceived constraints of economy and environment. Perhaps the longhouse served primarily as a metaphor for the construction of social order. Further insights will only come, as in recent publications on Bylany, through linking detailed analysis of data with innovative interpretations. Once the basis for a narrow economic model, Bylany in the twenty-first century is producing new stories about life in the Neolithic.

See also **First Farmers of Central Europe** (*vol. 1, part 3*); **Bruchenbrücken** (*vol. 1, part 3*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*).

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JONATHAN LAST

BEGINNINGS OF FARMING IN NORTHWESTERN EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

By the end of the fourth millennium B.C. most of the peripheral archipelagos of northwestern Europe had been colonized by Neolithic farmers and exploited for animal husbandry and cereal growing. At that time in the whole of northwestern Europe cattle—and livestock in general—were central to the economy and to symbolical systems, buried with the dead, accumulated in deposits, and represented on megaliths. Even in coastal areas stable isotope analyses (using carbon and nitrogen) quite paradoxically show evidence of a diet based mainly on terrestrial resources. This situation is strikingly different from the marine-based diet found in the same regions at the end of the Mesolithic, that is, one or two millennia earlier, depending on the region considered.

This essay reviews the processes involved in the far-reaching economical, social, and cultural transformations that led from harvesting the sea to stock rearing. Most curiously, while they led to the same results in the overall region, they varied widely in their nature and rhythms in the different parts of northwestern Europe. A new, "Neolithic" way of life appeared as early as 5000 B.C., or even a bit earlier, in the Paris basin and in western France, but it took a millennium for animal husbandry and crop growing to cross the English Channel and settle in Britain. The appearance and diffusion of domesticates and cultigens, as well as farming techniques, might have involved a native Mesolithic component in Brittany and, to some extent, in Ireland. In contrast, the establishment of farming in the Paris basin seems to have been linked largely to the arrival of new population groups, which were connected to the Rhine Valley and central Europe. Acknowledging that diversity of situations, the following text is divided into discussions of each particular region.

THE PARIS BASIN

In the Paris basin farming appeared abruptly at the end of the sixth millennium B.C., in connection with the arrival of a late *Linearbandkeramik* population originating from more easterly areas. This culture, represented from the Balkans to the eastern fringe of the Paris basin, had very long houses and a distinctive pottery style with linear designs. It was responsible for the spread of domesticates and cultigens in its distribution area. Whether this diffusion also involved an active role of local Mesolithic populations—via exchanges and acculturation—is still a matter of debate. In the Paris basin, however, the situation seems relatively clear. During the last centuries of the sixth millennium B.C., in the eastern part of this region, a "package" of new techniques—plant growing, animal husbandry, stone polishing, and pottery making—appeared, together with longhouses and single inhumations in flat graves.

Cuiry-les-Chaudardes, in the Aisne Valley 150 kilometers northeast of Paris, is a famous village of this period. It was rebuilt several times and includes about thirty very long houses. Hamlets of this kind also existed in the Marne, the Seine, and the Yonne Valleys. *Linearbandkeramik* people introduced peas (*Pisum sativum*), lentils (*Lens culinaris*), emmer (*Triticum dicoccum*), einkorn (*Triticum monococcum*), and naked barley (*Hordeum vulgare* var. *nudum*) to the Paris basin. Flax (*Linum usitatissimum*) and poppy (*Papaver somniferum*), represented at some *Linearbandkeramik* sites in Germany, the Netherlands, and Belgium, have not been found so far. As for domestic animals, cattle (*Bos taurus*), pigs (*Sus scrofa domesticus*), sheep (*Ovis aries*), and sometimes goats (*Capra hircus*) are present at *Linearbandkeramik* sites of the area. Animal husbandry usually relied on cattle and sheep. Dog (*Canis familiaris*) remains are very scarce at sites of this period, but this only means that the species probably was not consumed.

The hypothesis of local domestication of cattle and pigs (technically possible, as their wild progenitors—aurochs [*Bos primigenius*] and wild boar [*Sus scrofa scrofa*] respectively—were present in western Europe) that had been promoted for some time has been rejected in the light of new metrical analyses and, with respect to cattle, DNA results. Sheep and goats, which had no wild ancestors in Europe, were domesticated in the eastern Taurus region in present-day Turkey and in the Zagros region on the border between present-day Iraq and Iran during the ninth millennium B.C. and the beginning of the eighth millennium B.C. From the beginning of the seventh millennium they spread across Europe following the two main streams of Neolithic dispersal: along the northern coastline of the Mediterranean and across the Continent following the Danubian corridor. When they entered the Paris basin, shortly before 5000 B.C., these species had a long history of relations with humans and had traveled about 3,000 kilometers from their point of origin.

Scholars lose track of the Mesolithic cultures in the Paris basin several centuries before the arrival of the *Linearbandkeramik*. The direct causes of this disappearance are unclear, although they probably are linked to the arrival of farming groups. Data documenting the end of the Mesolithic are scarce in this region, but the evidence from sites at Noyen-sur-Seine in the southeast or at Dreuil-lès-Amiens in the north, both dated to the middle of the sixth millennium B.C., shows no warning of an imminent change. Both sites have yielded quantities of large game bones and no trace of domestic plants or animals. Noyen-sur-Seine, located at the very bottom of an old branch of the Seine, very likely was a fishing camp, as shown by numerous eel (*Anguilla anguilla*) and pike (*Esox lucius*) bones as well as the presence of fish traps made of willow twigs and hooks made of boar tusk enamel.

By the mid-fifth millennium the hamlets of longhouses vanished from the Paris basin, and causewayed enclosures appeared. In the southern part of the region an original culture, the "Cerny group," emerged. Its pottery retained features from the *Linearbandkeramik*, but other characteristics were entirely new: funerary practices, for instance, with the erection of earthen long barrows clustered in large cemeteries, which replaced the *Linearbandkeramik* small graveyards of flat graves. Balloy and Vignely, south and east of Paris respectively, as well as Passy-sur-Yonne and Villeneuve-la-Guyard, in northern Burgundy, are important cemeteries from this period. Grave goods included new items, such as wild boar tusks, deer canines, carnivore teeth, pond turtle (*Emys orbicularis*) shells, bird talons, and flint arrowheads. They evoke a very different universe from the one represented by joints of domestic animals placed in *Linearbandkeramik* graves. These new symbols might have had their roots in the Late Mesolithic, as suggested by the evocation of hunting and the close parallels with items recovered at the famous, well-preserved Late Mesolithic cemeteries of Téviec and Hoëdic in Brittany discussed below.

Important changes also took place in the economic sphere. The production of flint blades, previously important, declined, and the lithic industry shifted toward a heavy, flake-based one. Animal husbandry focused almost completely on cattle exploitation, and crop growing was marked by the disappearance of lentils and peas and the introduction, probably via connections with the south of France, of a new cereal, the bread-type wheat (*Triticum aestivum/durum*).

At the same time in the northeast of the Paris basin the Rössen and Epi-Rössen cultures developed in connection with the Rhine Valley. Although they were different from their *Linearbandkeramik* predecessor in the Paris basin, they retained an important blade component in their flint industries. Animal husbandry, which relied partly on pigs, showed significant differences with both the *Linearbandkeramik* and the Cerny group. On the basis of the Cerny group and the post-*Linearbandkeramik* Rössen culture, a northern branch of the Chasséen culture (*Chasséen septentrional*) and a westerly branch of the Michelsberg culture developed and interacted in the Paris basin toward the end of the fifth millennium.

A new cereal, the hulled barley (*Hordeum vulgare* var. *vulgare*), appeared in the records of this period and tended to replace the naked variety (*Hordeum vulgare* var. *nudum*). Poppy, which had been present for a long time in more easterly regions, is evident on several sites of either culture. Wetlands started to be extensively exploited at that time. The settlements of Bercy on the eastern outskirts of Paris and Louviers in Normandy are situated in regularly flooded areas, at the bottom of the Seine and the Eure Valleys respectively. Their locations offer good parallels with the Late Mesolithic site of Noyen-sur-Seine, but they are devoted to different activities: Bercy and Louviers probably are linked to the use of good pastures for cattle and not to fishing. The latter point is confirmed by stable isotope analysis (especially nitrogen) that shows no indication of freshwater fish in the human diet.

BRITTANY AND WESTERN FRANCE

Claims have been made that domestic animals appeared at the very end of the Mesolithic in Brittany. These claims relied on cattle and sheep remains at Beg-an-Dorchenn, near Quimper, in the southwest of this region, and at Téviec, near Quiberon, in the south. Some of these remains have been reexamined and turned out to be of much more recent date (Iron Age). Moreover, the reanalysis of the faunal assemblages from settlements dating to the end of the Mesolithic in this part of western France has not verified remains of any domestic animals except dogs. (Remains of this species have been found at Téviec.) The meat supply was based on a combination of shellfish, fish, large terrestrial and marine wild mammals, and various birds, mostly ducks and auks. Stable isotope analyses (carbon) have shown that among these different food sources, marine items were the most important. Livestock also is absent from funerary contexts at Téviec and Hoëdic, two Late Mesolithic cemeteries in the south of Brittany. In these contexts grave goods of animal origin are deer antlers, deer and wild boar mandibles, carnivore paws, and white-tailed eagle (*Haliaeetus albicilla*) talons.

In the 1990s, however, two complete bovine skeletons, in all likelihood domestic, were discovered below a long mound at Locmariaquer, in the Gulf of Morbihan. They were associated with an early date, c. 5300–5000 B.C., which corresponds locally to the Late Mesolithic. There are two potential sources for these domesticates. The first is the area to the south of the Loire estuary, where Neolithic elements of southern origin (Late Cardial), dating to the final centuries of the sixth millennium, have been found. The second is the eastern part of Brittany, where a village with longhouses of Villeneuve-Saint-Germain (a culture of *Linearbandkeramik* descent) character has been dated to the beginning of the fifth millennium. Other research has discovered a Mediterranean Neolithic influence on the late Mesolithic lithic processing techniques in southern Brittany, suggesting that a southern route is most likely.

Acquiring domesticates does not translate into becoming a farmer if technical knowledge was not transferred at the same time. Unfortunately, we have no zooarchaeological record of what followed this very first occurrence of livestock in Brittany, acidic soils often being merciless to bones. A few sites of the fifth millennium B.C., located farther south in west-central France, have yielded faunal samples containing sparse domesticate remains. They could indicate a gradual adoption of animal keeping, but more conclusive data is needed.

In Brittany stable isotope data showed a dramatic shift of the human diet from seafood to terrestrial resources occurring during the fifth millennium B.C. This shift presupposes a profound economic change and could have resulted from the adoption of farming. Whatever the real place of domestic animals in the Neolithic economy of Brittany and west-central France at that time, there is strong evidence that cattle and small livestock were at the center of symbolic systems in these regions. They are represented on megaliths of this period, as on the broken slab reused as capstones at Gavrinis and Locmariaquer, in the Gulf of Morbihan, and buried with the dead, as in the long mound of Saint Michel at Carnac (also in the Gulf of Morbihan). Their horns also adorn bowls of the Chambon and Monbolo groups, which extend from the Loire estuary to the Pyrenees in the mid-fifth millennium.

The appearance of domestic plants and plant growing in western France is not easy to trace either, data being scarce and incomplete. Bread-type wheat is the most common cereal found in the early to mid-fifth millennium B.C. in western Normandy, Brittany, and west-central France. This tends to confirm the role, also evident in pottery styles and lithic technology, played by the Mediterranean Neolithic, together with a Neolithic of *Linearbandkeramik* origin, in the dissemination of farming in the western part of France. Examples of naked and hulled barley also have been found at sites of the mid-fifth millennium B.C. Neolithic farming also spread over peripheral islands, and most of them were exploited for animal keeping and probably cereal growing before the turn of the third millennium B.C. Settlements in Brittany dated to this period on Houat Island, off the southern coast, and on Molène Island, off the western coast, contained quantities of domestic animal remains, mostly of cattle and sheep.

SOUTHERN BRITAIN

Strikingly, there is no evidence of domestic livestock or cultigens in Britain before the first centuries of the fourth millennium B.C., even though farming had appeared at about the end of the sixth millennium on the other side of the English Channel, in the Rhine Valley and in northern France. Domestic animals and cultivated plants seem to have appeared in great numbers in southern England around 3900–3700 B.C., often in causewayed enclosures (Maiden Castle, Dorset, and Windmill Hill, Wiltshire) or in funerary contexts, as in earthen long barrows (e.g., Fussell's Lodge, Wiltshire), where they outnumber other species.

The sacred character of tombs and the still unclear function of monumental enclosures have led many authors to consider faunal and plant remains found in these contexts as not representative of what really was produced and consumed in everyday life. Similar characteristics (with domesticates far outnumbering wild animals and cereal grains found in high concentrations) have been noted from non-causewayed enclosure sites in southern England, such as the settlement at Runnymede, Surrey, or in middens at Hazleton and the Stumble (in Gloucestershire and Essex respectively). The picture provided by causewayed enclosures perhaps is not that far from the economic reality of the period. This could signify that farming had taken over abruptly in southern England sometime around 4000 B.C.

With the exception of the Maiden Castle assemblage, the faunal spectra in southern England at the beginning of the fourth millennium B.C. correspond to those identified in the Paris basin and adjacent areas to the east during the last centuries of the fifth millennium and the first centuries of the fourth millennium in both causewayed enclosures and unenclosed settlements. These assemblages either are overwhelmingly dominated by cattle or else feature pigs as a major element. The first type (cattle) belongs to Cerny and Chasséen contexts (mostly in the western half and south of the Paris basin) and the second (pigs) to Rössen and Michelsberg contexts (in the northeast of the Paris basin and the Rhine Valley). This could point toward the Paris basin and to the Rhine Valley as areas of origin for the husbandry practices that appeared in southern Britain at the beginning of the fifth millennium B.C. Supporting this point of view are metrical data that show that Early Neolithic cattle from southern Britain were distinctly smaller compared with the local aurochs (which seriously weakens any hypothesis of local domestication). They also were very close in size to contemporary domestic bovines from the Paris basin and, to some extent, from western Germany.

Cereals found at Early Neolithic sites of southern England are mostly emmer and bread wheat, with einkorn and barley also sometimes represented. These were all species known at that time on the other side of the English Channel. These finds are in agreement with indications yielded by the Early Neolithic ceramic evidence, with the widespread

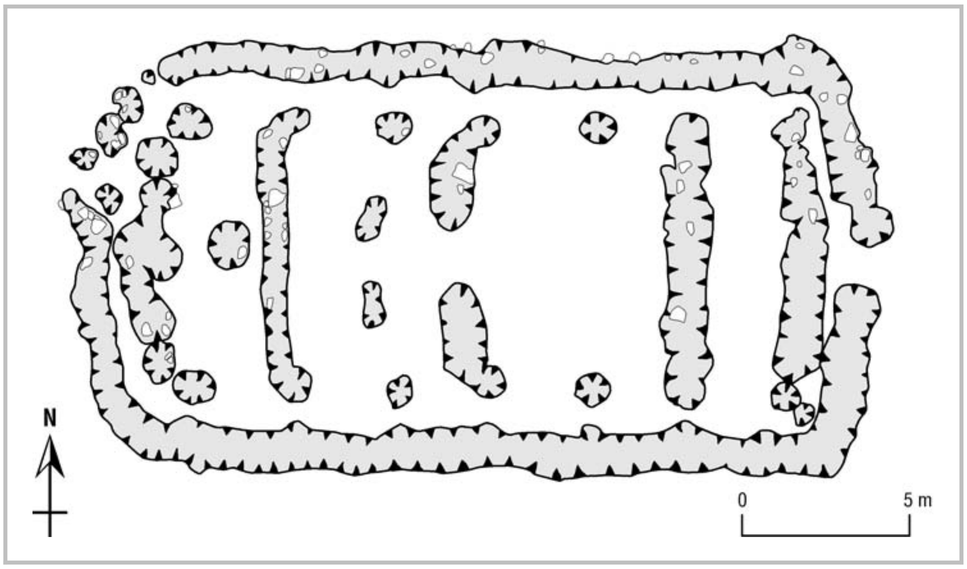

Fig. 1. The Balbridie timber hall plan (Grampian, Scotland). ADAPTED FROM FAIRWEATHER AND RALSTON 1993.

Carinated Bowl style echoing, though not exactly matching, Continental Michelsberg and northern Chasséen (*Chasséen septentrional*) pottery. Direct proof of contact across the English Channel is also offered by the presence of jadeite axes of Alpine origin in the south of England (and elsewhere in Britain and Ireland) around 3800 B.C. The presence of a few metadolerite axes from Plussulien (a polished axe workshop in the center of Brittany) in the south and the southwest of Britain also suggests contacts along a more westerly route.

SCOTLAND

As in southern Britain, there is no trace of domestic livestock or cultivated plants in Scotland before c. 4000 B.C. In this region acid soils have destroyed most of the zooarchaeological record relevant to the transition from the Mesolithic to the Neolithic. In coastal areas, however, shell middens have compensated for this acidity and have produced valuable data regarding the Late Mesolithic use of animals and the human diet. Several sites (namely, Cnoc Coig, Caisteal Nan Gillean, and Cnoc Sligeach) on the island of Oronsay (Inner Hebrides), dated to the end of the sixth millennium into the fifth millennium, produced quantities of limpet shells (*Patella* sp.) and remains of fish, mainly saithe (*Pollachius virens*); gray seal (*Halichoerus grypus*); harbor seal (*Phoca vitulina*); red deer (*Cervus elaphus*); wild boar (*Sus scrofa scrofa*); and marine birds, among them, auks, gannet (*Sula bassana*), geese, and ducks. Morton, in Fife, on the eastern coast of Scotland, yielded similar data.

As in the Mesolithic of Brittany, stable isotope analyses carried out on Mesolithic human bones from Oronsay confirmed the importance of marine items in the diet. None of these sites has produced bones of domesticated animals. Mesolithic plant remains found at Staosnaig on Colonsay (an island near Oronsay) and at Morton do not represent cultivated crops either but include a wide collection of wild greens, such as lamb's-quarter (*Chenopodium album*), corn spurrey (*Spergula arvensis*), and at Staonsnaig, a huge quantity of hazelnuts (*Corylus avellana*). (A cereal grain found at Staosnaig was radiocarbon dated to the second millennium B.C.)

A much different picture is furnished by one of the first Neolithic sites in Scotland, at Balbridie, in the Grampians. Dated to c. 3900–3800 B.C., it has a large timber hall, 24 by 12 meters (fig. 1), and has produced large quantities (more than 20,000) of charred cereal grains. Emmer wheat is the most important, followed by naked barley and bread wheat. Flax seeds also were present in the assemblage. As mentioned earlier, this plant has not been found in the Paris basin and western France but was encountered in the Neolithic of more easterly territories,

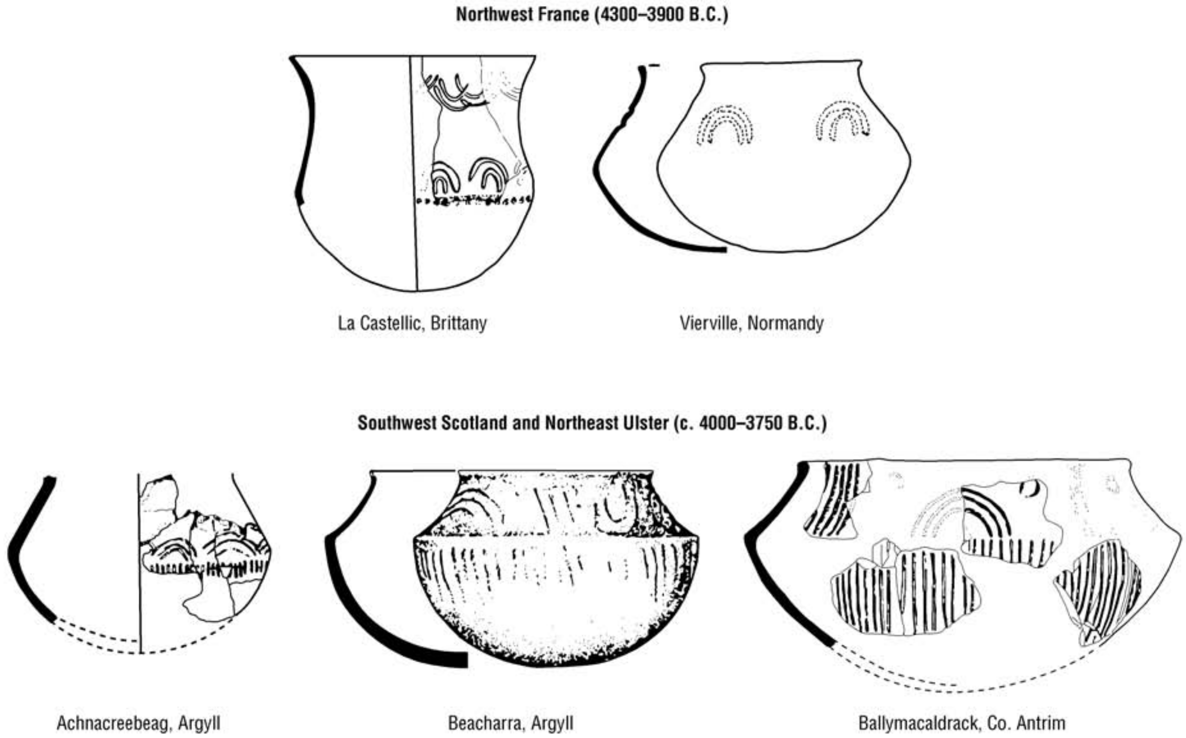

Fig. 2. Carinated bowls from Normandy and Brittany and from southwest Scotland and northeast Ulster, c. 4000 B.C. AFTER SHERIDAN 2000, MODIFIED, COURTESY ALISON SHERIDAN.

such as Belgium, the Netherlands, and Germany. This would suggest that domestic crops were introduced to eastern Scotland from a region situated in one of those areas.

Connections with the easterly territories also are implied in the timber hall architecture that finds good parallels in the Rössen culture. Unfortunately, Balbridie hall did not produce bones, nor did other Early Neolithic sites of mainland Scotland. Key information on Neolithic animal keeping has been obtained from the Orkney Islands. Probably already known to Mesolithic people, as revealed by lithic evidence, the Orkney archipelago was reached by farmers c. 3600 B.C., only a few centuries after the appearance of farming in the rest of Britain. The Knap of Howar, on the island of Papa Westray, is a small farmstead dated to this period. Shellfish, fish, and seabirds still were exploited at that time, as in the Mesolithic of mainland Scotland, but domestic animal bones far outnumber them in the assemblage. Animal husbandry relied on cattle and sheep; there was evidence of pigs as well but in far smaller quantities. Domestic animals had to be brought to the islands by sea, which indicates the existence of large seaworthy boats. The same is true of the Outer Hebrides, where farmers landed during the fourth millennium, introducing cattle, sheep, and pigs.

Paradoxically, Neolithic farmers of about 3000 B.C. also brought a wild species—red deer—to the Orkneys (from where it disappeared sometime during the Middle Ages) and at roughly the same time to the Outer Hebrides. In the Orkneys isolation of these animals on small islands quickly led to a significant reduction in their stature. Reasons for their introduction are unclear; the need for antlers as raw material does not seem to be a sufficient explanation, and a deposit of complete animals, at the Links of Noltland (Westray, Orkney), a site dated to the late third millennium or early second millennium B.C., argues that symbolic aspects are not to be neglected. However this deposit is explained, this example weakens any rigid definition that might be offered of the domestication process and domestic status.

IRELAND

Red deer was a major terrestrial resource for most of the Mesolithic groups in Europe. Research has

	Paris Basin	Brittany	Southern Britain	Southern Ireland
Introduction of domesticates or local domestication	Introduction	Introduction	Introduction	Introduction
Date	c. 5000 B.C.	Around or prior to 5000 B.C.	c. 4000/3800 B.C.	c. 4300–4000 B.C.?
Context	Farming pioneers	Late Mesolithic?	Farming pioneers?	Late Mesolithic
Origin assumed				
Cattle	Danubian World: Eastern France, Germany	Danubian World? Paris Basin? Dates could also fit with the Mediterranean stream	Northern Chasséen or Michelsberg? Paris Basin	NO DATA AVAILABLE - But France or Spain should be considered
Sheep	Danubian World: Eastern France, Germany	NO DATA AVAILABLE	Northern Chasséen or Michelsberg? Paris Basin or Rhine Valley/ W Germany?	NO DATA ANALYZED
Pig	NO DATA ANALYZED	NO DATA AVAILABLE	NO DATA ANALYZED	NO DATA AVAILABLE
Acquisition of domesticates by hunter-gatherers	NO EVIDENCE	YES? Locmariaquer	NO EVIDENCE	YES - Ferriter's Cove, Dalkey Island, Kilgreany
Introduction of husbandry techniques	YES	NO DATA AVAILABLE	YES	YES?
Origin assumed	Danubian World	NO DATA AVAILABLE	Chasséen/Michelsberg	Castellic?

The appearance of animal husbandry in northwestern Europe. ADAPTED FROM TRESSET 2002.

shown, however, that the species probably was absent at that time from Ireland. It is likely that it was (re)introduced to the island at approximately the same time as it was to the Orkneys and the Outer Hebrides, at the turn of the third millennium, at least one millennium after the end of the Mesolithic in the area. Thus, Irish Mesolithic peoples did not know red deer and relied primarily on wild boar, birds, and fishes (mostly members of the salmon family and eels) with shellfish as well on the coastline.

Domestic animals (mostly cattle but perhaps also sheep) seem to have appeared for the first time in coastal contexts, in middens dated to the end of the Irish Mesolithic (mid- to late fifth millennium B.C.). The radiocarbon date obtained directly from one cattle bone recovered at the Late Mesolithic site of Ferriter's Cove, in the Dingle Peninsula (southwestern Ireland), is situated c. 4350 B.C. At that date animal husbandry and plant growing had not yet taken hold in Ireland nor in neighboring Britain. As cited earlier, sheep and goats originated in the Near East and could not have been domesticated from wild progenitors in Ireland. Aurochs (*Bos primigenius*) were absent from earlier, Pleistocene and Early Holocene, contexts and probably never existed in Ireland.

This evidence points strongly to one or more episodes of contact between certain parts of Ireland and the western Continent, where domesticates and husbandry appeared during the sixth millennium B.C. (in Spain, Portugal, and southern France) and the early fifth millennium B.C. (in northwestern France). The appearance of a pottery style of Breton inspiration (the "Castellic" style) at the end of the fifth millennium or at the beginning of the fourth millennium at Achnacreebeag, on the Argyll Peninsula in the north of the Irish Sea (fig. 2), might substantiate such contact. The process of domesticate introduction in a Late Mesolithic context noted at Ferriter's Cove has a close parallel in Brittany one millennium earlier. The few stable isotope data obtained from human bones from Ferriter's Cove do not reveal any important impact of this introduction on diet, which continued to rely mainly on marine resources. As in Brittany, there is no proof that the presence of domesticates led to the adoption of animal keeping; it is not known whether or not husbandry techniques were introduced at the same time as the animals.

Information at present supports the idea that definitive animal husbandry and plant growing appeared in Ireland c. 3800–3700 B.C. as part of the "Neolithic package" that included houses, pottery making, stone polishing, and the building of funerary monuments. Sites at Tankardstown, in County Limerick, and at Cloghers, in County Kerry, that date to this period have produced evidence of rectangular house layouts together with the bones of cattle and sheep. Numerous grains of emmer wheat also have been found at Tankardstown. House plans dating to the beginning of the fourth millennium are widespread in Ireland, but owing to the acidity of soils, bones have been preserved at only a few. The pottery style represented at Tankardstown is of the Carinated Bowl tradition, also widespread in Britain (see above). Thus, the appearance of farming c. 3800–3700 B.C. does not seem to be linked to the introduction of livestock in the second half of the fifth millennium.

The appearance of farming in northwestern Europe was a long and complex process, stretching over nearly two millennia and effected through exchanges, influences, colonization, and acculturation. From that point of view, distinct regions tell rather different stories (see table): colonization of new territories most likely played a role in the dissemination of farming techniques together with livestock and crops in the Paris basin, in southern Britain, and to some extent in Scotland. In Brittany and in fifth-millennium Ireland more complex processes of interaction between farming incomers and local foragers seem to have been involved in the introduction of domesticates. In Ireland it is likely that two separate episodes of introduction occurred, one affecting some coastal areas during the late fifth millennium, the other, more widespread and from a different source, occurring at the beginning of the fourth.

Another striking dimension of the process is the numerous long-distance contacts involved, following routes between the Lower Rhine Valley and the eastern coast of Britain, the Paris basin and southern England, and the Continental facade and the Irish Sea. These long-distance contacts are perceptible through the circulation of very different items, such as pottery styles, lithic technologies, polished axes, cereals, and domestic animals. No general model can capture this complexity, and Gabriel Cooney's statement in *Landscapes of Neolithic Ireland* that it is essential to think about the Neolithic "in terms of local worlds linked by exotic elements" exactly applies here.

See also **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Neolithic Sites of the Orkney Islands** (*vol. 1, part 3*); **Hambledon Hill** (*vol. 1, part 3*); **Transition to Farming along the Lower Rhine and Meuse** (*vol. 1, part 3*); **The Megalithic World** (*vol. 1, part 4*); **Avebury** (*vol. 1, part 4*); **Barnenez** (*vol. 1, part 4*); **Boyne Valley Passage Graves** (*vol. 1, part 4*).

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ANNE TRESSET

NEOLITHIC SITES OF THE ORKNEY ISLANDS

Fifteen kilometers off the northern tip of Scotland at latitude 59° north lie the Orkney Islands. This northerly location makes Orkney a land of contrasts. During the summer, the days are long, with only a few hours of darkness, while in winter the situation is reversed. The islands have a desolate but verdant landscape on which few trees are found. Thus the sky and the horizon dominate all views of Orkney. Under the fertile soil lies sandstone bedrock that yielded the stone slabs that provided much of the building material used by the prehistoric inhabitants of these islands in the absence of timber.

The Orkney Islands were settled by farmers in the first half of the fourth millennium B.C. Radiocarbon dates place the oldest recorded Neolithic settlement at Knap of Howar (on the tiny island of Papa Westray) between 3600 and 3100 B.C., but since this is a fairly elaborate habitation site, it seems likely that pioneers reached Orkney somewhat earlier. The Neolithic settlement at Knap of Howar appears to have been a farmstead with two adjacent oval houses. Both are built of sandstone slabs with a main entrance at the west end. One of the houses is larger, 10 meters long and 4.5 meters wide, while the smaller one is 7.5 meters long and about 3 meters wide. Both are divided into rooms with large upright stone slabs. The large house is interpreted as the dwelling, while the smaller as a workshop, but it is puzzling why they were built as separate units rather than sharing a wall. Alongside the houses is a thick midden, or trash heap, containing bones of cattle, sheep, pigs, whales, seals, sea birds, mollusks, and fish. Grain and pollen from wheat and barley provide faint traces of cultivation.

Neolithic settlement on the Orkney Islands expanded in the late fourth millennium B.C. Along the

Fig. 1. Remains of the Neolithic site of Skara Brae, Orkney. © JOHN GARRETT/CORBIS. REPRODUCED BY PERMISSION.

Bay of Skaill on the largest Orkney island, called the Mainland, a settlement was constructed five thousand years ago at Skara Brae, again using the best local alternative to timber, sandstone slabs. After being occupied and rebuilt over several centuries between about 3100 and 2500 B.C., Skara Brae was abandoned and slowly covered over by drifting sand and turf. In 1850 a severe storm tore away the turf and opened the sand to erosion, revealing the buried settlement. In the 1920s the renowned prehistorian V. Gordon Childe cleared the sand from the houses and exposed the settlement plan at Skara Brae, one of his rare excavation projects. Since then, Skara Brae has become one of the most famous Neolithic settlement sites in Europe, although its unusual character often relegates it to only a brief mention in surveys of European prehistory.

The central precinct of Skara Brae consists of at least eight sandstone houses that had been built in hollows scooped into an old midden, or trash heap. The consolidated midden fill provided external backing for the walls, and the decision to build in it was made consciously. Each house consists of a large rectangular area between 4.5 and 6 meters across with a central hearth. In some houses, smaller alcoves, or cells, open from this central chamber. The houses are connected by tunnel-like passages roofed with stone. We do not know how the houses were roofed, but in light of the general scarcity of timber on Orkney, it is possible that they had rafters of whale ribs covered by hides. Since the house walls survive at a height of about 3 meters, movement under the roof would have been easy even if it was flat.

Of particular interest are the stone fittings within the houses that Childe interpreted as built-in furniture. Slabs and blocks of stone were fashioned into tiered shelf units, often characterized as "dressers," that may have held family belongings, although they could just as easily have stored vessels with food. Stone chests along the sides of the houses may have been filled with heather, straw, and furs to make beds. Stone pits in the floors had their seams filled with clay to make them watertight and may have served to store shellfish, either for human consumption or for bait. In the center of each house was a sunken stone-lined hearth.

The inhabitants of Skara Brae fished, kept cattle, pigs, goats, and sheep, and cultivated barley and wheat on a small scale, very similar to the economy at Knap of Howar. There is some evidence that deer were hunted, and stranded whales were prized as sources of massive amounts of fat and meat. Small fragments of sea-bird eggs suggest that these were gathered.

The pottery found at Skara Brae is known as Grooved Ware due to its characteristic decoration, and it was made in the form of large vessels up to 60 centimeters in diameter. Bone was used for many types of artifacts, including beads for necklaces and awls for working hides. Some of the most distinctive artifacts at Skara Brae are carved stone balls of unknown function, although one theory interprets them as badges of status and prestige.

Several sites with houses similar to those at Skara Brae have been found in the Orkney Islands. Rinyo on the island of Rousay is one such site, although it is not as well preserved as Skara Brae. The settlement at Links of Noltland on the island of Westray is believed to be substantially larger than Skara Brae. It seems that Orkney was the location of quite a few such Neolithic farming communities during the period between 3100 and 2500 B.C.

The most important Neolithic settlement excavated since 1980 on Mainland Orkney is Barnhouse, located on a low promontory in the center of the island, very close to several passage graves and stone circles. Barnhouse was constructed in several stages, with houses built, demolished, and built over. One house was rebuilt four times. The houses were freestanding, without the midden backing and connecting passageways observed at Skara Brae. Two of the houses are more complex and much larger than the others. The larger of the two is a square space 7 meters across with walls up to 3 meters thick, set on a clay platform that in turn was surrounded by a stone wall. It contained a large central hearth and a stone "dresser." The function of this building is difficult to discern. Was it the residence of a high-status individual, or was it a communal ceremonial hall?

Some of the most important information from Barnhouse has come from the chemical analysis of residues on sherds of Grooved Ware. Many of them tested positive for residues of wheat and barley, cattle meat, and, most interestingly, milk. The need to keep milk cool in upright vessels where they could not be knocked over suggests a function for the stone "dressers" and perhaps the other stone furniture as well.

The windswept Neolithic landscape on Orkney must have been dramatic. Coastal and interior communities with stone houses kept livestock, grew grain, and fished. Immense passage graves like Maes Howe and Quanterness were the repositories for the dead members of these communities. Silhouetted against the sky were ceremonial stone circles such as the Ring of Brodgar and the Stones of Stenness. Although remote from the main developments of prehistoric Europe, the Neolithic sites of the Orkney Islands provide a glimpse of a thriving tribal society making use of everything it could wring from the land and the sea.

See also **Beginnings of Farming in Northwestern Europe** (*vol. 1, part 3*); **The Megalithic World** (*vol. 1, part 4*).

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PETER BOGUCKI

HAMBLEDON HILL

Hambledon Hill is set as an "island hill" on the northwest edge of the Cretaceous ridge as it crosses southern England where Cranborne Chase and the North Dorset Downs are cut through by the River Stour as it flows to the south coast just east of Bournemouth. At this point the chalk downland, of which Hambledon Hill is geologically a part, overlooks an area of the broad inland floodplain of the Stour and tributary rivers to the northwest known as the Vale of Blackmoor. Rich dairy farming land now, this area in early prehistory would have presented a variegated range of potentials for both farming and hunting-gathering. The chalk downland appears to have been covered largely by woodland rich in oak, elm, ash, and birch. The River Stour and its northern tributary, the Iwerne, at the confluence of which Hambledon Hill stands, in themselves would have formed an important economic resource as well as being the focus of routes to the site.

Modern Hambledon Hill lies 6 kilometers northwest of Blandford Forum, Northeast Dorset (at British National Grid reference ST 848123). The site, of principally Neolithic date, comprises a complex of enclosures set on and around the hilltop that fall into the category of "causewayed" or "interrupted ditch" enclosures that occur widely throughout southern England and that increasingly are being recognized in Wales and Ireland. Some one hundred examples are known, although as yet none of established Neolithic date has been located in northern England or Scotland. These sites are found most often in valley settings, often occupying low spurs at the point where tributary streams enter the floodplain, where they usually are detected by aerial photography. Particularly in southern England, however, many have been known since the early twentieth century, surviving as much reduced earthworks on spurs and eminences of the Cretaceous and Jurassic ridges of the region. It is to this class that Hambledon Hill belongs. Sites of similar type and date occur widely in Northwest Europe from the Baltic to central France.

The investigation of Hambledon took place between 1974 and 1986 and was characterized by four specific approaches. First, a "landscape" perspective was developed of this massive site (the hill itself occupies some 120 hectares) and its hinterland. Second, very large-scale sampling strategies were adopted, involving mechanical topsoil clearance. The subsoil surface had been heavily eroded by solution and agricultural activity (since the Bronze Age), and considerable care had to be exercised to locate and excavate the features of Neolithic date. Third, stratigraphical analysis and taphonomic study were intensively applied to gain maximum information from the very large bodies of artifactual, faunal, and botanical material located on the site. Fourth, a program of radiocarbon dating, involving more than 160 assays, has been undertaken to provide a sensitive chronometer for this disparate mass of material.

The enclosure complex at Hambledon Hill focuses upon an 8-hectare single-causewayed ditched enclosure set, slightly askew, upon the crown of the hill at the point where the three spurs of the hill—north, east, and southeast—meet (see fig. 1). This enclosure is isolated from easy approach from the east and southeast spurs by a series of cross-spur ditches (and almost certainly was isolated from the northern spur before the introduction of the later Iron Age hillfort there eradicated any trace). Set within the southeast cross-spur ditches and immediately south of the focal causewayed enclosure was a small "Dorset-type" long barrow orientated north to south. Its mound had long been destroyed, but its ditches, encircling the south end, were still available for investigation.

These components, set at the focus of the complex, can perhaps be treated as a whole. They jointly, and broadly, compose the earliest facet of Neolithic activity on the site (c. 3800–3600 B.C.), although the long barrow may be of a little later date than the enclosure. Whatever the primary role of the enclosure, it soon was associated with the deposition of debris that appears to have been drawn from extravagant feasting of a periodic nature. Deposition of "prestigious" imported objects (pottery and stone axes) deliberately is evident in groups on the floor of the ditch and in successive recuttings and disturbances in its filling as well as in pits dug in the interior. Considerable quantities of human bone were included among this debris, especially skulls, with one articulated mass of human bone showing clear signs of gnawing by dogs. Some of the bone also showed signs of cut marks that might be associated with defleshing, or cutting the meat off the bone. This part of the complex is interpreted as an area associated with the exposure and treatment of human cadaver material of both sexes and all ages, with associated ceremonial activity, taking place over an extended period of time.

At the tip of the southeastern spur another causewayed enclosure of 1-hectare extent had been constructed at approximately the same date, per-

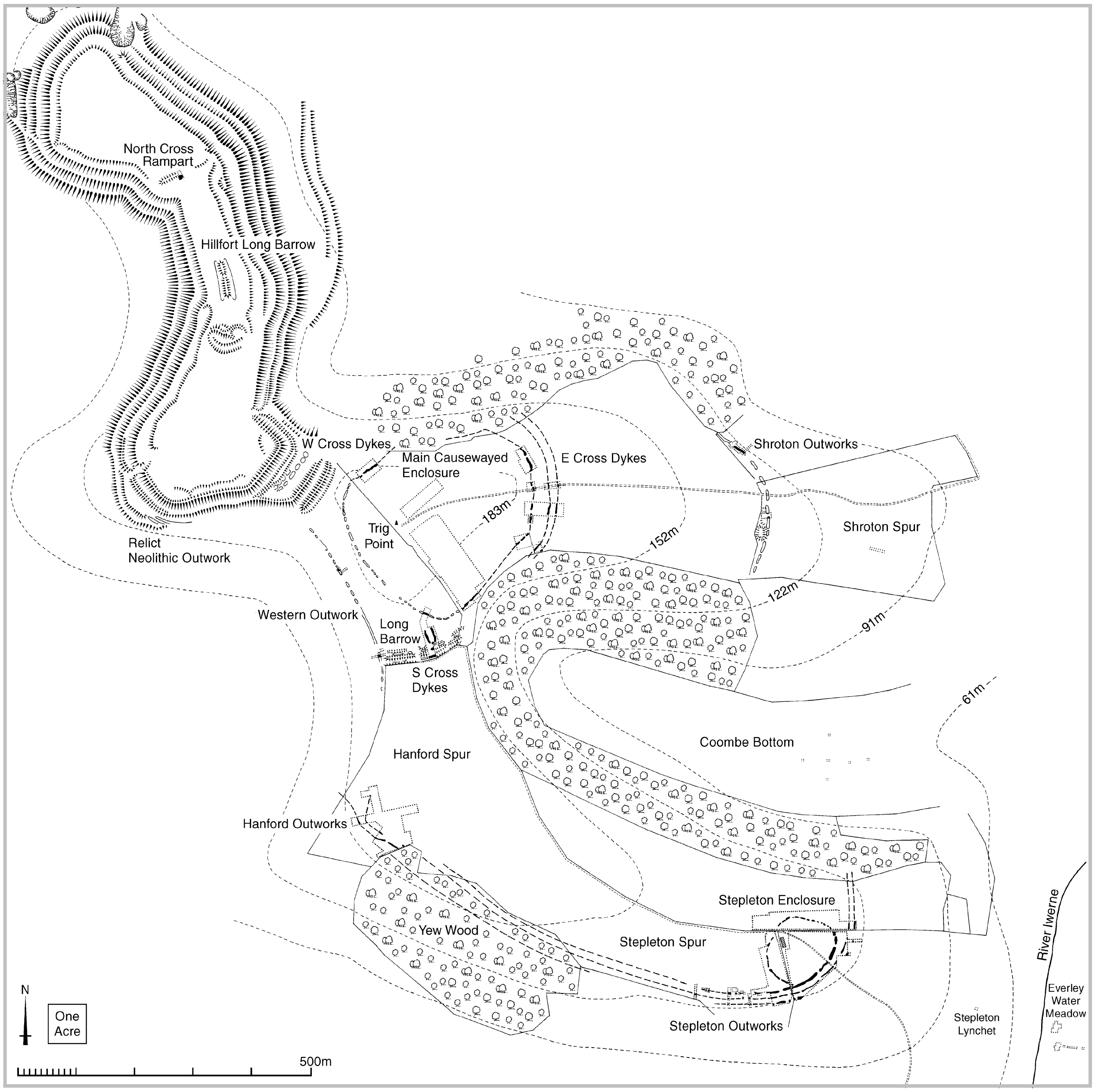

Fig. 1. Site plan of Hambledon Hill. COURTESY OF THE HAMBLEDON HILL PROJECT AND ROGER MERCER. REPRODUCED BY PERMISSION.

haps a little later (known now as the Stepleton enclosure). Deposits on this site, both in the ditches and in features of the interior, suggest a function distinct from that of the focal enclosure just described, not so closely associated with funerary activity but nevertheless ceremonial and not domestic in its character. At both this enclosure and the hilltop example the food consumed on the site seems already to have been prepared upon its appearance there; in fact there is evidence that it was extravagantly prepared and consumed. It may have been the surplus from a hinterland community producing emmer wheat and barley, cattle primarily raised for milk products, as well as sheep and pigs. Only the upper part of the food preparation chain, those parts of the crop or animal actually consumed, is present on this site, however. People came there with a hamper, as it were, to feast. They did not live there; they visited relatively seldom and probably seasonally.

After considerable time had elapsed, the whole hilltop (60 hectares) was enclosed with a series of "outworks" that presented an unassailable facade to all sides (3600–3400 B.C.). Again, in at least two episodes, these defenses (so sited and constructed) apparently were burned and indeed attacked. Two young men, both killed by arrows, lay in the ditch of one of these outworks, their skeletons almost intact. One of these young men seems also to have been partly defleshed.

This center of high prestige, subject to widely originating importation of specialized goods and a possibly isolated center for ceremonials that were associated, probably among other things, with circumfunerary activity over a period of several hundred years, eventually became a focus of power that attracted recurrent episodes of aggression. The program of excavation activity on or near the site continued into the Early, Middle, and Late Bronze Age, the Iron Age, and ultimately the Anglo-Saxon period.

See also **Long Barrow Cemeteries in Neolithic Europe** (*vol. 1, part 3*).

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TRANSITION TO FARMING ALONG THE LOWER RHINE AND MEUSE

The transition from hunting and gathering to food production along the Lower Rhine and Meuse Valleys between c. 5500 and 3500 B.C. is part of a much wider cultural transformation that covered the whole North European Plain from Holland to Poland. Prehistoric living conditions varied widely over the landscapes of this region. Moreover, variability in research conditions in the main natural zones has resulted in unequal data sets from the various zones, forcing investigators to use different research strategies.

MAIN ENVIRONMENTAL ZONES OF THE LOWER RHINE AND MEUSE BASINS

The lower courses of the Rhine and Meuse Rivers run through the country of the Netherlands, in the northwest corner of Europe, facing the southern part of the North Sea. About half of the Netherlands' territory consists of the combined lowland delta of several rivers, including the Rhine, Meuse, and Scheldt, which unload their sediments as they flow into the North Sea. The other half of the Netherlands, to the east and south of the delta, consists of uplands covered by Pleistocene sediments: a wide belt of sandy soils, with a patch of loess in the most southern part of the country. In this discussion, these three environmental zones—delta, sand, and loess—figure prominently.

The Delta Lowland. The lowlands of the western Netherlands measure about 200 kilometers along the coast and extend over 100 kilometers inland. The delta has been drained and transformed into the famous Dutch polderland, but geological research provides a picture of its ancient landscapes. Along the coast were tidal flats, salt marshes, tidal creeks, and lagoons. Behind this tidal zone were extensive peat swamps, and along the rivers a levee and back-swamp landscape formed.

In regard to archaeological sites, the delta is a sedimentary and preservative environment that is also dynamic and thus destructive. Although many sites have been destroyed by erosion, other places were protected by sedimentation. Prehistoric sites of the delta are highly informative for archaeologists, because they have: (1) superbly preserved organic material; (2) natural stratigraphy in sediments that can be correlated with habitation; and (3) intrasite patterns preserved by clay and peat covers. Field research is expensive and technically difficult, but the rewards are great.

The Sand Upland. The upland sand region of the eastern and southern Netherlands is an almost-flat Late Glacial cover sand landscape, less than 30 meters above sea level but with occasional sand and gravel hills as high as 100 meters. It is drained by small streams, and the eastern part of the region is dominated by the lower course of the Meuse. About 90 to 100 kilometers wide, the sand region contrasts archaeologically with the delta lowlands. Neolithic living surfaces still lie uncovered at the present ground level. Sites are surface scatters easily discovered in farmland by survey. Thousands of sites are known, but their information content is low. Material of all periods is often mixed up and difficult to separate, while organic material, bone included, does not survive in the acidic sand.

The Loess Zone. To the south of the sand zone, in the southern province of Limburg, lies the northern fringe of the European loess belt, a region with very specific conditions and a core area for prehistoric occupation and archaeological research. It is a landscape of rolling hills and river terraces, all loess-covered, rising to a height of 300 meters. Slope erosion, colluviation, and alluviation have erased upland evidence of Neolithic occupation and have buried sites on the valley floors. Only the loess communities that preferred plateau locations and dug deep "artifact traps" in the form of pits, silos, and ditch systems are archaeologically known in some detail. The communities established by the *Linearbandkeramik* (also known as the Linear Pottery culture or LBK) farmers of the sixth millennium B.C. are a prime example.

THE ARCHAEOLOGICAL RECORD, 5500–3500 B.C.

The Loess Zone. The LBK settlement cluster on the loess of southern Holland is one of the most thoroughly investigated Early Neolithic microregions in Europe. Beginning in the 1950s, excavations by P. J. R. Modderman at Sittard, Elsloo, and Stein provided detailed plans of LBK settlements. This work permitted the development of a typology of longhouses and led to studies of LBK settlement systems, settlement structure, stone-adze and flint procurement, and social structure. In the late 1980s, large-scale research continued with excavation of the palisaded early LBK settlement of Geleen-Janskamperveld.

Our detailed knowledge of the LBK settlements results from the happy coincidence of their heavy construction and deep pits on plateau-edge locations that were subject to moderate surface erosion. Information is thus available on site location, settlement layout, houses, raw material acquisition, technology, and plant use (based on charred macroremains). Bone has decayed almost completely in the decalcified loess. Environmental reconstruction is based on pollen diagrams from rare valley-floor peat deposits and on charcoal and seed identifications from pit fills. Charcoal from pits has provided dates that place the LBK occupation of southern Holland between c. 5500 and 4900 B.C., which is consistent with the dating of this culture across central Europe.

The loess of southern Holland has yielded considerably less evidence for the Rössen culture that followed the LBK in northwestern Europe, as well as for subsequent Neolithic cultures. A Rössen site has been discovered at Maastricht-Randwijck in a Meuse Valley–bottom location. Only the lower parts of some pits remained, but these yielded artifacts, charcoal, and plant remains. The Rössen culture was succeeded by the Michelsberg culture around 4300 B.C. Undated but certainly post-Rössen flint scatters are documented in the Limburg loess zone, especially on higher locations overlooking valleys. The most prominent Michelsberg sites are still the Neolithic mining centers, dated from 4000 B.C. onward. The well-known Rijckholt mines, with at least 600 and possibly many more shafts, have been investigated by professional miners.

The Sand Upland. The sand upland has yielded over four thousand Stone Age surface sites, but with no intrasite patterns and often mixed assemblages. Dating is based exclusively on flint technology, typology, and raw material. Despite intensive research, special sites that might have had a central function, like earthworks or ritual centers, are absent, nor is there burial evidence.

The Delta Lowlands. People settled in the Rhine-Meuse delta from the Mesolithic onward, and by lucky chance some of their sites have been discovered in special microregions that escaped erosion and where conditions for preservation, recovery, and excavation were favorable. Of particular interest are the dune tops and creek levees that provided small dry spots in the delta wetlands. Stone Age people settled on these high spots, and their rubbish was strewn down the slopes and into the surrounding marshlands, where it was covered over and preserved by later sediments and peat.

Two clusters of Early Neolithic sites, dated c. 4300–4200 B.C., occur in the freshwater peat zone,

Fig. 1. One of the three fish traps made from red dogwood twigs found at Bergschenhoek, The Netherlands. © RIJKSMUSEUM VAN OUDHEDEN, LEIDEN. REPRODUCED BY PERMISSION.

one in the IJsselmeer Basin, the other in the Rhine/Meuse district. The first cluster, near the village of Swifterbant, includes settlements and small inhumation cemeteries on dune tops and on the levees of former creeks. The Swifterbant sites are highly informative due to the preservation of intrasite organization, preservation of bone and botanical remains, and the absence of earlier and later contamination. The second cluster lies in the Alblasserwaard peat district, where systematic prospection revealed that most of the approximately 100 known dune tops were used as settlement locations in several Neolithic phases. No settlement structures survive on these dune-top sites, but Neolithic refuse layers on the dune slopes and in the peat cover are full of information, including wooden and bone artifacts, animal bones, botanical remains, and pollen.

An exceptional site was discovered in 1976 north of Rotterdam near the village of Bergschenhoek, eight meters below sea level, where a small campsite was situated in a wetland landscape that was originally on a peaty lakeshore. Microstratigraphy indicated that the camp was used for ten to twenty years. The remains were silted over shortly after its final abandonment and preserved in very good condition. These include reed bundles that formed the living surface, remains of a dugout canoe, impressive fish traps, and fish remains—scales included. Dated c. 4300 B.C., it can be considered a fowling-fishing station of early agricultural communities in distant regions. Many, perhaps thousands of such sites lie hidden under the delta deposits.

After 4000 B.C., the dune-top site of Hazendonk provides a cultural yardstick for the next two millennia. Phases of intensive occupation were separated by periods of occasional use or even abandonment. The main activities at this site were fishing and hunting, primarily of wetland animals such as beaver and otter but also of large game such as red deer, roe deer, and wild boar. Most surprising is the presence in all occupation phases of domestic animals and plants, as well as pottery and polished axes, marking it as a fully Neolithic site. Yet its location is not one that is favorable for crop cultivation, so the cereals must have been brought in from elsewhere. Hazendonk must have served as a special camp for fishing, fowling, hunting, and herding by societies in transition to a fully agrarian economy.

CULTURAL GEOGRAPHY, SUBSISTENCE, AND SETTLEMENT SYSTEMS

"Classic" Early Neolithic LBK settlements are restricted to the loess zone to which their agricultural system seems to have been intimately linked. But the situation there is complicated by the appearance of two unusual pottery styles, not found farther east, named La Hoguette and Limburg. These have distinct southwestern connections that reach as far as the Mediterranean. Their pottery is generally found in low percentages as an admixture in LBK pit fills. La Hoguette seems to be the earlier of the two, possibly even preceding the earliest LBK in our area of study.

The LBK communities were fully agrarian before their appearance on the Limburg loess. Crops included emmer and einkorn wheat, linseed/flax, lentils, peas, and poppy seeds, all but the last with Near Eastern origins. The poppy has west Mediterranean sources and, in addition to the La Hoguette-Limburg pottery, is a strong argument for contact with that region. The poppy seed is found mainly in the westernmost LBK and only occasionally in central Europe. Charred weed remains indicate small, shaded fields in the woodland. Experimental data suggests good yields over long time spans without manuring. Zoological evidence from the loess region is scarce but seems to indicate a low interest in hunting (only about 10 percent of the animal bones are from wild animals). Cattle are the dominant domesticated species, with pig second and sheep/goat third.

On the sand north of the loess, LBK adzes and arrowheads are thinly spread all over the Meuse Valley as far north as Nijmegen. Neolithic pottery—never more than a few sherds on a site and restricted to later LBK phases—is found only in the southern twenty to thirty kilometers of the sand bordering the loess and generally in association with an LBK flint assemblage. There is some non-LBK pottery on these sites, too. A "pure Limburg" assemblage (without any LBK sherds) has been found at Kesseleyk, and La Hoguette-related sherds were found as far north as Gassel on the fringes of the delta.

What do these modest but significant finds north of the loess reflect? Exchange with Late Mesolithic groups? Expeditions or wanderings from the loess to the north for prospection, hunting, or cattle herding? Or even an extension of permanent Neolithic settlement into this zone? How are La Hoguette, Limburg, and LBK related? The "pure" La Hoguette and Limburg assemblages in this zone might reflect separate, possibly semiagrarian, groups outside the LBK territory. The Late LBK sites with pottery might be seen as a growing penetration of this zone, possibly with transhumant cattle camps. The wider spread of arrowheads and axes tells us that the zone up to 100 kilometers north of the loess must be considered a contact or "availability" zone.

The change from LBK to Rössen around 4900 B.C. represents the transition to a pottery style that had developed along the Upper Rhine between Mainz and Strasbourg. As with the LBK, there is a similar involvement with the area north of the loess, but the Rössen culture probably made wider and more intensive use of this zone. Ephemeral Rössen sand sites lie not far from the loess boundary, and there is a wider and denser spread of two leading types of groundstone implements, the high-perforated shoe-last adze and the broad wedge. The Rössen culture reflects continuity from LBK society, but with a distinct transformation, not only in pottery style but also in economy and settlement system.

Significant economic changes took place during the LBK/Rössen transition, reflected by site location and botany. The crop spectrum changed to bread wheat and barley instead of the earlier einkorn/emmer combination. Moreover, site location seems to have been less prescribed and extended to valley floors. One may speak perhaps of a better adjustment to the specific geographical qualities of the regions as opposed to the more rigid LBK traditions. The subsistence evidence for the Michelsberg culture that succeeded the Rössen is very limited, but many archaeologists argue that it can be considered a "normal" agrarian Neolithic society. It is a great handicap that the Michelsberg sand sites lack biological evidence, which complicates the interpretation of the earliest delta evidence in its wider geographical context.

Until recently, we did not know much about the Mesolithic communities of the sand zone and the delta. In the early 1990s, some modest pottery finds on sites in the Northeast Polder of the IJsselmeer District were dated to c. 4500 B.C., and two baseless (but perhaps originally point-based) pots from Bronneger, in Drenthe Province, yielded accelerator dates of charred crusts at c. 4700 B.C. Based on these finds, it was assumed that the area was used by a western Mesolithic counterpart to the Ertebølle hunter-fisher-gatherer communities of southern Scandinavia.

In 1993 coring in advance of the construction of a new railway line near Rotterdam led to the discovery at Hardinxveld of Late Mesolithic sites on the tops of two small dunes about five meters below sea level. These sites were occupied during the period 5500–4450 B.C. Finds at these sites include the burials of humans and of dogs; many different wooden artifacts, including paddles, bows, and a dugout canoe; and large quantities of animal bone, including fish, birds, beaver, otter, wild boar, and red deer. In the upper levels (4700–4450 B.C.), the earliest bones of domestic animals north of the loess zone were uncovered in modest numbers, including cattle, pig, sheep, and goat. Cereals, however, are still absent in this phase. Finally, a small amount of pointed-base pottery appeared on these sites about 5000 B.C. Thus we have our first glimpse of the communities who may have been in contact with the LBK and Rössen farmers of the loess, 100–150 kilometers distant across the sand belt.

The next stage to be considered is the period of 4300–4100 B.C.. In the northern part of the delta the Swifterbant group can be identified. Its pottery technology and style have close similarities with Late Ertebølle, employing pointed bases, flaring rims, simple shoulder decoration, coiling, and organic temper. The flint industry is, however, quite different and derived from a local Late Mesolithic microblade tradition. Some groundstone broad wedges demonstrate a continuity of adze exchange until this phase. There is, however, one major difference from Scandinavian Ertebølle: the delta sites are distinctly semiagrarian, as will be described below. Contemporaneous assemblages in the southern half of the delta (Hazendonk 1, Brandwijk, Bergschenhoek) have distinct technological and stylistic connections to the southeast, that is to the Late Rössen of the Rhineland. But there are also traits in common with Swifterbant along with some original characteristics.

The early delta Neolithic sites (4300–4100 B.C.) are located in agriculturally unattractive zones and on locations that offered restricted opportunities for farming and animal husbandry. Surprisingly, all sites produced quantities of charred seeds and chaff of cereals, and bones of domestic animals make up 10 to 50 percent of the total. In view of the location of the sites and evidence of many hunted animals (mainly beaver and otter), successive occupations by specialist hunters provides the most plausible interpretation for all Hazendonk levels. The Swifterbant levee sites, with evidence for complete households (milk teeth of children, burials), are probably summer residences, with permanent settlement as a second option. Bergschenhoek is undoubtedly a repeatedly used short-term winter fowling-fishing camp.

This type of subsistence in the delta could be called not only semiagrarian but also "extended broad spectrum," since all classical Mesolithic subsistence activities (hunting, fowling, fishing, foraging) were extended with animal husbandry and at least the consumption, if not also the growing, of cereals. But the delta Neolithic sites are only the wetland elements of larger regional settlement systems. The presumed upland sites of these systems are as yet hardly known.

Some adoption of agriculture, more specifically animal husbandry, had begun north of the loess at least around 4500 B.C., while crop cultivation is only attested about five centuries later. The process was predominantly, if not exclusively, one of addition and not a new wave of colonization. Neolithic elements were included in a basically native Mesolithic society: early pottery styles have distinct regional traits; settlement systems and subsistence strategy have firm Mesolithic roots and contrast to the "full Neolithic" of the loess zone.

We can conclude several things. First, apparently the delta wetlands were perceived as an attractive environment and that the demonstrably variable means of subsistence apparently was fully acceptable at that time. Second, in view of the ecological constraints of the delta environment, communities with a similar or even fuller adoption of food production should be presumed on the upland sand, independent of the functional interpretation of the delta sites. Third, the wide occurrence of Michelsberg sites in the Meuse Valley—contrasting with the absence of upland sites farther north—might be partially caused by the use of the highly diagnostic and conspicuous large Rijckholt flint artifacts, but it might also reflect a more permanent and stable settlement system.

EXPLAINING THE TRANSITION TO AGRICULTURE

We have to cope with not one but essentially with two problems: first, why did the Mesolithic people of the North European Plain *not* turn to agriculture in LBK times and, second, why did they did they then adopt agriculture in the second half of the fifth millennium B.C.? This change took place all over Northern Europe—not exactly in the same way everywhere, but that's not so astonishing in view of the size of Northern Europe. One might think of a technical or agro-technical improvement that made agriculture, especially crop-cultivation, sufficiently attractive to be adopted around 4200 B.C. The development of the ard, a light plow, might meet these requirements. It allowed the cultivation of large fields with relatively low yields on the poor or even acid northern soils. More speculative is the idea that improved crops were developed for cultivation in these conditions and at these latitudes, but there are no archaeological arguments in this respect.

Perhaps this is a situation that has no good modern analogy. We are studying the confrontation between fully agrarian colonist-settlers who practiced hoe cultivation and broad-spectrum hunter-gatherers with presumably restricted mobility. They met in an unspoiled temperate environment with full opportunities for all communities involved to select optimal site locations for their activities. Both populations, the colonists and the natives, had widely different cultural roots. Those of the LBK and its successors are traced to southeastern Europe and ultimately the Near East. They were non-mobile and built heavy, more than minimally functional, housing. Most striking, however, is their attitude toward nature, their perception of environment. Their way was to play it safe—to adopt a low-risk strategy. This meant that they utilized a very narrow range of subsistence activities, which are reflected in their choice of specific settlement locations on the edges of loess plateaus or along brooks in loess-covered districts and in their reliance on cattle and cereals. In other words, they disregarded the natural food sources of the area to a large extent.

The Mesolithic "natives" and their descendants, in contrast, had their roots far back in the Late Palaeolithic of Northern Europe. Their subsistence shows an appreciation of everything nature offered. Their perception of nature clearly was different from that of the LBK people. They were, moreover, mobile, with light "minimalist" housing.

Such differences in mentality can possibly explain the lack of adoption of Neolithic elements in the millennium of contact between 5500 and 4500 B.C. Fundamentally different attitudes had to be bridged. This implies that each culture complex gradually had to transform in the other's direction. The adoption of cattle and crops at a given moment by the native communities might have had something to do with the lowering of risks in the harsh season, with the perceived prestige involved with agriculture, or with technological innovation that made the growing of crops more attractive than it had been before.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **The Mesolithic of Northwest Europe** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Transition to Agriculture in Northern Europe** (*vol. 1, part 3*).

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LEENDERT P. LOUWE KOOIJMANS

TRANSITION TO AGRICULTURE IN NORTHERN EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

The beginning of the Neolithic is defined as a change in economy where domesticates become part of the subsistence. Other aspects of material culture, such as pottery, certain axes, longhouses, and burial mounds, are not a priori associated with the term "Neolithic." Cereals and livestock were introduced from the Middle East and spread through southeastern Europe to central and northern Europe. This process moved by fits and starts; domesticates extended very quickly over vast areas, followed by a standstill lasting up to several hundred years. The first Neolithic culture to make its way into central Europe was the *Linearbandkeramik* (5700–4900 B.C.). In northern Germany the earliest domesticates are found in the context of late Ertebølle-Ellerbek culture c. 4700–4600 B.C. In southern Scandinavia food production appears with the advent of the Funnel Beaker culture and at some late Ertebølle sites c. 4000–3900 B.C. The spread of food production in central and northern Europe is a process that has been the focus of debate and many investigations. The main question is whether farming spread through colonization or by the indigenous adoption of ideas by the local population. A combination of migration and local adoption is a third option.

The transition to agriculture in northern Europe began during the Atlantic climate zone, characterized by a relatively warm and damp climate; a dense climax forest of linden, oak, elm, and ash; and cyclical sea-level changes called the Littorina transgressions. By about 4000 B.C. the start of the Subboreal climate zone brought about a change toward a cooler and drier climate, but still warmer than today. A drastic decline in elm c. 3900 B.C. took place over central and northern Europe; this decline appears to have been a natural phenomenon caused by elm disease. Clearing of the woodlands is indicated by fewer numbers of the dominant trees of the primeval climax forest (linden, oak, and ash) and by a second growth of light-demanding trees, such as birch, poplar, willow, and hazel. Deforestation probably reflected the work of farmers as they made way for fields and pastures.

Around 5700–5600 B.C. the *Linearbandkeramik* culture brought the first farming settlements to the central European uplands as well as to parts of the North European Plain along the Oder and Vistula Rivers. The *Linearbandkeramik* economy was based almost entirely on domesticated plants and animals, and its settlements are concentrated on fertile loess soils along streams. The spread

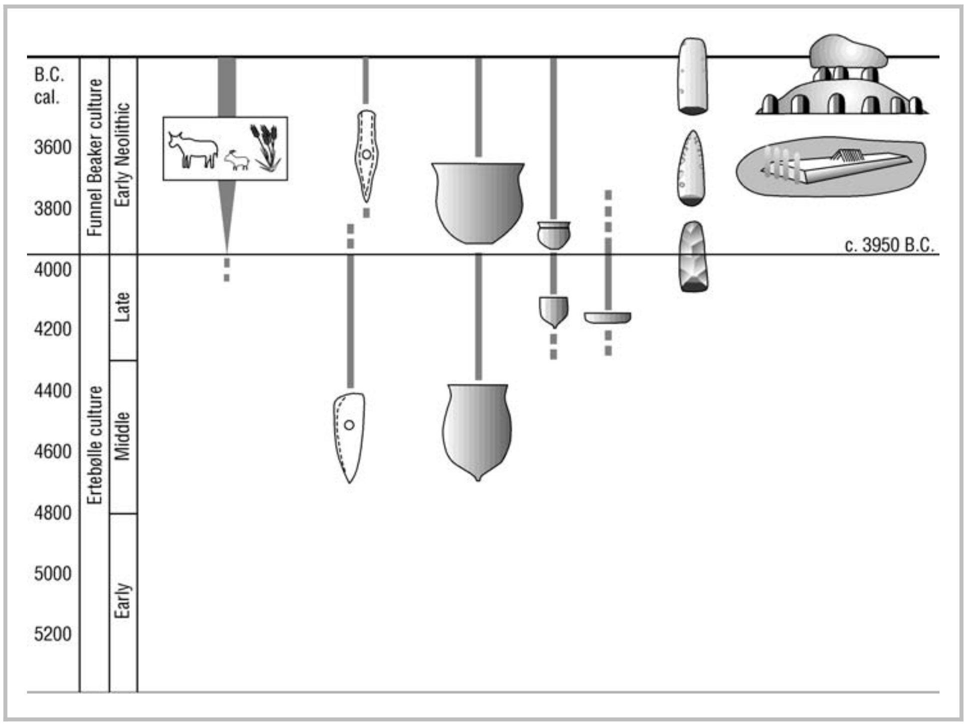

Fig. 1. Schematic of changes in material and economic culture between Ertebølle and Early Neolithic Funnel Beaker cultures in Denmark-Scania. ADAPTED FROM FISCHER IN FISCHER AND KRISTIANSEN 2002.

of the *Linearbandkeramik* is commonly attributed to the colonization of habitats favorable to agriculture through the progressive movement to the north and west of farming peoples from the Danube Valley. Analyses of strontium isotopes from *Linearbandkeramik* skeletons in the Rhine Valley suggest that local people also may have been involved in the establishment of these early farming communities.

After about 4900 B.C. central Europe continued to be occupied by farming peoples descended from the original *Linearbandkeramik* communities, among them, the Rössen culture of central and southern Germany, the Stroke-Ornamented Pottery culture of eastern Germany and Bohemia, and the Lengyel culture of Poland, Slovakia, and Hungary. These groups pursued the same general way of life of the *Linearbandkeramik* farmers through most of the fifth millennium B.C. An important development during this period is exchange, particularly in the form of stone axes, between the farming communities of central Europe and the Mesolithic foragers of southern Scandinavia. Still, for several centuries, the northern frontier of farming did not extend farther than the lowlands of northern Poland and Germany. At this time, the Late Mesolithic Ertebølle-Ellerbek culture flourished along the Baltic coast.

THE ERTEBØLLE-ELLERBEK CULTURE

The Mesolithic Ertebølle culture is found c. 5400–3950 B.C. in the western Baltic area: southern Sweden, Denmark, and northern Germany between the Elbe and the Oder Rivers. Ertebølle is roughly contemporary with *Linearbandkeramik* and descendant groups farther south. In Schleswig-Holstein the local name is Ellerbek; in Mecklenburg it is the Lietzow group. In Scandinavia Ertebølle is divided into an older aceramic phase, from 5400 to 4600 B.C., and younger phase with pottery, T-shaped antler axes, and imported axes. Shell middens are a characteristic feature of coastal sites in the northern Ertebølle region, where the salinity of the sea was sufficient to support the growth of oysters. Burials appear in greater numbers and with more variety compared with the burials of earlier periods.

Ertebølle Technology. Ertebølle flint technology was based on blades used to produce arrowheads with a transverse edge, end scrapers with a convex edge, and tanged scrapers with a concave edge. There were flat-trimmed flake axes and core axes; core axes with a special edge trim and, in a few cases, polish are characteristic of the final days of the Ertebølle. Antler axes with shaft holes near the burr date from the older Ertebølle, while T-shaped antler axes, in which a shaft hole was drilled through the center of the large antler beam, are characteristic of the younger Ertebølle. T-shaped antler axes have a wide European distribution in fully Neolithic contexts, where they appear earlier than in Ertebølle. Such an axe was found in the oldest layer at Rosenhof in northern Germany, dating to c. 5100 B.C. In Denmark T-shaped antler axes appear c. 4600–4500 B.C. Groundstone axes were made of green stone. Numerous wooden artifacts are known from this time period, many examples, such as fences, traps, leisters, dugout canoes, and paddle oars (some decorated in curvilinear designs), relate to fishing. Wooden bowls and spoons also occur. Ornamental beads were made from animal teeth, and bone rings were carved from shoulder blades. Combs were carved from bone as well.

Two shapes of pottery vessels were common in the Ertebølle; there were shallow, oval bowls presumably used as lamps and pointed-bottom vessels in three sizes—small beakers and medium and large pots used for drinking, cooking, and perhaps storage. Pottery from Schleswig-Holstein (Germany) has been dated on the basis of food remains found in the pots: dates range from 5300–5100 B.C. at Schlammersdorf (site 5) to 4300-4100 B.C. for the youngest Ertebølle examples, at Wangels. The oval lamps date from 4400–4200 B.C., but they also have been found in the context of Funnel Beaker sites at Siggeneben-Süd in Germany. In Denmark Ertebølle pottery appeared c. 4600 B.C.; the youngest pottery is dated to 4250–3870 B.C.

The source of this pottery has been sought in other Mesolithic groups along the Atlantic coast, such as Roucadour in southern France, or in Comb-Ceramic groups in the eastern Baltic, such as the Narva group in Latvia, beginning in 5300–5200 B.C. Only a few examples of imported pottery have been found among the farmers to the south, at such sites as Rosenhof in Schleswig-Holstein, Mölln and Hammer in southern Holstein, and Lietzow-Buddelin and Parow (site 4) in Mecklenburg. These sherds could have derived from the Stroke-Ornamented Pottery group. Perforated shoe-last axes were imported from the *Linearbandkeramik* area, where they were in use for about a millennium. A small group of triangular axes made from exotic stone were imported from the south during the late Ertebølle, together with a few copper axes. The Ertebølle region west of the Great Belt, which is the strait between Zealand and Fyn, is characterized by such artifacts as T-shaped antler axes; bone combs, rings, and disks; bird-bone points; a straight type of harpoon; and a special shape of the pointed bottom of pottery vessels. In the eastern group many bone objects are absent; Limhamn stone axes, a curved type of harpoon and vessels with a different shape of pointed bottom were used. Imported stone axes of the shoe-last type and the late triangular axes are found mainly south of the Baltic and among the eastern Ertebølle peoples.

Ertebølle Settlement Patterns, Settlement Types, and Houses. Ertebølle settlements are concentrated in coastal and riverine environments with good fishing opportunities. Typically, settlements each comprise a large central site occupied more or less continuously year-round and numerous small, seasonal sites both on coasts and along inland freshwater systems. This more permanent form of habitation was made possible by the resource stability provided by fishing using nets and traps. Analyses of carbon 13 in Ertebølle skeletons indicate that marine foods were as big a part of the diet as they are among modern people on Greenland.

Large central sites include settlements with shell middens, such as Bjørnsholm, Ertebølle, and Norsminde in northern and eastern Jutland, and sites without middens, such as Smakkerup Huse in Zealand, Tybrind Vig on the island of Funen, Skateholm in Scania, and Wangels in Schleswig-Holstein. Among the examples of special extraction camps are Aggersund in northern Jutland, where swans were hunted during winter. An inland site, Ringkloster, was used in the winter for hunting wild boar and fur-bearing animals. The coastal site of Ølby Lyng was occupied in the fall and winter for the purpose of fishing and hunting migrating porpoises, seals, and certain marine birds. Other sites in the Åmose swamp in central Zealand appear to have been smaller summer camps. There seems to have been a pattern of seasonal movement between the coast and inland areas on Zealand. It has been suggested that there was a split between inland and coastal peoples in Schleswig-Holstein. Territories of about 15 kilometers in diameter have been inferred in fjords along the eastern coast of Jutland, and it has been proposed that there were territories some 40 kilometers in diameter on Zealand, based on stylistic differences in the shape of flake axes.

At the settlements, burials are found farthest from the coast and at the highest elevations, sometimes placed between habitations; alternatively, living areas, such as dwellings, hearths, and sites of waste disposal, are located just below burials. Right along the shore there is typically a midden (with or without shells), and immediately offshore would have been the fish traps, dugout canoes, and a dump. On the settlement itself, usually only flint and charcoal are preserved, while the waterlogged dump area contains well-preserved organic remains. Some sites of the Ertebølle culture had round huts with an off-center hearth, such as those at Lollikhuse (5.5 × 4.0 meters) and at Nivå (2.5 × 3.5 meters), both in northern Zealand. In Scania substantial houses have been found at Tågerup (15 × 7 meters) and Skateholm I (10.7 × 6.5 meters). These houses each had one interior row of posts supporting the roof, a slightly sunken floor, and a noncentral hearth.

Ertebølle Burials. Numerous burials are known, especially from the older Ertebølle culture. At Skateholm in southern Scania, burial grounds were found in relation to two Ertebølle settlements; at the older, Skateholm II (5800–4900 B.C.), there were twenty-two burials, and at the younger, Skateholm I (5300–4800 B.C.), sixty-five burials were located. In addition, eleven graves contained dogs. At Vedbæk-Bøgebakken twenty-two women and men of all ages were buried in seventeen graves, which were simple earth-cut, trough-shaped pits.

Burials in the extended supine position are the most common, but at Skateholm some bodies were found lying on their sides, and others were buried in a sitting position in narrow, funnel-shaped pits. Most burials were inhumations, but a few cremations also were found. The dead were buried in their clothes, perhaps wrapped in fur or hides and sometimes in sheets of bark. The men were given knives, daggers, and axes, and the women wore ornaments made from animal teeth. Concentrations of red ochre were found in the head and chest areas. Apart from the ritual activities connected with the ancestors, offerings made in wet places may have been part of the Ertebølle cult. The items deposited typically were shoe-last axes, a few pots, and a stash of beads made from animal teeth.

THE EARLIEST TRACES OF AGRICULTURE IN NORTHERN EUROPE

In Schleswig-Holstein in northern Germany, there were traces of agriculture as early as 4700–4600 B.C., suggesting that domesticates were adopted in a late Ertebølle-Ellerbek context. In the Lietzow group of Mecklenburg and Rügen, no agrarian elements appeared during the late Ertebølle. In southern Scandinavia domesticates appear c. 3950 B.C.; only a few finds indicate the presence of domesticates during the final centuries of the Ertebølle culture.

According to Sönke Hartz and colleagues, the adoption of food production in Schleswig-Holstein can been divided into three phases, illustrated by cultural layers at three settlement sites: Rosenhof, Wangles, and Siggeneben-Süd. These phases cover the Ertebølle and the early Funnel Beaker cultures. In phase A (c. 5100–4100 B.C.), evidence of early agriculture among the Ertebølle people is provided by pollen analyses showing deforestation and cereal growing along the Baltic coast from 4770 to 4580 B.C. The earliest cattle bones show up at Rosenhof c. 4700 B.C. Cattle were the only domestic animal apart from dogs, but they represented only 1 to 2 percent of the mammal bones. The material culture and the economy at Rosenhof at this stage are otherwise purely Mesolithic.

For phase B (c. 4100–3900 B.C.), pollen analyses continue to show cereal cultivation. At Wangels crop processing is indicated by quern stones and a charred emmer grain. Livestock was the main meat source, constituting 50 percent of the mammal bone finds; hunting declined. Numerous sheep or goats are present as well. Flint, bone, and antler tools still reflect Ertebølle traditions. The earliest Funnel Beaker pottery is dated from charred food remains to 4100–3800 B.C. at the coastal site of Wangels, the inland site of Bebensee, and Parow (site 4) in Mecklenburg. Types of pottery include slender and wide bowls, flasks, disks, and lugged amphorae (i.e., pottery with decorative knobs or bosses). Stabs below the rim are the main decoration; two vessels have thickened rims. The Rosenhof pottery vessels form the closest parallel to that from Wangels, but similarities can be found in Michelsberg and post–Stroke-Ornamented Pottery groups to the south and early Funnel Beaker examples in eastern Denmark. A drastic change took place in the settlement pattern during phase B, along with increased dependence on farming. Smaller settlement units replaced the large year-round settlements that had been based on hunting of sea and land mammals.

Phase C (3900–3500 B.C.) is exemplified by a pure Funnel Beaker assemblage from Siggeneben-Süd. Pottery types and decoration are similar to those of phase B, but beakers constitute 90 percent of the inventory. The earliest polished flint axes appeared, and typical Ertebølle tool types of flint, bone, and antler disappeared at this time. Domesticated animals, primarily cattle and pigs, made up 60 percent of the small quantity of bones from Siggeneben-Süd. Some hunting and fishing took place, as evidenced by arrowheads, leister prongs, and a small number of sea mammal bones. Pollen analyses and more charcoal both inland and along the coast indicate the practice of swidden agriculture.

Funnel Beaker Distribution, Dates, and Local Groups. The Funnel Beaker culture was distributed across the North European Plain to the north of the groups that followed the *Linearbandkeramik* between the Netherlands and the Vistula River valley. The earliest Funnel Beaker radiocarbon date, obtained at Sarnowo in central Poland, was 4400 B.C. Most other dates suggest that the start of the Funnel Beaker was closer to 4000 B.C. In southern Scandinavia the earliest Funnel Beaker stage dates to 3950–3500 B.C., the middle stage to 3500–3200 B.C., and the final stage to 3200–2800 B.C. The oldest Funnel Beaker site, at Åkonge in the Åmose on Zealand, dates to 3950 B.C.

Pottery is the characteristic element of material culture and included funnel-necked beakers, two-handled or four-handled amphorae, flasks, bowls, and flat clay disks. Decoration of the early pottery usually was limited to a series of stabs below the rim. Large vessels may have thickened rims with finger impressions. Clay disks often have finger impressions on the rim. Later, decoration of the vessel body with vertical incisions became very common. Flint tools of the period comprised flint axes with pointed or thin, butt-end, flat-trimmed daggers; round scrapers; transverse arrowheads; and knives. Flat hammer axes and club heads were made of ground stone. Amber beads and pendants were used as ornaments, and jewelry also was made of small disks and wire spirals. Copper was imported in the form of flat axes with splayed edges.

Vegetation and Agriculture. During the Early Neolithic, 3950–3500 B.C., only small plots were cultivated, using digging sticks to prepare the soil. Charred grain and pottery with grain impressions date to 3780 B.C., but cereal appeared earlier in the pollen diagrams. The oldest domesticated animals date to 3960 B.C.: in Zealand there were cattle at Åkonge and sheep or goats at Lollikhuse. Livestock may have been more important than cultivation. Cattle were dominant, followed by pigs; sheep and goats were of minor importance Extensive swidden agriculture and plowing with the primitive ard did not appear before c. 3600 B.C. Until then, wild resources remained an important part of the diet.

Funnel Beaker Settlement. Early Neolithic settlements were relatively small and mobile and were located on light, sandy soils. The habitation was spreading inland at this time, but sites still were located in the vicinity of lakes and streams or on the coast. Settlements, earthen long barrows, and bog deposits reflect the local Early Neolithic community. By about 3600–3200 B.C. a three-tier settlement pattern had been organized around regional centers at causewayed enclosures and surrounded by small communities, each with a settlement, a cluster of megalithic tombs, and bog deposits. This was a period of intense construction of thousands of megalithic tombs and numerous enclosures, as well as elaborate sacrifices in the bogs. During the final Funnel Beaker period, 3200–2800 B.C., habitation became concentrated in large settlements. In terms of size, the early settlements covered c. 500–700 square meters, increasing to 4,000 square meters in the middle stage and 20,000–30,000 square meters in the final stage, according to a study from eastern Jutland.

Many sites, such as Muldbjerg and Åkonge in Åmose, show evidence of continued exploitation of wild resources. The top layers of several Ertebølle shell middens date to the Early Neolithic. At Bjørnsholm, northern Jutland, a settlement and a long barrow located adjacent to a shell midden indicate that some coastal sites were more permanent. Limited grain cultivation and livestock supplemented an otherwise Mesolithic lifestyle at this site.

The internal structure of the Funnel Beaker settlements is still uncertain, and preservation of organic remains is rare, except at some riverine and coastal sites. At Mosegården, eastern Jutland, a settlement of about 500 square meters was preserved beneath an earthen long barrow dating to c. 3900 B.C. The remains include a living area with scattered postholes, perhaps representing two to three huts; a hearth; a dump area; and light debris from artifacts. Structures of small oval houses 10–18 meters long and 4–6 meters wide, with a single row of three to eight central posts, have been found at a few Early Neolithic sites: Bygholm Nørremark in Jutland, Ornehus and Skræppegård on Zealand, Limensgård on Bornholm, and Mossby in Scania. These small longhouses sometimes were supplemented by other types of houses, such as one D-shaped structure from Hanstedgård, Jutland.

Causewayed enclosures were constructed between 3500 and 3100 B.C. in Denmark. A common feature for the twenty-three sites found thus far in Denmark is a system of parallel ditches or ditches combined with palisades enclosing a natural promontory. The enclosures vary in size from 1.6 to 20 hectares. The interior generally is void of finds. Deposits of whole pots, heaps of tools or animal bones, and human skulls or part of skulls represent ritual activities in the ditches. In some places there were traces of fire. The causewayed enclosures have been interpreted as ritual sites serving as regional centers for scattered tribal communities. Activities may have been related to the ancestor cult, as indicated by the human skulls in the ditches. It has been suggested that the interior areas served as temporary repositories for the dead before the skeletons were placed in megalithic tombs.

Funnel Beaker Burials. One type of burial was simple inhumation in the extended supine position, without a mound; these burials sometimes are called "flat graves" or "earth graves" and are possibly a continuation of the Ertebølle tradition, as seen at Dragsholm, northern Zealand. These nonmonumental burials continued throughout the Funnel Beaker period, as is evident at Stålmosegård, Zealand. Similar graves have been found in earthen long barrows enclosed by large timber settings or trenches, a new feature appearing at the very beginning of the Funnel Beaker culture over a wide area from Jutland to the Elbe-Saale region in Germany and from Kujavia in Poland to Lower Saxony. In general, trapezoidal earthen mounds are present in the east, in Kujavia and western Pomerania, and rectangular mounds are common in the west, in Lower Saxony; trapezoidal mounds are found in both zones. Ian Hodder has suggested that continental longhouses were the prototype for the long barrows. The nearly contemporary villages of Lengyel longhouses (such as those at Brześć Kujawski) and Funnel Beaker long barrow cemeteries in Kujavia have been proposed as the possible origins. The already established timber mortuary architecture was translated into megalithic monuments constructed of large boulders during the middle period of the Funnel Beaker culture. Only selected bones were deposited in the megalithic graves; the bodies were skeletonized elsewhere, perhaps at the causewayed enclosures.

Bog Deposits. Wetlands were chosen for deposition of selected items, most often individual pots (or sometimes several pots) with food and occasionally the remains of large ceremonies involving sacrifices of cattle and humans. At Sigersdal, northeastern Zealand, the skeletons of two women, ages sixteen and eighteen, one with a cord around her neck, were found together with a large lugged vessel. The skeletons date to c. 3500 B.C. and may be the oldest human sacrifices in Europe. At Gammellung, Langeland, a votive deposit from the beginning of the Middle Neolithic comprised five oxen, four pigs, one goat, one dog, and three humans. At least two of the oxen and a forty-year-old woman were killed with a violent blow to the head. Bones were split to extract the marrow, indicating that the deposit represented the remains of a large feast. These bog offerings seem to have been part of a fertility cult. Other depositions included such valuables as polished flint axes and amber.

EXPLAINING THE TRANSITION TO AGRICULTURE IN NORTHERN EUROPE

Three explanatory models have been discussed for the introduction of agriculture within the Ertebølle distribution area: immigration by farmers or acculturation of foragers, caused by a food crisis brought on by economic-ecological changes or by socioeconomic competition. In the case of the *Linearbandkeramik,* the most persuasive argument in favor of immigration is the appearance of a new culture as a "package" different from what had been present earlier. This does not appear to have been the case in northern Europe. In terms of both flint and pottery technology the late Ertebølle and the early Funnel Beaker cultures were very much alike. Such continuity in material culture makes a large-scale migration unlikely, but limited migration by small groups of farmers or assimilation of single individuals might have occurred. Another problem with the migration theory is how to explain what became of the substantial Mesolithic population in the Ertebølle area. Minor differences exist in the skeleton remains from the Ertebølle and Funnel Beaker cultures, but the comparison is made between populations that existed a thousand years apart. Almost no skeletons from the time of the transition to agriculture have been found.

Food Crisis. The logic of the migration hypothesis is, in part, that farming was a more advantageous and superior way of life. This opinion changed under the influence of ethnographical studies in the 1960s that suggested that only minimal labor was required to sustain life as a hunter-gatherer and that the transition to farming would be more demanding. Many ideas have been put forward to explain why the apparently well adapted Ertebølle people would choose to become farmers. It has been proposed that population pressure resulted from a more sedentary lifestyle on the permanently inhabited coastal sites. An increase in inland sites also has been noted, but evidence from the early part of the Neolithic does not support growth in the population.

Ecological changes have been invoked to explain an imbalance between population and resources, especially marine resources. At the same time, regression in sea level may have produced an expansion in beach ridge formations and a decline in shallow-water fishing. Climate changes are cyclically recurrent, however, and apparently did not have adaptational consequences earlier in the Ertebølle period. A unique episode of a decrease in tidal amplitude may have caused a shift from marine to more brackish conditions, as reflected in a corresponding decline in the numbers of oysters seen in shell middens.

The natural reduction in numbers of oysters has been proposed as the cause of the adoption of domesticates as an alternative food source. Oysters allegedly filled a gap in resources in late winter. This explanation does not seem plausible, considering that farming was adopted at the same time in areas without a natural supply of oysters. At the Bjørnsholm shell midden in northern Jutland, Neolithic artifacts appear in the oyster layer before a change from oysters to cockles took place. A more brackish environment possibly meant a decline in productivity. Nonetheless, fishing was still important in the Early Neolithic, although the carbon-13 content of Neolithic skeletons confirms a diet based on terrestrial rather than marine resources. Despite the changes, there is no proof of a food crisis during the late Ertebølle period. The most persuasive argument against the food-crisis hypothesis is probably that farming played only a limited role in the subsistence economy during the first several hundred years of the Neolithic within the Ertebølle region.

Socioeconomic Competition. Competition for prestige and power has been posited as the impetus for the introduction of domestic food sources among the Mesolithic Ertebølle people. Exotic and highly desirable goods were exchanged through far-reaching networks. Small societies gained prestige through the value of the exchanged goods. Gift exchange might have taken place during feasts where special foods were served. The Ertebølle people had a tradition 800 to 1,000 years long of exchanging goods with neighboring communities, which is documented by imports of ceramics and axes made of exotic raw materials. Such exchange possibly intensified during the final Ertebølle period, as reflected in such artifacts as jadeite and copper axes. Exotic foods might have been received as prestigious gifts at first, which would explain the imprints of cereal grains in Ertebølle pottery at Löddesborg and Vik in Scania and the remains of cattle at Smakkerup Huse, Zealand.

Through an inflationary process it became more difficult to maintain power and prestige and more advantageous to start producing domesticates for exotic prestige food, such as cereal-based alcoholic beverages and different kinds of meat. Livestock also served as a measure of wealth in its own right. A gradual change then took place toward greater social inequality, more surplus production, increased specialization, and larger capacity to redistribute goods and food.

CONCLUSION

Local hunter-gatherer groups appear to have adopted agriculture to a limited extent in southern Scandinavia before the major cultural changes that accompanied the arrival of the *Linearbandkeramik* and the emergence of the Funnel Beaker culture. Domestic foods initially served as a supplement to the Mesolithic diet. A mixed economy lasted for about five hundred years during the early Funnel Beaker period in southern Scandinavia. Continuity in flint and pottery technology and burial rites suggest local development of the Funnel Beaker culture, influenced by the introduction of ideological trends from the south, including new fashions in elite weapons and burial monuments. Perhaps an escalating process of socioeconomic competition led first to the adoption of domesticates and later to a fully agrarian subsistence economy, followed by another wave of major cultural changes in settlement and ritual.

See also **Archaeology and Environment** (*vol. 1, part 1*); **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **Skateholm** (*vol. 1, part 2*); **Tybrind Vig** (*vol. 1, part 2*); **First Farmers of Central Europe** (*vol. 1, part 3*); **Sarup** (*vol. 1, part 3*); **Long Barrow Cemeteries in Neolithic Europe** (*vol. 1, part 3*); **Consequences of Farming in Southern Scandinavia** (*vol. 1, part 4*).

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ANNE BIRGITTE GEBAUER

SARUP

Around 3400 B.C., in the Fuchsberg phase of the Funnel Beaker culture, a Neolithic enclosure with several causeways was constructed on a sandy promontory in the village of Sarup in the southwestern area of Funen, Denmark. The enclosure defined an elongated area of 8.5 hectares, 6 hectares of which were uncovered between 1971 and 1984 (fig. 1). Watercourses bound two of the three sides of the promontory; the third side was bordered by a palisade fence, four-sided fences built on the outside of the palisade, a fenced entrance passage, and two parallel rows of segmented ditches with several causeways between them. The enclosure was constructed in a period characterized by marked human impact on the environment, in the clearance of land for cultivation and grazing. In this timeframe the building of megalithic graves, or dolmens, began. In the two centuries c. 3400 B.C., both types of monuments (causewayed enclosures and megalithic graves) were constructed in the Atlantic region of western Europe.

The palisade on the Sarup enclosure originally stood in a trench, which could be followed for 572 meters. The planks were of split-oak trunks with diameters up to 42 centimeters. The close-standing planks of the palisade probably rose at least 3 meters above the ground. On the outer side, but close to the palisade, amounts of pottery, burned bones (including those of humans), scorched stones, and charcoal for hearths were found. Joined to the palisade or placed in the gaps between the ditches, nineteen four-sided fences were uncovered (fig. 1). No finds explain the function of these fences, but they must have had special significance because the placement of the ditches respects them. The entrance was a 1.6-meter-wide gap in the palisade, shielded by a fence 3 meters in front of it. Access to the entrance was along a path 2–3.5 meters wide, which at one spot was restricted by a cross fence to only 1.4 meters, so that nothing wider could come in (fig. 2).

In front of the palisade and fences lay two parallel rows of segmented ditches. Originally, the ditches were about 15 meters long, 4 meters wide, and between 0.20 and 2.0 meters deep. At the base of the ditches there occasionally were special finds or layers, for example, of decomposed organic deposits, whole pots or large fragments of pots, skulls of cattle, sheep, or pigs, plus human skulls or skull fragments and other bones. Only a very few flint artifacts have been found in the ditches. Above the bottom layers a homogeneous fill of the original upcast was thrown back deliberately from the heaps of upcast subsoil until then placed along both sides of the ditches. There is no evidence that the site had been fortified with banks.

Excavations of two-thirds of the interior of the Sarup enclosure have produced eighty-seven features dating to the same period. Most of them were scattered small pits, but some of the features had a special function, for instance, deposit of ritual materials (whole pots and axes), storage, or waste disposal. In a few of the pits there was considerable waste material, but the segmented ditches had only a few samples of waste. The finds from the site consisted of mainly materials specially selected by the inhabitants, such as human bones, axes, and whole or crushed pots. The material had been deliberately smashed, in the case of pottery, or burned, in the case of axes, grain, and human bones.

Some 150 years later, in about 3250 B.C., another enclosure was constructed on the promontory at Sarup. In the form of a crescent, this uncovered enclosure demarcated an area of about 3.5 hectares on the southern point of the sandy promontory. This structure also comprised a palisade fence, four-sided fences, and two parallel rows of ditches. In the interior 144 features were found. Some of them were small pits, perhaps postholes, but others were used for deposits of ritual materials and still others for storage. Three pits contained the burned human bones of adults. In this period passage graves were built, and very high quality pottery was manufactured and frequently offered in front of the graves—perhaps to a kind of prehistoric deity.

About thirty Neolithic enclosures have been found in Scandinavia. All these sites belong to the Funnel Beaker culture and date to a very short period between 3400 and 3200 B.C. The finds from all the enclosures are of special types (those that do not represent a daily life or settlement), with little or no debris but with selected bones of animals and humans, flintaxes, pots, etc. The enclosures seem originally to have been used for a short interval only, but

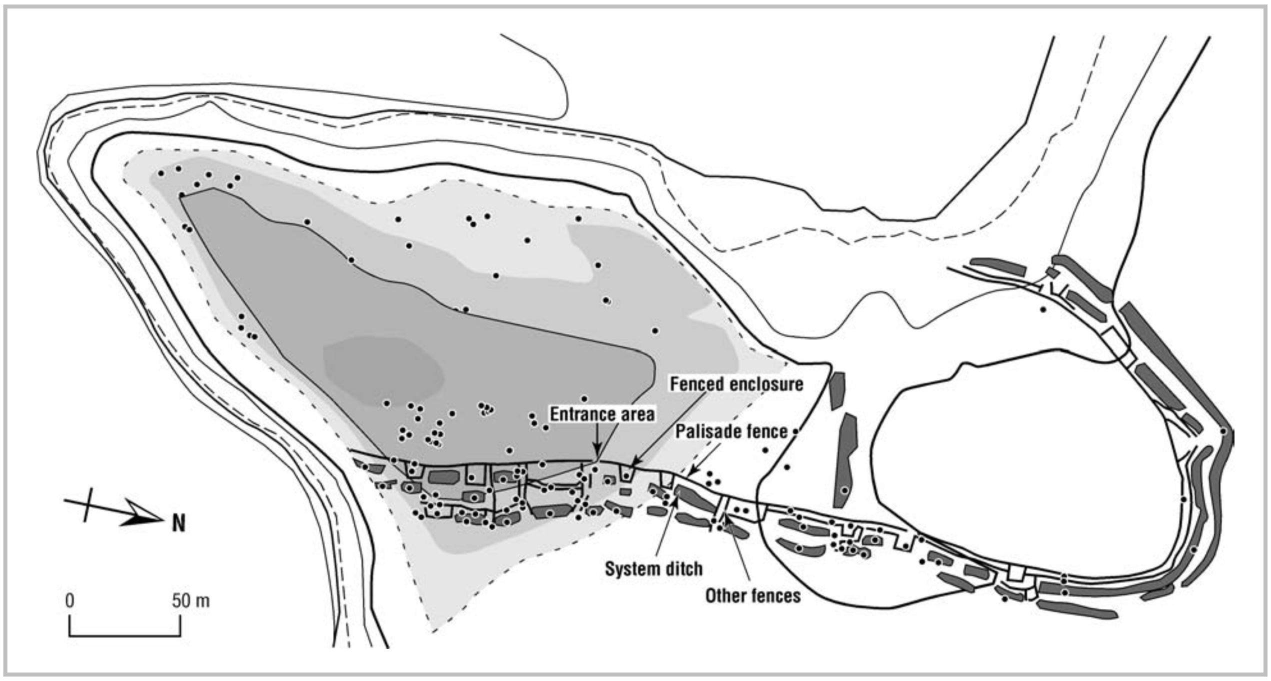

Fig. 1. Site plan for Sarup I, with features from the Fuchsberg phase (3400 B.C.) marked. Various types of features in the enclosure system are also shown: palisade fence; entrance area; small four-sided fences; and big four-sided fences. ADAPTED FROM ANDERSEN 1997.

the ditches later were reused. A couple of hundred years later, most of these places became settlements.

Hundreds of enclosures of the Michelsberg, Chasséen, Windmill Hill, and Wartberg cultures, characterized by segmented ditches, have been discovered since 1882 in western Europe. Although these cultures were not entirely contemporaneous, they do have many features in common. These enclosed sites could have served similar functions. Excavations of the enclosures have provided much new information about the Neolithic period. This new type of monument must be looked at in connection with the contemporary megalithic graves and settlements. Since 1988 intensive surveys of the fields around the Sarup site have been carried out. Within less than 20 square kilometers, 152 sites have been found from the periods of the two Sarup sites, that is, between 3400 and 3200 B.C.

Twenty-two of the sites are regarded as settlements. These were of limited size, about 500 square meters, and were situated in different zones, which means that the Stone Age farmers made use of a variety of topographical situations, with sites for hunting and fishing, for cattle herding, for pig farming, and for cereal cultivation. The settlements had many different tool types and clear evidence of toolmaking, plus a variety of livestock and cultivated cereals. The analyses of the settlements reveal significant differences with respect to size, location, and finds. The small settlement units suggest that only one or two families were living there, for a short period.

In the area around Sarup, 121 megalithic graves, now preserved only as plow-damaged sites, can be added to the four previously known. The damaged sites were found by intensive field survey. Twenty-eight of these megalithic graves have been excavated, and in the coming years many of the other graves will have to be excavated because intensive plowing is quickly destroying them. The megalithic graves developed in Denmark between 3400 and 3200 B.C. from small dolmen chambers reminiscent of the body-length earthen graves of the preceding period, to large dolmen chambers, to dolmens with a passage, and then to passage graves. The chambers often were placed within an enclosure or a barrow surrounded by a row of stones in a circular or oblong form or a palisade in a trench. A very small dolmen, less than 1 meter long, was

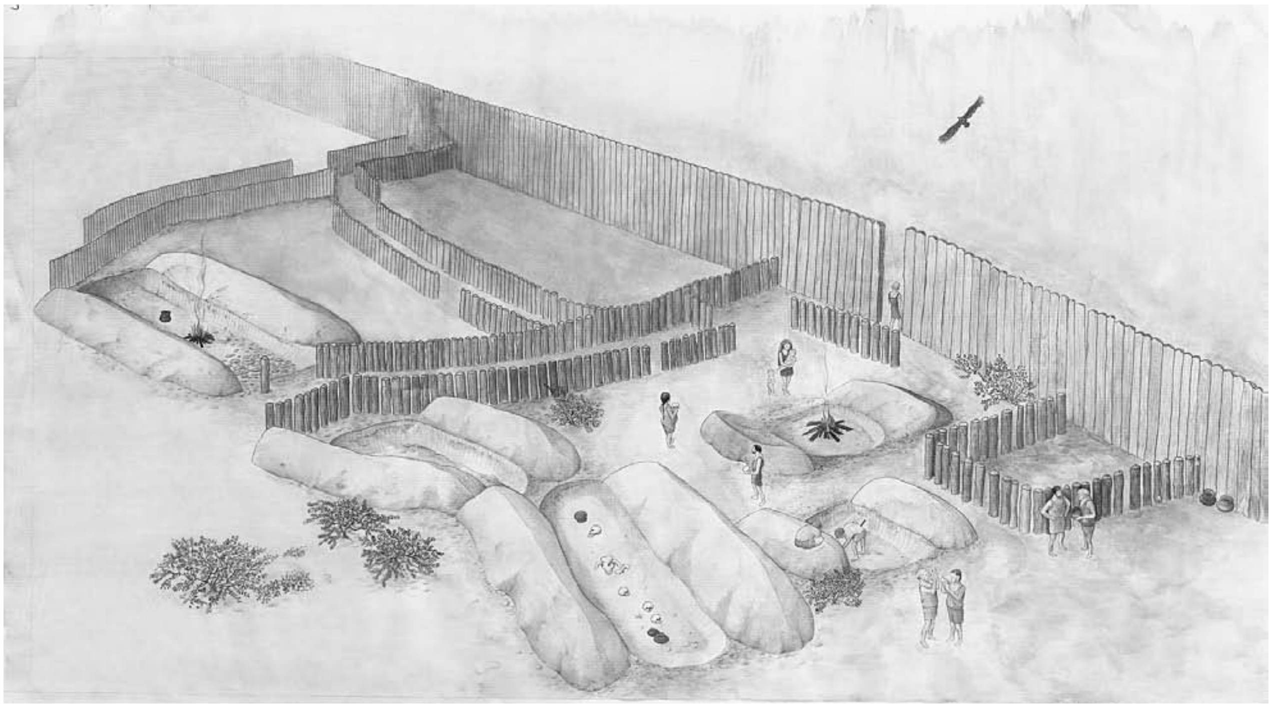

Fig. 2. Graphic reconstruction of the entrance area at Sarup I, looking southwest. DRAWING BY LOUISE HILMAR. COURTESY OF NIELS ANDERSEN. REPRODUCED BY PERMISSION.

placed at the bottom of a segmented ditch within an enclosure.

The distribution of megalithic graves close to Sarup indicates that they frequently were concentrated in clusters, dividing the area into units of equal size, which perhaps can be treated as territories. Division of the land into units of equal size together with the many small settlements of uniform size may be signs of the social organization of a segmented tribal society. It is of special interest that no complete primary burials have ever been found in the megalithic grave, only body parts. A similar situation exists at the causewayed enclosures, where only parts of buried individuals have been found. These details indicate a link between the megalithic graves and the causeway enclosures.

The enclosures and the megalithic tombs were erected some six hundred years after the introduction, in about 4000 B.C., of a farming economy in Denmark. Traces of the earliest forms of agriculture are finds of grain and domesticated animals and vague signs in the pollen diagrams of pollen from grain. At this time the first funerary monuments, the long barrows without chambers, containing the remains of one or more persons, appear. Significant changes in the landscape are first found in about 3400 B.C., at the time of the enclosures and megalithic tombs. Studies of pollen grains show that there was a smaller quantity of pollen pertaining to oak and lime forest and a higher proportion from birch and, later, hazel. Proportions of pollen of grasses and herbs characteristic of an open landscape also increased. These changes represent the deliberate creation of open areas for both cereal cultivation and grazing, which is known as Iversen's *landnam* ("land taking" or, simply, "land occupation").

Beneath some megalithic barrows there are traces of a primitive scratch plow, the ard. Working with an ard drawn by bullock required large fields cleared of big stones, trees, and stumps. The fields were plowed only a few times, and then the Neolithic peoples had to move on to new areas, looking for fresh land to cultivate. The introduction of the ard may have brought with it a series of changes in social relations, specifically, men undertaking cultivation and women carrying out tasks related to settlement. Land rights and inheritance would have become important, because a great deal of work had been invested in clearing plots for cultivation.

Rights to the land could have led easily to conflicts between different groups.

In the Sarup, the enclosure is placed conspicuously in the center of a wide area of land featuring groups of megalithic tombs. The enclosure must have been shared by several groups, from the evidence of the labor expenditure necessary for construction alone. It is possible to interpret the enclosure, with division by many four-sided fences and segmented ditches, as a picture that correlates to the settlement pattern of the surrounding area. The individual segments may have symbolized or been associated with a family, a settlement, a clan, or a land unit. When the deceased were temporarily buried in the enclosure, they were brought into a wider community; there, during a dangerous transitional phase, they underwent transformation into members of the realm of the dead. Participation in the building of the enclosure and in the activities that took place there must have strengthened the social, economic, and religious institutions. Through a network of this kind a social forum was created, which would have facilitated the resolution of conflicts over, for instance, land rights and food distribution in time of shortage. It might have represented an element of stability in a period that saw many new and important innovations and profound changes in social structures.

About 3100 B.C. further social changes took place in the Sarup area. The pattern consisting of a major enclosure associated with a large number of small settlements and building of megalithic tombs came to an end, and a concentration of settlement at a few sites began. One of them, on the promontory of Sarup itself, was about 4 hectares in size, or 80 times larger than the settlements of former centuries, which suggests a more stable economy. These changes indicate that the big ritual landscapes were in use for a period of only about two hundred years, when the final and most profound evolution took place from a society of hunter-gatherers to one of farmers.

See also **The Megalithic World** (*vol. 1, part 4*); **Consequences of Farming in Southern Scandinavia** (*vol. 1, part 4*).

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NIELS H. ANDERSEN

LONG BARROW CEMETERIES IN NEOLITHIC EUROPE

In the middle of the fifth millennium B.C. new cultural groups emerged in northern and western Europe. They arose as a consequence of a long period of contact and mutual influence between the central European Danubian farmers and the indigenous hunter-gatherers who encircled the Danubian world. These new communities, best exemplified by the northern Funnel Beaker and the western Cerny cultures, not only incorporated elements of an agro-pastoral economy and new material culture into the hunter-gatherer milieu but also, perhaps more significantly, created a new vision of the world through restructuring within the social and ritual spheres.

One of the symbols of this process was the emergence of monumentality—dramatically expressed in the creation of monumental long barrow cemeteries.

Although long barrows—earthen mounds with timber-built burial chambers—have been known for a very long time, their significance in the development of the Neolithic funerary tradition always has been overshadowed by the scholarly attention directed mainly toward the so-called megaliths (Greek *megas:* large; *lithos:* stone). Megaliths, by virtue of spectacularly surviving stone-built chambers, indeed represent the most tangible remains of the Neolithic populations. Yet because timber and earth were the principal medium of construction of long barrows—the former prone to quick natural decay and the latter easily subject to destruction through several millennia of plowing and other industrial activities—these monuments have remained largely in the background of archaeological research. Spectacular discoveries during the 1980s in the southern Paris basin, however, once again have focused scholarly attention on this important phenomenon.

The distribution of long barrows in continental Europe is vast. They reach from southern Scandinavia in the north to Moravia in the south and stretch westward through Normandy deep into central France, with long mounds equally prominent along the Atlantic coast; the Channel Islands form a convenient link between the continental and British barrows. Within this distribution, however, the monumental cemeteries (conglomerations of a dozen or more barrows) make a highly significant appearance on the periphery of the disintegrating Danubian world. They are found in the regions of Kujavia and western Pomerania in Poland, in France on the Plaine de Caen, along the river valleys of the Yonne, Seine, and Marne, and on the Plaine de Beauce. These are precisely the areas of intensive cultural contacts between the indigenous hunter-gatherers and the early Danubian farmers, and here the long barrow cemeteries constitute a prelude to the monumentality of the Neolithic funerary tradition in Europe.

Cemeteries of up to a hundred barrows are intimated in the early-nineteenth-century surveys from western Pomerania, in northwestern Poland—all long destroyed in the building of roads, farmhouses, and field walls. Smaller cemeteries of up to a dozen barrows still survive in Kujavia in Poland, while those discovered through aerial surveys in France—where several millennia of plowing and other activities have obliterated all surface traces—comprise up to thirty structures. Although the barrow cemeteries display considerable variety, with elements of design, construction, and rituals clearly reflecting both natural and cultural conditions prevalent in different regions, certain aspects of location and spatial arrangement within the cemeteries and burial practices transcend geographical boundaries, emphasizing the wider, European character of this phenomenon.

CEMETERIES: SPACE AND ORGANIZATION

The location of the cemeteries suggests that "islands"—natural elevations within a relatively boggy, marshy, and waterlogged environment—may have been selected deliberately for burial purposes. The Kujavian cemeteries of Sarnowo and Wietrzychowice were surrounded by marshy valleys and streams. At Barkær, on the Djursland Peninsula in Jutland, a pair of barrows, each nearly 90 meters long, was located on a hill in the sea inlet of Kolind Sund. The gravel elevations within the ancient meanders of the river Yonne in France, upon which the cemeteries of Passy and Escolives (fig. 1) had been located, also appear to have been "islands," frequently cut off by the river from the surrounding land.

Other features have an equally wide occurrence, for example, foundation of cemeteries on abandoned settlements and arrangement of the barrows within the cemeteries. The cemetery of Sarnowo was founded upon an abandoned Funnel Beaker settlement, possibly when the inhabitants chose to move onto slightly higher and drier land directly to the north. Foundations of small, rectangular houses, together with traces of an ancient plowed field, have been found underneath the earthen mounds. Although scholarly opinion with respect to the plowed field at this site is strongly divided, some of the later Danish mounds were unarguably placed upon previously cultivated fields, with plow marks surviving under the protection of the mound.

The arrangement of barrows in a fanlike pattern (fig. 2), witnessed as far apart as Kujavia and the Yonne valley, is reminiscent of the spatial arrange-

Fig. 1. Aerial view of the long barrow cemetery at Escolives, Yonne Valley, Burgundy, in process of excavation. COURTESY OF MAGDALENA S. MIDGLEY. REPRODUCED BY PERMISSION.

ments of houses in villages of the late Danubian settlements in these regions. The idea of a house of the living serving as a prototype for a house of the dead has a long ancestry. It goes back to the mid-nineteenth century, when Sweden's Sven Nilsson speculated on the similarities between the ground plans of Eskimo houses and the Swedish passage graves. Since then many scholars have raised this possibility, most notably V. Gordon Childe, whose suggestion that the northern European barrows approximated the habitations discovered at the late Danubian Brześć Kujawski settlement in Kujavia, has had a profound impact. Indeed, the original, if misguided, interpretation by P. V. Glob of the two long barrows from Barkær as being the remains of "Danubian-style" longhouses is a perfect example of similarities between the two forms. In Kujavia this pattern can be shown by comparing the layout of barrows at Sarnowo with the arrangement of houses at Brześć Kujawski. The two sites are only 15 kilometers apart and may well have been contemporary toward the final stages of the occupation of the Brześć Kujawski village. Similar arrangements are characteristic of other Kujavian cemeteries, such as Obałki, Leśniczówka, and Wietrzychowice.

In the southern Paris basin the barrows are reminiscent of individual Danubian houses by virtue of their shape and delineation by ditches, with some of the medium-sized barrows at Escolives offering a perfect dimensional and conceptual match. The site of Balloy, at the confluence of the Seine and Yonne Rivers, offers the most spectacular evidence for such an interpretation. Here, a late Danubian settlement of several trapezoidal houses was inhabited about 4700 B.C. After the village had lain abandoned, a group of people of the Cerny culture used the same location to create, in about 4500–4450 B.C., a large ceremonial center devoted to burial and other rituals.

They constructed a causeway enclosure and, to the northwest, they built a monumental cemetery of seventeen barrows. At least five of these barrows

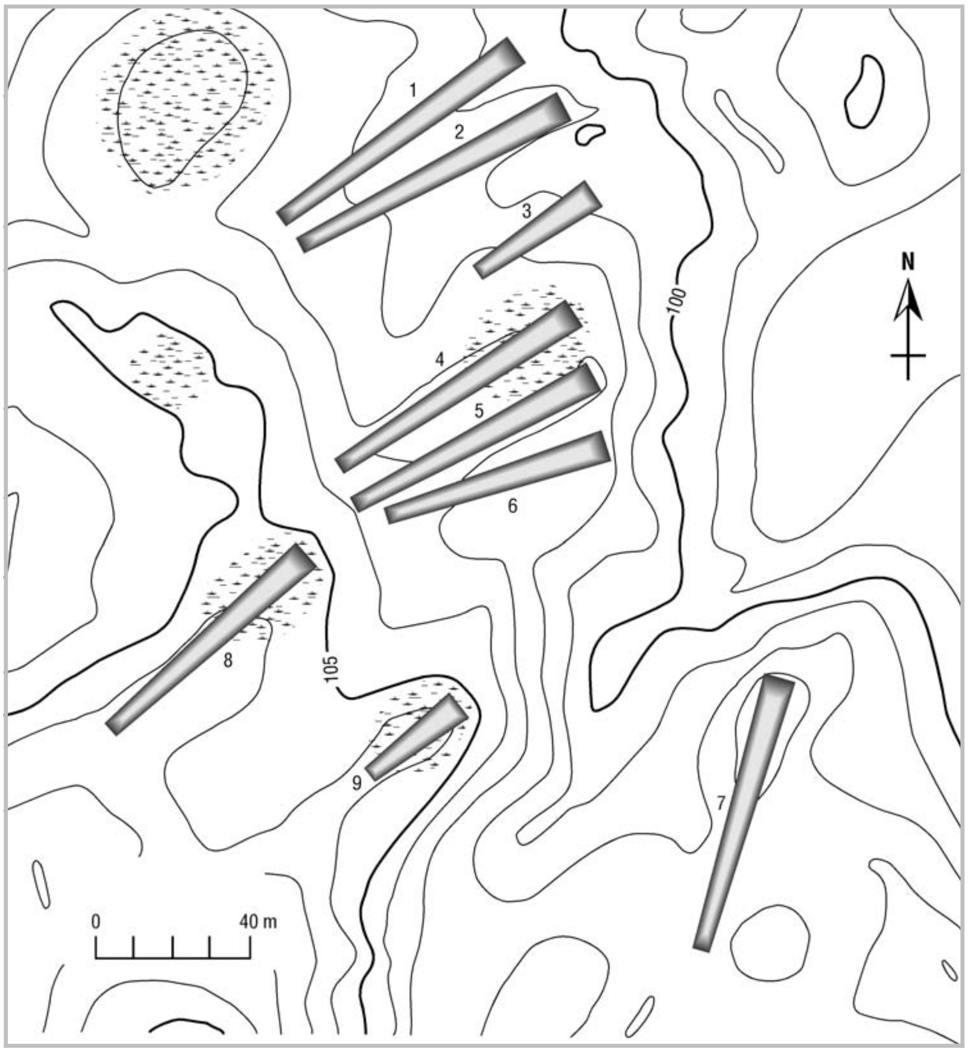

Fig. 2. Plan of the cemetery at Sarnowo, in Kujavia, displaying the fanlike arrangement of the long barrows. DRAWN BY MAGDALENA S. MIDGLEY.

were placed on top of earlier houses; the orientation is exactly the same, the barrows covered the houses precisely, and these house remains were much better preserved than those that remained uncovered. The evidence from Balloy shows beyond any doubt that, while ruined, the houses were still visible on the surface, to guide the positioning of the burial mounds some two hundred years after the settlement had been abandoned. The desire to place barrows upon disused settlements was prevalent even in those regions that had never been settled by the Danubian communities. The long barrow cemetery at Sachsenwald, near Hamburg, is a good example, and many of the individual long barrows from Denmark similarly were located upon abandoned Funnel Beaker settlements.

THE MOUNDS, GRAVES, AND BURIALS

The shapes of the mounds vary from oval, rectangular, and trapezoidal to triangular, with lengths ranging from as little as 20 meters to as much as 300 meters; the width rarely exceeds 10 meters. In central France, a region not well endowed with stone for building material, the barrows were defined by ditches, which, as was noted at certain of the Passy and Escolives monuments, may have had timber posts placed in them, forming a sort of palisade.

Such timber palisades are well documented in Denmark, where they occasionally were burned and, in rare cases, as at Bygholm Nørremark in eastern Jutland, were aggrandized by replacement with a substantial stone curb. By contrast, in Kujavia, where glacial erratic boulders were present in abundance, the mounds were retained within a stone curb that generally did not exceed 1 meter in height, although the mounds themselves seem originally to have been piled up to a much greater height. In all cases such enclosures delineated a sacred area in which burials were placed and where small timber temples sometimes allowed for the performance of ceremonies accompanying the funerary ritual.

Usually, one or two graves oriented east-west are found within a barrow, although more such graves are not uncommon. One of the barrows at Escolives contained three separate graves placed on the main axis, at least six were noted at Rybno in Kujavia, and in one of the barrows at Balloy eight centrally placed graves were discovered in excavation. The graves display a remarkable variety of constructions: pits lined with timber planks or, exceptionally, with thin stone slabs are prevalent in France. Rectangular boxes made from wooden planks standing on the surface, supported within an external stone frame and often covered by a mantle of field stones, typically are encountered in Kujavia and Denmark; the little stone cairns regularly tumbled into the grave upon the decay of a timber roof. In other instances, the bodies, either in coffins or wrapped in shrouds, were simply placed at the bottom of the grave pit.

At least some of the timber graves were intended to be accessible after the initial burial: the disturbance of bones in a double grave at Escolives indicates that the second person was placed there quite some time after the first burial. Indeed, such chambers may have served as prototypes for the future megaliths in these regions. At Barkær one of the graves is clearly a stone replica of a neighboring timber chamber, with the end stones shaped like thick wooden planks. The practice of covering some of the French grave pits with a huge stone slab of the kind discovered at Malesherbes, Loiret, represents a different facet of this development.

Human remains generally are poorly preserved, but where skeletons survive, they reveal that the dead were buried in an extended position with arms stretched out along the sides of the body, a tradition commonly practiced by the preceding Mesolithic communities. Anthropological analyses indicate that both sexes and all ages, from newborn babies to adults, were buried in the long barrows. Because, clearly, only a small percentage of the population was buried within these cemeteries, they were without doubt privileged places reserved for selected individuals. The presence of children is particularly significant and confirms some form of social elevation of those who were afforded burial in the barrows; the children hardly could have distinguished themselves otherwise in their short lives.

The grave goods are typically scanty, although the French burials tend to be more richly equipped than those of Kujavia or Denmark. A ceramic pot or two, flint tools, and jewelry are common grave furnishings; some people wore necklaces of wild animal teeth, shells, and, in the more northerly latitudes, amber beads. Rare finds of copper beads and rings in northern Europe suggest that metals, while they were exotic, were making their way northward from the central European production centers.

Certain items encountered in a significant number of graves merit consideration. Hunting within the Funnel Beaker and Cerny cultures is witnessed through animal remains on settlements and, more significantly, finds expression in funerary contexts. While complete arrows do not survive, the number and positioning of the arrowheads are indicative of quivers full of arrows arranged alongside the deceased. The placement of what is essentially hunting equipment, in the context of a funerary ritual within an agricultural community, may emphasize the indigenous nature of these communities, whose ancestry was rooted deeply in the local hunting-gathering background. On the other hand, the accompanying presence of bones of domesticated animals and, in the Cerny context, vessels decorated with stylized bucrania (cattle skulls) identify an equally strong agricultural connection.

INTERPRETATION OF THE MONUMENTAL CEMETERIES

At first glance the long barrow cemeteries signal a dramatic break with preceding traditions: demonstratively monumental architecture, different burial customs attesting to social transformations, and the emergence of new hierarchies within the Neolithic societies of the mid-fifth millennium B.C. Their significance lies not only in these new manifestations but also, and equally, in the encoded symbolism that reflects the merging of the Danubian and hunter-gatherer worlds.

Cemeteries first emerged in Europe in the Mesolithic, as witnessed at Skateholm in Scania or Vedbæk on Zealand, with Hoëdic and Téviec in Brittany providing corresponding examples along the Atlantic. The principles of these burial traditions are seen clearly within the Funnel Beaker and Cerny funerary practices. While the Danubian farmers also buried their dead in cemeteries at the periphery of their settlements, it was the villages, with massive timber-built longhouses, that were an important symbol of the stability and permanence of the world of these early farmers.

By the middle of the fifth millennium B.C. the Danubian villages were magnificent abandoned ruins, with their dilapidated houses still impressively marking the landscape. They thus provided a powerful image of an ancestral place still accessible to the living communities. While the vernacular tradition of that period is, sadly, unknown, we would be wrong to assume that there was not an entire store of tales, songs, and superstitions associated with these abandoned villages. On occasions, pilgrimages to these sacred places would have evoked powerful memories of ancestors and times past. It is not surprising that such a distinctive symbol was transferred from the domestic to the funerary sphere, resulting in a village of the living becoming, both physically and metaphorically, a permanent abode of the dead.

See also **Brześć Kujawski** (*vol. 1, part 4*); **The Megalithic World** (*vol. 1, part 4*).

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MAGDALENA S. MIDGLEY

4

CONSEQUENCES OF AGRICULTURE, 5000–2000 B.C.

INTRODUCTION

Between about 5000 and 2000 B.C. prehistoric society in Europe transformed itself yet again. What had been a collection of pioneer farmers and foragers on the brink of agriculture became a series of developed farming and herding societies. Although each part of Europe was different, there were several widespread developments. Agriculture became a stable economic system, and in each area a sustainable mix of cultivated plants and livestock permitted farming hamlets to be self-sufficient. People ceased to consider their herds simply as tame sources of meat and began to see them increasingly as providers of useful products while still alive, such as milk, wool, and pulling power. Alongside stone, bone, and pottery, metals came to be used first for ornaments and then for tools. Finally, people began to invest considerable effort in ceremonial behavior, which manifested in the form of burial monuments, ritual locations, and the first use of bogs for offerings.

Archaeologists in Europe call this period by a variety of names. It perhaps is most common in continental Europe to regard it as the later part of the Neolithic period; thus, "Late Neolithic" generally is appropriate as a universal designation for these societies. In northern Europe and the British Isles, where agriculture arrived the latest, this period spans virtually the entire Neolithic; for this reason, local divisions into Early, Middle, and Late Neolithic are more compressed. In southeastern, southern, and central Europe, where copper came into use as the earliest metal, archaeologists often speak of the "Copper Age" (or "Chalcolithic," from a combination of Greek words for "copper" and "stone"). Finally, especially in older publications, the term "Eneolithic" is used in southeastern Europe, although it is falling out of favor in more general application.

AGRICULTURE SUCCEEDS

After the initial period of agricultural dispersal, communities that relied on domesticated plants and animals became ubiquitous throughout Europe, except in the most remote northern regions. In only one area, coastal Sweden and the island of Gotland, was there a relatively brief abandonment of cultivation in favor of a return to an economy based on marine resources. Everywhere else, a combination of farming and stock herding succeeded as the dominant economic strategy.

Agriculture is inherently risky. Weather can cause variations in crop yields, while livestock can become ill or be stolen. Risks, however, can be calculated, and educated gambles can be made. Farmers and herders are astutely aware of their environment and can assess the risks that they are taking. As farming came to be ubiquitous uncertainty—the simple inability to know what is going to happen next—diminished. Within a few centuries of the initial use of domesticated plants and animals in a region, the Late Neolithic farming communities had accumulated a store of knowledge and experience that enabled them to deal with risk rather than uncertainty, which had important implications for other aspects of social life.

Once much of the uncertainty had been removed from agriculture and an appropriate mix of domesticated plants and animals for a particular region had been established, people could devote more attention to aspects of life other than making sure they were fed. Attachments developed to particular locations and territories, and it was necessary to define clearly who was kin and who was not, so that fields and grazing lands could remain in the family. Trading relationships emerged between communities, but raiding and conflict also were a part of life, as people strove for social and economic advantages. More attention could be paid to public ceremony and the creation of sacred locations for burial and ritual.

SECONDARY ANIMAL PRODUCTS

Although dairying had been practiced in many areas in earlier centuries, it was during the later part of the Neolithic that livestock came to be valued for the products that they could provide while they continued to live. Just as domestication required a shift in the relationship between people and animals from hunting to tending, the use of so-called secondary products, such as milk, wool, and pulling power required a change in how animals were viewed. No longer were they valuable just for the meat and leather that could be obtained from them only once, when they were killed. Cattle, sheep, and goats could furnish important resources throughout much of their lives, before making their final contribution to the human diet when they died. Pigs, of course, afforded no such secondary products, so they continued to serve exclusively as sources of meat and hides.

When the living animal became valuable, it began to be viewed as a true source of wealth. A household with sheep and goats to produce milk and wool had additional resources at its disposal. Milk could be made into cheese, which could be stored longer, while wool offered new possibilities for garments and furnishings. The greatest advance, however, was the use of cattle to pull plows and wagons. Plows could break through tough soils that previously had been difficult to cultivate and also increased the area that a single household could plant. Wagons could move harvested crops, firewood, animal carcasses, and many other large, bulky items easily across land. Using animal traction, a household could expand the amount of labor at its disposal.

On the steppes that connect Europe and Asia horses were domesticated c. 4500 B.C., affording new transportation possibilities. In particular, the combination of horse riding and an economy based on herds of sheep permitted the development of the system of nomadic pastoralism that came to characterize this region for several subsequent millennia. One result of animals' taking on value was that the possibilities increased for imbalances in household wealth to emerge. Some families may have been able to amass larger herds than others, while others may simply have been unlucky or foolish in the ways in which they managed their resources. It is possible that the roots of the social inequality that emerged more clearly in later periods of European prehistory had their roots in the Late Neolithic.

MANY TYPES OF SETTLEMENTS

One of the most remarkable aspects of Late Neolithic Europe is the diversity seen in settlements. They range from large collections of many houses to groups of only a few structures, from tightly clustered agglomerations to widely dispersed farmsteads. In certain places, such as the Balkans, settlements with clay houses were continually rebuilt in the same location, forming mounds, or tells, while in northern and western Europe, the rebuilding and relocating of timber structures resulted in little significant accumulation of debris. If timber was not available, houses and even their interior furnishings were made from stone, as in the remarkable settlements on the Orkney Islands.

The variation in Late Neolithic settlements is additional evidence for strong local attachments and the emergence of regional customs and traditions in domestic architecture. Houses are square, rectangular, oval, or round, depending on local styles and the materials available. There also are clear local preferences for settlement locations. For example, in the lake basins of the Alpine foreland, houses were built on piles driven into the soft mud of the lake shores, whereas on the island of Bornholm in the Baltic Sea, settlements with longhouses were erected along streams at the fall line, where the interior plateau meets the narrow coastal plain. In some areas, settlements were constructed on defensible points in the terrain or were surrounded by ditches and palisades; elsewhere they were open and easily approached.

In general, however, it is possible to say that the houses of Late Neolithic Europe and their inhabitants were grouped into what might be called "hamlets." It is unlikely that there was any long-term political leader of such a community, and their constituent households were still relatively autonomous. They needed to act together on occasion, and in such situations, temporary leaders might emerge. It is still too early, however, to see much evidence of hereditary social ranking, which did not become apparent until the Bronze Age.

THE QUEST FOR COPPER

The Late Neolithic inhabitants of Europe had mastered the art of pottery manufacture, which was the first process that resulted in the chemical transformation of a raw material to a new state from which it could not revert to its natural form. Once potters had achieved temperatures that were high enough to smelt metals from their native ores, the same principles of "pyrotechnology" were applied to minerals. Copper became the first metal to find its way into common use in Late Neolithic Europe. When smelted from its ore, copper could be hammered and cast into shiny ornaments and tools.

Between 4500 and 3000 B.C., copper use became exceptionally common in southeastern Europe and on the Iberian Peninsula. Miners followed copper seams, heating and then dashing cold water on the metal-bearing rocks to fracture them. The smelted copper then was transported over long distances. For example, the copper used at sites in north-central Poland came from as yet undetermined sources in the Carpathians, as least 500 kilometers away.

Most Late Neolithic copper was made into ornaments, such as beads, bracelets, and pendants. Making these ornaments was relatively simple, since the copper could be hammered into sheets and strips and then rolled. One burial at Osłonki in northern Poland contained a headdress around the skull made from several dozen copper strips that had been bent around a belt of leather or cloth. Later, copper was cast into tools, such as the massive copper axes found in the great cemeteries of the Carpathian Basin, such as Tiszapolgár in Hungary. By the end of the fourth millennium B.C., coppersmiths were able to manufacture relatively graceful tools, such as the copper axe carried by the Iceman whose corpse was found in the Alps in 1991.

The greatest number of Late Neolithic copper artifacts are in graves and hoards, where they were deliberately buried. This practice removed copper from circulation in society and enhanced its value and desirability even more. In many regions the possession of copper ornaments and tools became another way for a household to accumulate and display its wealth.

RITUAL, CEREMONY, AND MONUMENTS

Perhaps the most spectacular development of Late Neolithic Europe was the establishment of clear locations for ritual and the building of public monuments. The landscape was transformed not just by clearing land for fields and pastures but also by investing particular locations with profound meanings. The Irish archaeologist Gabriel Cooney has written of "sacred landscapes" in which natural and artificial features held particular significance for generations of prehistoric inhabitants. Everywhere in Europe, Late Neolithic peoples created these sacred landscapes. In Denmark and northern Poland offerings began to be deposited in bogs and marshy depressions. High in the Carpathians, circular ditched enclosures probably were places where ceremonies were held. On the Salisbury Plain in England, the first bank and ditch was constructed at Stonehenge, and to the north there was the great stone circle at Avebury. Enigmatic standing stones called "menhirs" began to be erected at many locations in Brittany.

Perhaps the most impressive expression of Late Neolithic ceremonial architecture was the construction of large stone burial monuments called "megalithic tombs" in an arc reaching from Sweden in the north through France, Britain, and Ireland and south to Spain and Portugal. Tens of thousands of megalithic tombs were built, using large boulders to form chambers and passages that were covered over with mounds of earth or cairns of stones. Most megalithic tombs were collective burial monuments, in which deceased members of a community or a clan were buried together. They were opened repeatedly, and the bones of earlier generations were pushed aside to make space for new corpses.

Although their basic function seems clear, archaeologists continue to debate the broader significance of megalithic tombs for Neolithic society.

CONCLUSION

During the Late Neolithic we begin to see the traces of regional variation and local identity that persisted throughout later prehistoric times. Such economic practices as the use of secondary animal products and patterns of long-distance trade began to emerge. The landscape was restructured dramatically, yet people continued to live in fairly small communities with relatively few differences in access to status, power, and wealth. Nonetheless, Europe during the Late Neolithic finally starts to become "recognizable" to us, as we look backward from the twenty-first century, much more familiar than the worlds of the postglacial hunter-gathers or the pioneer farmers of earlier millennia.

PETER BOGUCKI

EARLY METALLURGY IN SOUTHEASTERN EUROPE

The earliest technologies employed by humans and their hominid ancestors, such as stone tool manufacture, were developed nearly two million years ago by reducing raw materials that occur in nature to a specific form or shape (e.g., a nodule of chert was reduced to a flake). Later, humans began to develop more complex composite technologies that required the combination of separate naturally occurring raw materials to create something new and different (e.g., clay, fire, and water were combined to create ceramics). The developments of these techniques mark important moments in the prehistory of humanity, but the innovators were limited by their inability to produce durable artifacts that could be reused and refashioned when they were worn-out or broken. Once the pot broke, it had to be thrown away. When the stone tool was resharpened so many times that it no longer fit into its haft, it had to be discarded.

It was not until human societies learned to develop technologies that would let them turn rock into metal that they would be able to create artifacts that could be used to the point of exhaustion and then re-created into something new. With the advent of metallurgy, the products manufactured by a human technology could be reused and recycled several times, thus making both the products themselves and the knowledge involved in their production more precious and valuable to their makers. Unfortunately, these very characteristics—reusability and recyclability—of metal artifacts make the study of early metallurgy extremely difficult for archaeologists. Simply because the tools were so valuable, they seldom were left behind in their original forms for archaeologists to find.

THE AUTONOMY OF METALWORKING IN SOUTHEASTERN EUROPE

Metallurgy, like several other early technologies, developed independently across the world in several different cultural contexts—in North America, Central America, Southeast Asia, the Near East, Mesopotamia, and southeastern Europe. As a result, the precise timing of the advent of early metallurgy and its spread throughout the world has been a topic of much discussion.

Since the beginning of the twentieth century, archaeologists have uncovered evidence for copper production during the Neolithic and the Copper Age in the Balkan region of southeastern Europe, the Near East, and Mesopotamia. The prevalent theoretical paradigm during the early 1900s assumed that most cultural innovations occurred earliest in the Near East and spread by processes of cultural diffusion and migration throughout Eurasia. This *ex oriente lux* (light from the east) framework was encouraged by relative dating methods that forced archaeologists to establish regional chronological sequences based upon typological similarities in artifact types found in stratigraphic sequences—or corresponding layers—at different sites. It was not until the advent of absolute dating methods, such as radiocarbon dating, that archaeologists were able to establish independent absolute chronological sequences for specific regions that then could be related to absolute sequences in other areas.

In a seminal article entitled "The Autonomy of the South-East European Copper Age," Colin Renfrew convincingly demonstrated, using both absolute and relative dating methods, that the development of copper smelting technology occurred earlier in the Balkans than in the Near East and Mesopotamia. In addition, Renfrew argued, metallurgy was not "a single invention, but a number of distinct and separate discoveries." He noted that in most areas the first stage would have been the hammering and drilling of native—or naturally pure—copper to produce beads. This stage would have been followed by annealing—a process of heating and cooling to facilitate shaping—and hammering the metal into a desired form. This procedure naturally would have led to forming the melted metal in casts. Finally, he suggested, the process of melting and casting would have led to the addition of other rocks, including ores, which would have led to smelting—extracting the metal from rocks—and eventually to alloying—or mixing—copper with other metals, such as tin and arsenic, to produce bronze.

While the precise chronological relationship between early metalworking technology in southeastern Europe and southwestern Asia remains unclear, by the fifth millennium B.C. copper production in southeastern Europe was more sophisticated than its Asian counterpart and dramatically influenced trade networks and socioeconomic organization.

EARLY COPPER ARTIFACTS

A few native copper artifacts dated to the eighth millennium B.C. have been identified at Çayönü in eastern Anatolia and to the seventh millennium B.C. at Çatal Hüyük in southwestern Anatolia. At the beginning of the sixth millennium B.C., the Hassuna and Halaf cultures in Mesopotamia boasted modest assemblages containing copper and lead ornaments, all cold-hammered from native materials.

The earliest copper artifacts in southeastern Europe appeared late in the sixth millennium B.C. at such sites as Lepenski Vir. Archaeologists, including Henrietta Todorova, have suggested that, in addition to being used to produce artifacts, colorful azurite and malachite ores (both copper carbonates) may also have been used for body decoration. At Lepenski Vir, malachite and azurite beads were found in Early Neolithic contexts. And small ornamental copper artifacts, such as awls, beads, rings, and armbands, were found on settlements and in cemeteries throughout the Balkans.

By the middle of the fifth millennium B.C., much larger copper tools were being produced, initially in the form of flat copper axes and later in the form of "hammer-axes" with a hole for hafting, called a shaft-hole. By the end of the fifth millennium B.C., toolmakers were producing ax-adzes and large chisels. Interestingly, at the beginning of the fourth millennium B.C., the variability in copper tool types decreased considerably, suggesting a shift in the organization of production that was perhaps related to the exhaustion of productive ore sources in the area of modern-day Bulgaria and Serbia and to the discovery of more remote sources, possibly in the Transylvania region.

COPPER PRODUCTION

One of the biggest stumbling blocks archaeologists encounter when trying to understand the organization of prehistoric copper production is the fact that, unlike most other early technologies, such as ceramic and chipped-stone manufacture, the production of copper artifacts leaves behind almost no traces. Chipped-stone production, a reductive technology, leaves behind flakes and debitage each time an artifact is modified. Similarly, pots frequently break when they are being fired or at some point during their use, leaving behind fragments that cannot be efficiently reused for the archaeologist to find.

Not only does copper production leave little residue, the copper products themselves can be reused to the point of exhaustion and then reincorporated—or recycled—into new products. As a result, the current understanding of copper production techniques is based only upon the very sparse evidence that remains behind in those areas where copper was initially exploited, where the artifacts themselves were produced, and where the artifacts finally came to be deposited in the ground.

PRODUCTION TECHNIQUES

The earliest copper artifacts found in Neolithic contexts in southeastern Europe were produced from native copper sources that easily could be manipulated by cold-hammering techniques. These techniques were no more complex than those that had been used to produce stone tools for ages: once identified and acquired from the source, the raw materials were drilled and pounded into the desired shape. Similarly, annealing would have built on well-known techniques, such as heat treating lithic raw materials to promote their flaking characteristics.

The extraction of metals from ores, however, is a process that requires extensive knowledge of both the chemical properties of the raw materials themselves and the atmospheric conditions necessary for manipulating the raw materials to produce and modify the metals. As a result, metalworkers in several ethnographic societies are treated like shamans—respected individuals who have restricted access to specific knowledge. Frequently, metalworkers establish guilds or secret societies into which novices are inducted through elaborate rites of passage and long apprenticeships.

Native copper, which occurs naturally but is rare, requires a temperature of 1,083°C (1,981°F) to reach a molten state. The smelting of copper metal from ores, such as malachite and azurite, does not require as high a temperature, but it must occur in an oxygen-deprived atmosphere, also called an oxygen-reduced environment. Both of these conditions can be achieved, with substantial effort, in an open fire with a crucible or in a furnace or kiln. Normally, additional geological materials, called fluxes, must be added to the ore at high temperatures in the reducing atmosphere to remove impurities from the metal. The fluxes fuse with the impurities during the melting process to create a waste product, called slag, that separates from the remaining crude copper.

Renfrew noted that the conditions necessary for smelting copper had already been achieved in the fifth millennium B.C. by craftspeople who produced the graphite-decorated pottery that became common throughout the southern Balkans during that time. Like smelting, the graphite decoration was created in an oxygen-reduced, heated environment. The widespread use of graphite decoration indicates not only that potters knew how to create the atmospheric environments necessary for smelting copper but also that they were experimenting with different rare minerals while producing pots.

COPPER EXPLOITATION CONTEXTS

Unlike the raw material sources for producing stone tools and ceramics, which occur in several different types of environments throughout southeastern Europe, sources of copper ore occur only in very specific microenvironments. The copper ore sources in southeastern Europe are concentrated in veins that run through limestone massifs in the Balkans, particularly in Bulgaria and Serbia, where mines dating to the Copper Age have been discovered. Copper sources also occur in Transylvania, but so far there is no evidence to suggest these sources were exploited in prehistory.

COPPER PRODUCTION CONTEXTS

Extensive research since the 1970s has helped develop an understanding of the nature of copper ore exploitation and mining. Unfortunately, the elusive nature of metallurgical technology, which leaves behind very little evidence, prevents a good understanding of where the remaining steps of copper production occurred.

Scant evidence from contemporary settlements throughout the region suggests that access to the ore sources was unrestricted throughout the end of the Neolithic and during most of the Copper Age. Most steps of copper production—including smelting, annealing, casting, molding, and recycling—probably occurred on regular habitation sites and not at special-purpose sites, as seems to have been the case at the end of the Copper Age. There were several contemporary settlements within a short distance of the mines at Ai Bunar that produced copper oxide fragments that derived from the mines themselves. But there is no evidence to suggest that these settlements were special-purpose settlements that were responsible for smelting the copper from the ore. No contemporary settlements have been identified in the vicinity of the mines at Rudna Glava.

The vast majority of evidence for copperworking derives from infrequent finds of copper slag and ore fragments at settlement sites. At the site of Selevac in Serbia, Ruth Tringham and Peter Glumac reported finding a single piece of copper slag and several small fragments of ore that they suggest indicate on-site processing. Copper slag traced to the source at Rudna Glava has been found at the site of Slatino in southwestern Bulgaria. Slag has also been discovered at the sites of Vadastra in Bulgaria, Anza in Yugoslavia, and Sitagroi and Mandalo in northern Greece.

The presence of copper slag at these settlement sites suggests that copper processing occurred as part of the normal economic activities carried out by people living in southeastern Europe during the late fifth and early fourth millennia B.C. There is no evidence to suggest that access to the copper sources was restricted during this time, and the absence of specific settlements or specific parts of settlements dedicated to copper processing suggests that each individual household most likely was responsible for producing its own copper artifacts, just as each most likely was responsible for producing its own ceramics.

By the end of the Copper Age, c. 3000 B.C., some settlements were probably divided into areas that were specifically dedicated to copper processing. Evidence at the site of Vučedol in Croatia demonstrates this development. Located on the right bank of the Danube River, about 5 kilometers east of Vukovar, on a loess terrace about 30 meters above the river, the site comprises 4 flat-topped mounds that were occupied at various times throughout the Neolithic and the Copper Age. During the Copper Age, the settlement extended across most of the site, covering an area of approximately 3 hectares (7.4 acres). The site is considerably larger than contemporary sites in the vicinity and may have been a regional economic and social center.

The highest part of the site at Vučedol was separated from the rest of the settlement by two parallel ditches. These ditches enclosed a large rectangular structure that was considerably larger than the houses located in surrounding residential areas, and this area also produced the only evidence of copper smelting on the site. Stašo Forenbaher has argued that this part of the settlement may have been occupied by a local elite that exercised control not only over Vučedol but also over the production and exchange of precious goods and that dominated the smaller settlements in the area. Unfortunately, there is little convincing evidence for the presence of an elite class within that or any other settlement of the Late Copper Age in the area. Thus, while the settlement may have been an economic and ideological center where copper processing occurred, it seems unlikely that it would have been the center of a chiefdom.

Sometime during the Copper Age, however, there seems to have been a shift in the methods of copper production. Whereas it had been a task carried out by individual households at the beginning of the period, by the end of the period it had become a task carried out by a specific subset of the population. But this general pattern of increasing specialization does not seem to have been associated exclusively with metalworking. Timothy Kaiser and Barbara Voytek have argued that there was a general trend toward increasing specialization and more intensive production in households during this time in southeastern Europe. The trend extends to various aspects of economic organization, including ceramic and textile production and subsistence practices.

COPPER DEPOSITIONAL CONTEXTS

A great deal can be learned about the economic organization of prehistoric societies by studying how and where they exploited and processed copper ores, but it is considerably more difficult to understand how copper tools themselves were used and perceived by the people who produced them. To approach this question, it is necessary to study those contexts where copper objects came to be deposited in the ground, either intentionally or accidentally.

The vast majority of copper artifacts from the Neolithic period, until about 4500 B.C., have been discovered in burials or as random finds in settlement deposits. With the exception of a fishhook at the Early Vinča site of Gornea, nearly all copper artifacts from this period are small and associated with body decoration, including beads, rings, and armbands. However, copper artifacts from the Copper Age, after about 4500 B.C., are found in three different types of depositional contexts: in settlements, in burials, and as stray finds (which means that their provenience is uncertain or unknown). The artifacts found in settlements tend to be small and fragmentary and related either to body decoration, such as beads, pendants, and rings, or to domestic tasks, such as awls used in sewing and textile production. The copper artifacts found in burials tend to be either small ornaments associated with body decoration or much larger, more functional tools, including hammer-axes, adzes, and chisels. Several of these large tools are reported as stray finds.

Although nearly half of the smaller objects exhibit evidence of use, few of the larger artifacts, whether found in burial contexts or as stray finds, appear to have been used at all. This leads some authors, such as Douglass W. Bailey, to suggest that the larger, more extravagant copper artifacts were intended primarily for display and not for functional uses. It is equally likely that used large artifacts are found less frequently than used small artifacts because the large artifacts were continually being recycled and small artifacts were not or because large artifacts were not considered appropriate as burial goods if they had been used. Indeed, the wide variety of artifact types and their occurrence in several different social contexts suggests they filled diverse social roles—as functional tools, items of prestige, and items of display.

GOLD

About the same time copper began to be extensively exploited in the region, artifacts of gold also began to circulate and be deposited in the ground, primarily in mortuary contexts. Compared with the complex technological processes necessary to process copper, little smelting is required to work gold. Since the raw material is itself very soft, it easily can be beaten and hammered without being heated. Gold is available in streams in Bulgaria, and nuggets may have been mined there in prehistory.

The vast majority of gold in southeastern Europe comes from the Black Sea coast of Bulgaria. Most of the gold artifacts are small ornaments of body or clothing decoration found in burials. Over three thousand gold objects were recovered from the fifth millennium B.C. cemetery near the site of Varna. Gold artifact types in the Varna cemetery include cinched beads, thin sheets, spirals, diadems, earrings, lip covers, lip plugs, bracelets, and a penis sheath. Other gold artifacts have been found in fifth millennium B.C. contexts on the Great Hungarian Plain and at other sites in northern and eastern Bulgaria.

As Alasdair Whittle has noted, it may seem counterintuitive, but the paucity of gold in burials during this period in southeastern Europe may be a reflection not of gold's high social value but rather of its low social value, perhaps because of the ease with which it could be worked. Given this interpretation, the preponderance of gold in the cemetery at Varna may therefore be explained as having been a substitute for copper.

GENERAL TRENDS OF EARLY METALLURGY IN SOUTHEASTERN EUROPE

Throughout the Neolithic period, until about 5000 B.C., the farmers and herders of southeastern Europe exploited the rich deposits of nearly pure native copper located in the Balkan mountains to make trinkets—beads and other small artifacts—that were used primarily for ornamentation and body decoration. During this time, they used techniques of manufacture that did not differ considerably from the techniques they used to exploit lithic raw materials, such as chert.

About 5000 B.C., the early metalworkers learned to adapt techniques they had developed to make graphite ceramics to smelt copper from carbonate ores, such as malachite and azurite. This innovation probably occurred independently in southeastern Europe, and by the middle of the fifth millennium B.C., metalworkers there had far surpassed the quantity and quality of work being carried out in the Near East and Mesopotamia. Much larger artifacts, including axes, adzes, and chisels, were being produced from ores that were excavated at complex mining sites, such as Ai Bunar and Rudna Glava. There was a general increase across the region in the quantity and variety of types of artifacts that were produced throughout the fifth millennium B.C.

By the end of the fourth millennium B.C., copper production decreased considerably in the Balkans, perhaps because of the overexploitation of local resources. Some authors, such as E. N. Chernykh, suggest that metalworking became more primitive during this time, when the mines at Rudna Glava and Ai Bunar also fell into disuse. Once again, objects made of copper became smaller types associated with ornamentation and body decoration.

Beginning in the middle of the fourth millennium B.C., metalworkers in the northern Balkans began to experiment with different alloys. They mixed copper with other metals, such as arsenic, which in some cases occurred as a natural impurity in copper ores. They quickly learned that these "arsenic bronzes" improved the quality of the final product by making the material harder and generally easier to work. By the second millennium B.C., probably via diffusion from Anatolia, the metalworkers learned that one of the best alloys for copper was tin. The combination of these two metals created a new material that was much harder and much more durable than copper but that could be recycled and reused in a similar fashion. That material was bronze.

See also **Warfare and Conquest** (*vol. 1, part 1*); **Early Copper Mines at Rudna Glava and Ai Bunar** (*vol. 1, part 4*); **Varna** (*vol. 1, part 4*).

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WILLIAM A. PARKINSON

EARLY COPPER MINES AT RUDNA GLAVA AND AI BUNAR

Extensive research by eastern European scholars has reshaped our understanding of early copper ore mining techniques that were used during the Late Neolithic and Early Copper Age in the Balkans. Since the late 1960s, archaeological investigations at two copper mines—Rudna Glava and Ai Bunar—have revealed the complexity of early copper metallurgical techniques and revised our understanding of early copper exploitation strategies and their relationship to other socioeconomic processes.

One of the most well-known prehistoric copper mines is the site of Rudna Glava in eastern Serbia. The site, located 140 kilometers east of Belgrade on the Romanian border, was a magnetite mine until the late 1960s. Archaeological excavations by Borislav Jovanović in the 1970s revealed over twenty prehistoric mine shafts that followed veins of copper ore throughout the limestone massif.

The mine was excavated in antiquity using techniques that had been employed for thousands of years to exploit lithic resources, such as chert. Armed with stone mauls and antler picks, the prehistoric miners followed the vertical veins of copper ore into the hillside. They employed a method of heating and cooling to break up the ore and facilitate quarrying. First they would light fires along the wall face. Then they would throw water onto the hot rock, causing it to crack and thus making it easier to chip apart. Some of the veins were followed 15 to 20 meters into the center of the hill, with small horizontal access platforms extending off the main shaft. In those cases where the shaft appeared to be in danger of collapsing the miners built stone supporting walls out of the debris they excavated.

The mine at Rudna Glava is well dated to the Late Neolithic and Early Copper Age, a period also known as the Chalcolithic, which took place during the second half of the fifth and the first half of the fourth millennium B.C. This dating is based on pottery from the Vinča culture that was found in the mine shafts. Jovanović recorded three different accumulations of pottery in the shafts. The oldest, which was found on an access platform in the mine along with a damaged antler tool and a large stone maul, dates to the transitional phase, known as the Gradac phase, between Early and Late Vinča, during the fifth millennium B.C. The two other pottery concentrations are characteristic of Late Vinča culture and date to the early fourth millennium B.C.

Another early copper mine was excavated at the site of Ai Bunar in northern Bulgaria in the Sredna Gora Mountains of central Bulgaria. The mine at Ai Bunar is roughly contemporary with the mine at Rudna Glava, and the miners used similar techniques. They excavated narrow open trenches to follow the veins of copper carbonates into the hills. As at Rudna Glava, archaeologists found antler picks and stone mauls in the mine shafts, in addition to two shaft-hole copper tools and the remains of three human individuals.

The ceramics found at Ai Bunar are characteristic of the ceramics found in the sixth layer at the Karanovo tell (Karanovo VI) and date to the late fifth millennium B.C. While this discovery demonstrates that the mines at Ai Bunar were in use during the later fifth millennium B.C., other evidence suggests the mines probably were in use somewhat earlier, possibly as early as the end of the sixth millennium B.C. Copper objects and ore that have been demonstrated chemically to have derived from the sources at Ai Bunar were found at several sites in south-central Bulgaria that are contemporary with Karanovo V, a phase that dates to the beginning of the fifth millennium B.C.

Chemical analyses, primarily lead isotope analyses, carried out by E. N. Chernykh, Noël H. Gale, and several Bulgarian specialists have demonstrated that Ai Bunar and Rudna Glava were not the only sources for copper ore in prehistory. The analysis of copper artifacts from several sites in south-central Bulgaria suggests that at least four other copper sources were exploited, though they remain unidentified.

A handful of other copper mines have been located in northern Thrace, one of which contained Karanovo V and VI pottery, and another prehistoric mine also is known to have existed at Mali Sturac, a site in the Rudnik mountain range in central Serbia. Unfortunately, none of these sites has been extensively explored, and little has been published about them.

See also **Early Metallurgy in Southeastern Europe** (*vol 1, part 4*); **The Early and Middle Bronze Ages in Temperate Southeastern Europe** (*vol. 2, part 5*).

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WILLIAM A. PARKINSON

MILK, WOOL, AND TRACTION: SECONDARY ANIMAL PRODUCTS

Zooarchaeologists distinguish between primary animal products, such as meat, bone, and marrow, and secondary products, such as milk, wool, and traction (animal labor). Primary products, also known as slaughter products, require the death of the animal and thus can be harvested only once. Secondary products are extracted from the living animal. This is a crucial distinction because secondary products permit a higher yield from the same number of animals. While people can acquire primary products from either wild or domestic animals, secondary products normally are available only from domestic herds. Some researchers have suggested that secondary products may have been the motivation for animal domestication, but the evidence does not support their use to any significant extent until considerably later than the time when animals were domesticated.

It is difficult to study the use of secondary products in prehistory because they typically are not preserved in the archaeological record. Most primary products leave relatively direct evidence in the form of animal bones. Bones are by-products of meat consumption, and bone breakage patterns can indicate their use for marrow. For the most part, secondary product use must be approached indirectly. Sometimes artistic representations portray these products or their use, but it is quite possible for societies to use them without leaving a pictorial record. Indeed, with the exception of the use of animal traction to draw wheeled vehicles, the first artistic depictions of secondary products generally are much later than their earliest use. Thus, the most widely employed method to detect the use of secondary products is the demographic study of the animal bone assemblage.

Such a study focuses on the differing herding strategies that are necessary to achieve significant production of secondary products. If meat is the main concern and secondary product use is absent or insignificant, most males typically are slaughtered at a juvenile or subadult stage, when growth slows and more feed produces little additional weight gain. If herders want milk, they need lactating females, and they must limit competition from the infant animals through slaughter or early weaning. Thus, most males likely will be slaughtered as infants, and the herd will consist mainly of adult females. Both males and females produce wool, so when wool is the desired secondary product, the herd will consist of both sexes, and most animals will live into adulthood. Traction (pulling plows or vehicles) also requires adults, and males or castrates may be better suited to the task. Each strategy creates a distinctive kill-off pattern, or mortality profile. Age and sex information can be derived from the study of the animal bone remains to reconstruct these strategies.

MILK

All mammals produce milk, so it is certainly possible that ancient herders used dairy products from the beginning of animal domestication. There are real advantages to dairy products. Animal milk is a good substitute for human milk when a mother dies or cannot produce adequate milk. Dairy products provide a sustainable source of protein and fat that substantially enhances the productivity of the herd. For example, Paul Halstead has calculated that a Greek Neolithic (early farming) village of 40 to 240 inhabitants could meet its caloric needs with 2,400–14,400 sheep if the villagers ate only the meat, but they would need only 1,000–6,000 sheep if they used the milk as well. Dairying thus could be used to reduce herd size and devote more land to agriculture or, alternatively, to keep more animals alive for their wealth value while still deriving protein and calories from the herd. Moreover, processed milk products, such as cheese, can be stored, unlike fresh meat or milk.

There are also drawbacks to dairy production, however. Even with today's electric milking machines, dairy farmers know that maintaining dairy herds is a labor-intensive undertaking. The animals need to be milked regularly (at least once a day) to maintain production. (For maximum yield, modern dairy farmers milk two or even three times daily, at regular intervals.) To accomplish this, either the milking animals must be kept near the settlement—requiring fodder because there probably will not be enough pasture nearby—or a remote dairy-processing camp must be set up in the mountain pastures and some people will have to spend considerable time there. Any milk that is not consumed immediately must be processed and stored.

Lactose intolerance poses a further difficulty. Lactose is the form of sugar found in milk. Mammals normally drink milk only in infancy. The ancestral condition in humans, just as in other mammals, is to lose the ability to digest lactose after infancy as a result of shutting down production of the enzyme lactase. This is still true of most living humans. Human populations with a long history of drinking milk (in East Africa and central and northern Europe) have evolved the capacity to continue producing lactase throughout life. It is safe to assume that the people who first domesticated herd animals would not have been able to digest their milk in adulthood. Even people with lactose intolerance are able to consume dairy products if they are fermented (as are cheese and yogurt), which significantly reduces the lactose content. Little is known about the origins of these fermented products, but the techniques to produce them could not have been developed until after milk already was in use. Most present-day populations that use dairy products, in fact, are not lactose tolerant and rely mainly on fermented dairy products.

Lactose tolerance seems to have developed where it was important to use fresh milk: in arid East Africa, where the water content may have been useful, and in northern Europe, where the lactose itself was helpful. Lactose enhances calcium absorption and helps prevent rickets in places where vitamin D intake from sunshine or fish is inadequate. In sum, an extended period of cultural or biological adaptation or both would be necessary before animal milk could make a significant contribution to the adult diet.

While milk may have been consumed occasionally from the earliest days of herding (sheep and goats were domesticated c. 8000 B.C.), there is little sign that it was used to any significant extent until much later. The mortality profiles of early herds reflect a meat-oriented herding strategy. At this point there are too few mortality profiles to gain a clear picture of when dairy achieved prominence in various regions. Current evidence suggests not simple diffusion from a center of origin or a single horizon of change, but more piecemeal adoption according to local conditions. Mortality profiles indicate dairy use by about 6000 B.C. in northern Italy (sheep and goats), 5800 B.C. in western Iran (sheep and goats), 5500 B.C. in Greece (sheep), 4000 B.C. in the northern Balkans and the alpine forelands of Switzerland (sheep, goats, and cattle), and 1000 B.C. in Britain but quite possibly as early as 3500 B.C. (cattle).

The mortality evidence has drawbacks, however. The mortality profiles from archaeological sites rarely are a close match to the idealized meat, milk, or wool herding strategies. This probably results from a combination of differential loss of the bones of young animals, which are softer and more fragile, and the fact that prehistoric herders, who were not involved in market economies, practiced less-specialized forms of herding than those seen today. A further difficulty relates to the let-down reflex. Milk is held in the mammary glands until it is "let down" into the milk ducts. Lactating females generally let down their milk through a hormonal reaction in response to the suckling of their infants. Not all animals let down their milk if their own offspring is not present, and some researchers have suggested that this would have been true of early domesticates.

There are many stratagems for "tricking" the mother into letting down, however. These schemes include the use of surrogate offspring and the use of a tube to blow air into the mother's vagina (triggering a hormonal reaction). Experts disagree over how great a problem this would have been for early herders. Those who see it as a major impediment suggest that offspring would have had to be kept alive and milk shared with them, which would clearly alter the mortality profile from what is expected for dairy. One instructive study examines medieval Irish cattle mortality profiles. In this case documentary evidence indicates that cattle were kept primarily for dairy, but the mortality profile of the archaeological remains shows later kill-off than expected, between one and two years of age. At best, dairy mortality profiles indicate a herd structure that would support the use of milk but do not provide evidence that it actually was used.

Given these ambiguities, it is useful to seek other lines of evidence. One study of sites in Israel takes a more direct approach. Studies of present-day livestock show that lactating female sheep suffer calcium loss in their bones if they are nutritionally or otherwise stressed. Reasoning that ancient dairy animals would have been stressed at least sometimes, the researchers used X rays to measure the bone mass of sheep and goat specimens from several sites spanning the Neolithic, Chalcolithic, and Bronze Age. While there was some local variation, such calcium loss does not appear before the Chalcolithic (fifth millennium B.C.) and then intensifies in the Middle Bronze Age. So far, this promising but labor-intensive method of analysis has not been applied elsewhere. It is encouraging, however, that it accords well with the mortality profile evidence from the Chalcolithic sites.

Artifacts also have provided evidence for dairy use. Bowls resembling those now used in dairying have been found at Swiss Neolithic sites, where mortality profiles also suggest the use of milk. Ceramic sieves from the Early Neolithic Linear Pottery culture of central Europe (c. 5500 B.C.) may have been used in cheese making (fig. 1). Such arguments rest on analogies to modern uses of artifacts, however. Chemists now have developed a more direct method. It is possible to detect and identify lipid and protein residues from milk on ancient pottery. Analyses of lipid residues on pottery fragments have provided chemical evidence for the widespread use of milk products during the Neolithic in Britain, about 4100–3500 B.C. The earliest artistic depiction of milking is on a Sumerian cylinder seal from c. 3300 B.C., probably well after the inception of dairy use in the Near East.

WOOL

Wild sheep (*Ovis orientalis*) are hairy rather than woolly, and early domestic sheep would have been the same. These sheep have a short woolly undercoat in the winter, which is shed in the spring. Under domestication, this woolly layer became longer and was retained year-round while the outer hair (or kemp) was reduced. The pigment in the coat also was lost. Thus, the development of wool was necessary before sheep could be managed for wool production.

Wool is a perishable material that is rarely preserved in archaeological deposits. There are, however, occasional finds of textiles or textile impressions or other preserved fibers. The earlier finds, from the Upper Palaeolithic through the Neolithic, are all vegetable fibers. In the Neolithic of Europe and the Near East, these fibers usually are flax (linen). Wool appears only c. 3000 B.C. in the Near East and about 500 years later in Europe.

It is difficult, but in some cases possible, to distinguish male and female sheep bones other than the relatively fragile and archaeologically rare horn cores. This problem is compounded by the challenge of distinguishing sheep and goat bones, yet it is primarily sex ratios (the presence of adult males in numbers nearly equal to females) that differentiate wool from dairy mortality profiles. As a result, there are few analyses that can pinpoint wool use on the basis of mortality profiles, and researchers can say only that demographic evidence generally supports the picture derived from fiber remains.

There is more indirect evidence from the bones, however. At the beginning of the Bronze Age, a new population of larger sheep abruptly appeared in Europe, probably spreading rapidly from the steppe zone of eastern Europe. Sheep also became more common in temperate Europe at this time. Given that Bronze Age figurines seem to represent woolly sheep, many researchers believe that these large steppe sheep were the first woolly sheep to reach Europe, largely replacing the earlier hairy sheep. It

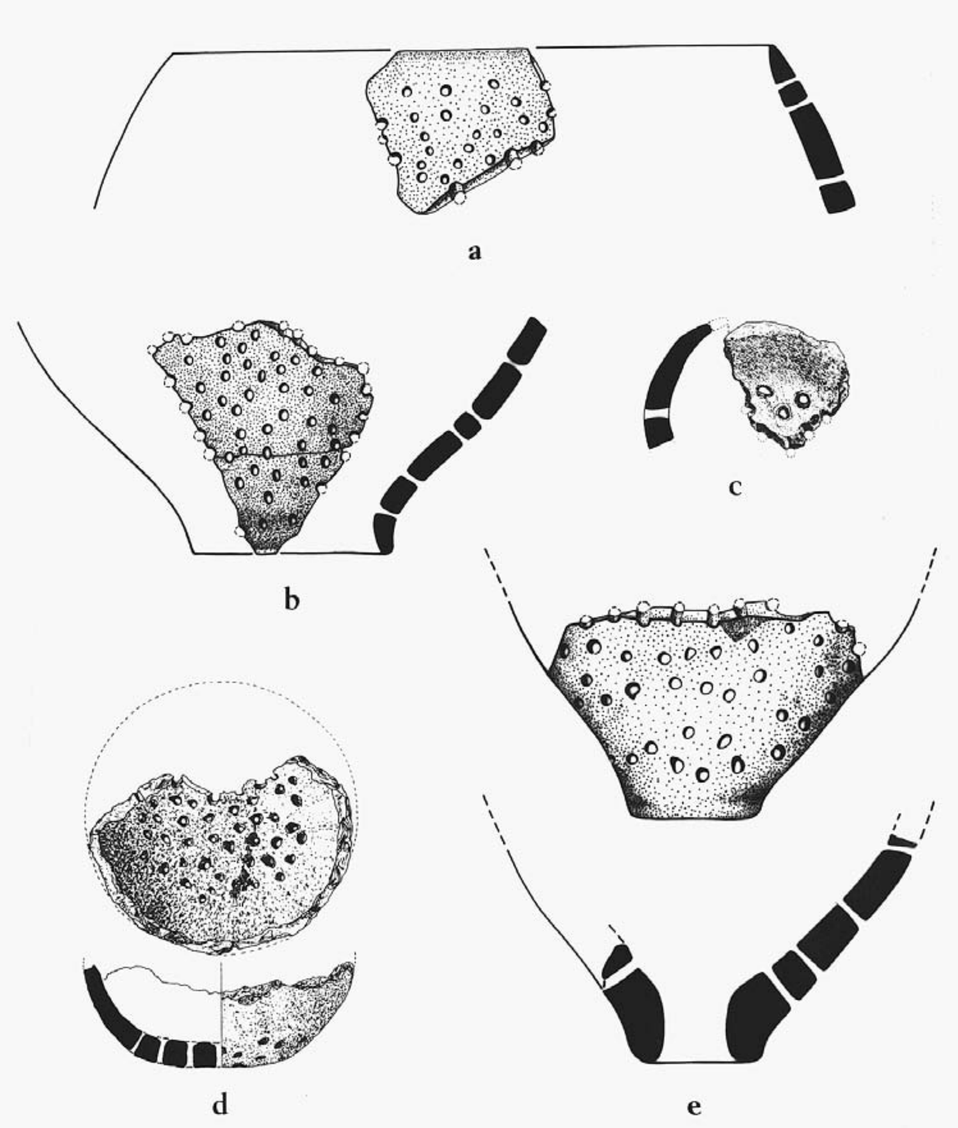

Fig. 1. Ceramic sieves of the *Linearbandkeramik* (5500–5000 B.C.) in central Europe. Key: a,b,e = Brześć Kujawski, Poland; c = Murr, Germany; d = Ditzingen-Schockingen, Germany. REPRINTED WITH THE PERMISSION OF CAMBRIDGE UNIVERSITY PRESS AND PETER BOGUCKI.

is worth noting that this pattern of rapid spread differs from the pattern of dairy use, which appeared more patchily and over a much longer period of time. Of course, the situation is somewhat different. In this case a preexisting textile industry based on flax could readily adopt wool, and the switch depended on a new kind of animal rather than simply different herding practices.

TRACTION

Harnessing animals to supplement human muscle power often is hailed as a critical step in the intensification of human energy use. Animal-drawn carts and plows permit higher agricultural yields and facilitate their transport both locally and over long distances. Chariots drawn by horses or donkeys also transformed warfare. There are many ways of using animal labor, but here the focus is on transport and plowing. In prehistoric Europe cattle and horses mainly performed these functions.

Domestic horses made their first appearance in most of Europe at this time. While horses were at times a major meat source on the Eurasian steppe, in most of Europe their adoption appears to have been based primarily on their role in transport as well as their wealth and status value. This is not to say that horses were never eaten, but they did not form a significant part of the diet, and there is no indication that they were raised primarily for meat.

In the case of cattle, an animal already long used in Europe for meat and by this time probably also for milk, traction was a new role, in addition to providing food. The use of cattle for traction meant that more animals were allowed to reach adulthood. Bulls or oxen (castrated bulls) probably were used for this purpose, although female cows pull carts in the modern-day Balkans. Traction is more difficult than dairy or wool use to detect in mortality profiles because only a few animals might have been kept for this purpose (and, like the Balkan cows, they might have been used for meat and milk as well). Animal bone studies can detect the presence of oxen. Castration tends to alter the shape of the horns (reflected in the bony horn cores, which are preserved, whereas the keratinous horn sheath usually is not). It also affects the growth pattern, so that limb bones tend to be longer and narrower than they are in intact males. Recognizing oxen, however, depends on finding a reasonable number of intact horn cores and limb bones. Particularly in the Neolithic, animal bones often were processed heavily for their marrow and fat content, leaving them highly fragmented. Thus mortality profiles do not provide a clear picture of the inception of the use of cattle for traction.

Another approach is to examine changes in the bones themselves. Extensive use for traction stresses the bones and joints of the animal, causing remodeling of the bones and such pathological conditions as osteoarthritis. Studies applied to faunal remains of the northern Balkans have suggested the use of cattle in traction (probably plowing) in the Late Neolithic, c. 4500 B.C. Other studies of later and modern cattle have developed criteria for the alterations caused by use in traction, but they have not yet been applied widely to early animal bone assemblages.

Other evidence has been brought to bear on the appearance of plowing in the archaeological record. The plows themselves probably were made of perishable materials, such as wood (although some Late Bronze Age plows are preserved in bog deposits). Plow marks, however, often are preserved below burial mounds in northern Europe in the Late Neolithic and Bronze Age (from c. 4000 B.C.). This probably was not simply a result of happening to build a mound on a plowed field but rather a ritual turning or penetration of the earth as part of the funerary ceremony itself. It is also most likely the ritual significance of plowing that has led to its frequent representation in Bronze Age rock art in much of western Europe (fig. 2). In any case, these are clear indications that plowing was practiced by 2500 B.C. The location of sites on heavy soils where they had not been found previously also has been seen as indirect evidence for plowing in the Late Neolithic of the northern Balkans, c. 4500 B.C.

In sum, much detail remains to be filled in, but drawing on the various lines of evidence it is reasonable to suggest that plowing began in southeast Europe in about 4500 B.C. and was practiced in northwest Europe by 4000 B.C. Clearly, plowing was entrenched across Europe by 2500 B.C., probably earlier. Thus, the plow, too, may have spread fairly rapidly, although somewhat earlier than wool.

Wheeled vehicles, which are inherently mobile, seem to have spread even faster. On current evidence, they appeared at about the same time in Europe and the Near East, c. 3500 B.C. (fig. 3). At this point wheeled vehicles are depicted in pictographs and models in Mesopotamia and surrounding regions. Likewise, in northern Germany a burial mound covers a set of wagon ruts, and in Poland a depiction of a wagon appears on a pot of the Middle Neolithic Funnel Beaker culture. To date, the earliest evidence of wheeled vehicles on the eastern European steppe is slightly later, in about 3100 B.C., but perhaps earlier finds will come to light, as this seems one possible route connecting Mesopotamia and the northern European plain. All of these early vehicles are slow, four-wheeled carts, apparently drawn by cattle. At this same time burials of pairs of cattle appear in eastern and northern Europe, probably yoked pairs sacrificed as part of ceremonies.

There is considerable debate concerning whether horses were ridden before or after they were used to draw carts and chariots. It is clear, at least, that the domestic horses that reached Europe from the steppe zone to the east were not used primarily for food and presumably were for some kind of transport. Animal bone remains at archaeological sites suggest that they were rare and probably were kept only by the elite classes that emerged in the fourth

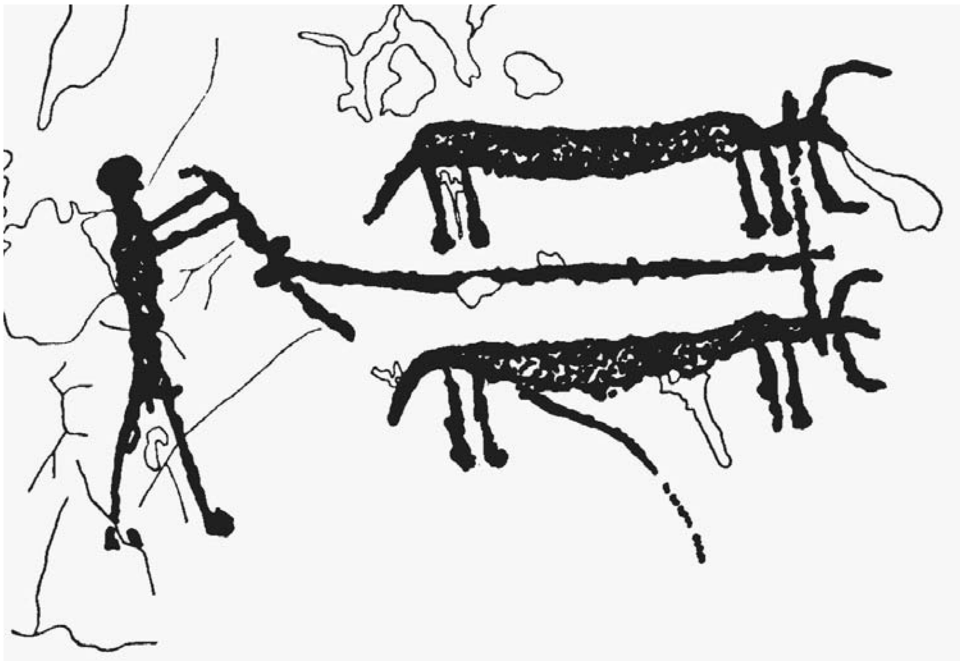

Fig. 2. Rock art depiction of plowing with cattle.

millennium B.C. A few horses appeared in graves of the Tiszapolgár culture of the Carpathian Basin shortly before 4000 B.C. They then disappeared, so perhaps they were isolated imports that did not establish a local breeding population. They turned up again in this area c. 3500 B.C. and slightly later in northern Europe. They did not become common throughout Europe until the Early Bronze Age, in about 2500 B.C.

THE SECONDARY PRODUCTS REVOLUTION

Gordon Childe, in a metaphor of lasting power, characterized the major economic, social, and ideological changes accompanying the origins of agriculture as the Neolithic Revolution. In an analogy to this concept, Andrew Sherratt has proposed a similarly crucial Secondary Products Revolution (SPR). The premise of the SPR is that dairy, wool, and traction appeared at roughly the same time in the Near East and Europe and that the use of products derived from living animals rendered animal husbandry dramatically more productive, with profound consequences.

In the SPR model, dairy, wool, and traction are linked into an integrated system quite different from the mixed farming model (with animals raised only for meat) that preceded it. Plowing increased agricultural productivity by permitting cultivation of larger areas and the use of heavier (and often more fertile) soils. Animal transport facilitated agriculture and made it possible for cities to draw their sustenance from a larger surrounding area, promoting economic integration at a regional level. In this view, it is no accident that animals used primarily for transport (horses, donkeys, and camels) were domesticated at about this time.

Wool provides a valuable, nonperishable, and easily transportable product that can be raised in areas that are marginal for agriculture. This probably contributed to the development of specialized pastoralism. The protein, fat, and calories of dairy products offered a source of animal nutrients that was an alternative to meat. Thus, herders could afford to keep animals alive for wool production and traction. Use of living animal products made the animals more valuable, adding to their overall worth. This value encouraged raiding and so may have contributed to increased warfare.

Comparative studies of contemporary societies have shown that plow agriculture leads to a greater investment in a particular plot of land, and, in this

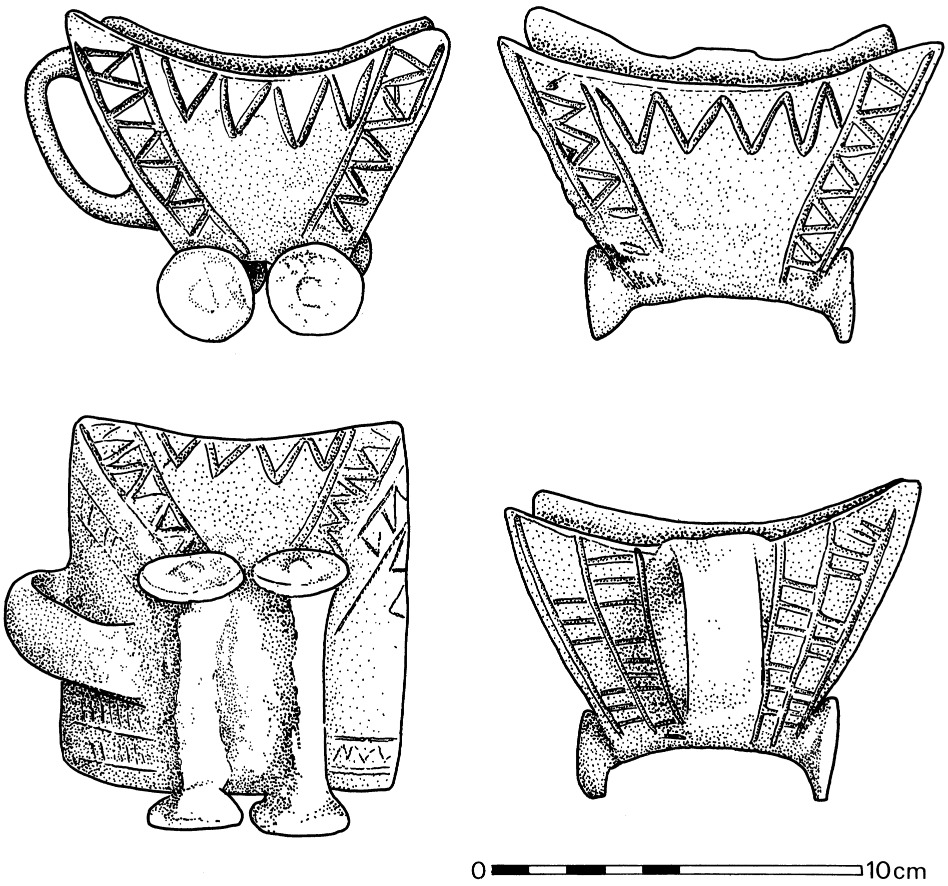

Fig. 3. Clay cup in the shape of a cart from Szigetszentmárton, Hungary (Baden culture, c. 3000 B.C.). REPRINTED WITH THE PERMISSION OF CAMBRIDGE UNIVERSITY PRESS AND ALASDAIR WHITTLE.

context, land tenure and inheritance rules take on new significance. In general, women perform most of the labor in hoe agriculture, whereas men do most of the work in plow agriculture. If this was true in prehistoric Europe, it means that this period marked a major change in gender roles. Rock art that shows men plowing supports this argument, although the association of ards (early plows) with female-associated artifacts in bog hoards in Late Bronze Age Denmark might mean that women plowed in some cases. If the generalizations from contemporary societies are followed, hoe agriculture typically is associated with matriliny (tracing descent through the female line) and plow agriculture with patriliny (tracing descent through the male line). Together with the new importance of wealth in both land and livestock, providing higher stakes for inheritance, the kinship system may have experienced considerable change.

These changing roles may have led to an imbalance in power between men and women. Sherratt suggests that female labor may have been devoted increasingly to the weaving of woolen textiles; women also may have been involved in dairy production. Sherratt also believes that men came to dominate the economy, whereas women were relegated to the domestic sphere. Growing textile production for exchange, however, may have given women considerable economic power.

The enhancement of land and livestock wealth brings with it greater opportunity to create inequalities of wealth and power. Along with improved transport, Sherratt believes that this underlies another of Childe's concepts: the Urban Revolution, or the rise of the first cities in the Near East. He also suggests that the use of animal traction had important long-term effects. Regarding traction as the first step in the mechanization of agriculture, leading to further mechanization, Sherratt claims that it ultimately explains why the Industrial Revolution happened in the Old World rather than the New World.

Many researchers have critiqued the concept of the SPR, particularly the claim that dairy, wool, and traction appeared more or less simultaneously. As already noted, dairy, in particular, may have a rather longer history, and the various elements of the SPR seem to have spread at different rates and perhaps by different routes. Nevertheless, most researchers agree that there seemed to be a significant intensification of secondary product use starting in about 3500 B.C. There also are signs of changes in settlement patterns, inequality, and gender roles at roughly this time and indications that herding may have taken on greater importance in relation to plant agriculture. It is important to remember, however, that this was not a unified phenomenon across Europe but instead was locally variable. Wheeled vehicles seemed to be more important in eastern and northern Europe, whereas plows were more significant in western Europe, for example.

Moreover, as is often the case, the direction of causality is not clear. Sherratt thinks that the use of secondary products drove the other changes and that secondary product use, in turn, was necessitated by population growth that required intensified food production. Because, however, secondary products permitted herders to slaughter fewer animals, it may be that it was not the secondary products that converted livestock into wealth but the wealth value of living animals that motivated the use of secondary products. In any case, extensive use of these living animal products had wide-ranging consequences for the societies keeping the animals.

See also **Domestication of the Horse** (*vol. 1, part 4*).

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NERISSA RUSSELL

LATE NEOLITHIC/COPPER AGE SOUTHEASTERN EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

The end of the Neolithic period in southeastern Europe was marked by several changes in settlement layout, house form, and economic and ritual organizations, which suggest that the farming societies that inhabited the region underwent a social transformation at the end of the period, about 4500 B.C. This article outlines the various changes that occurred during the Late Neolithic (c. 5000–4500 B.C.) and the Copper Age (c. 4500–3000 B.C.) throughout southeastern Europe.

The area discussed here extends from the Carpathian Basin south to the Thessalian Plain, including the modern-day countries of Hungary, Romania, the former Yugoslavia, Bulgaria, Albania, Macedonia, and northern Greece. This region forms a relatively cohesive geographic unit that is bounded on the north and west by the Austrian and Slovakian Alps and on the east by the Carpathian Mountains. The geographic layout of the region, consisting of several small, discrete microregions, each with its own set of local resources, encouraged regional differentiation among the farming societies that inhabited the area at the end of the Neolithic period. This was a sort of prehistoric version of Balkanization that persisted in the region until the twentieth century.

CHRONOLOGY

In most of northern and western Europe the Neolithic period led directly into the Bronze Age, but the phases in southeastern Europe included a formal Copper Age, or Chalcolithic period, that started throughout the region c. 4500 B.C. In Greece, where the Bronze Age began slightly earlier than it did farther north in the Balkans and in the Carpathian Basin, this time period is called the Final Neolithic and extended from approximately 4500 to 3300 B.C. In the central Balkans, that is, in Bulgaria, Macedonia, and Albania, the time period from c. 4500 to 3000 B.C. is labeled the Eneolithic. In the former Yugoslavia the same time period is called the Eneolithic or the Chalcolithic, and in Hungary and western Romania it is termed the Copper Age.

Despite the regional variations in the names that archaeologists have given to this time span, the phase generally is defined by a dramatic increase in the exploitation of copper as a raw material source for producing artifacts. In the first half of the twentieth century archaeologists thought that copper was not utilized at all until the Copper Age. As detailed knowledge of the region has grown from additional excavations and from the development of more precise dating techniques, it has become clear that the exploitation of copper as a source of raw material began in several parts of the region during the Neolithic. Early copper use, however, focused primarily on the production of small artifacts, such as beads, hooks, and decorative trinkets from "native" (pure) copper. By contrast, copper artifacts dating to the fifth millennium B.C. tend to be much more massive than their trinket predecessors. These items include adzes and axes that were produced not simply by hammering native copper into specific shapes but by much more intensive processes of excavating copper-bearing minerals (e.g., malachite) from mines, extracting the copper from the ore (a process called smelting), and casting artifacts in premade molds.

Thus while the Copper Age initially was defined on technological grounds as a time when humans first began to exploit copper resources, it now is considered to be a period that saw a dramatic increase in the level of production and the widespread use of smelting to form more massive cast tools. Even more important, the Copper Age has come to be defined as a period when societies throughout eastern Europe underwent dramatic changes in economic and social organization that established the social framework for the transitions in political organization that occurred during the Bronze Age.

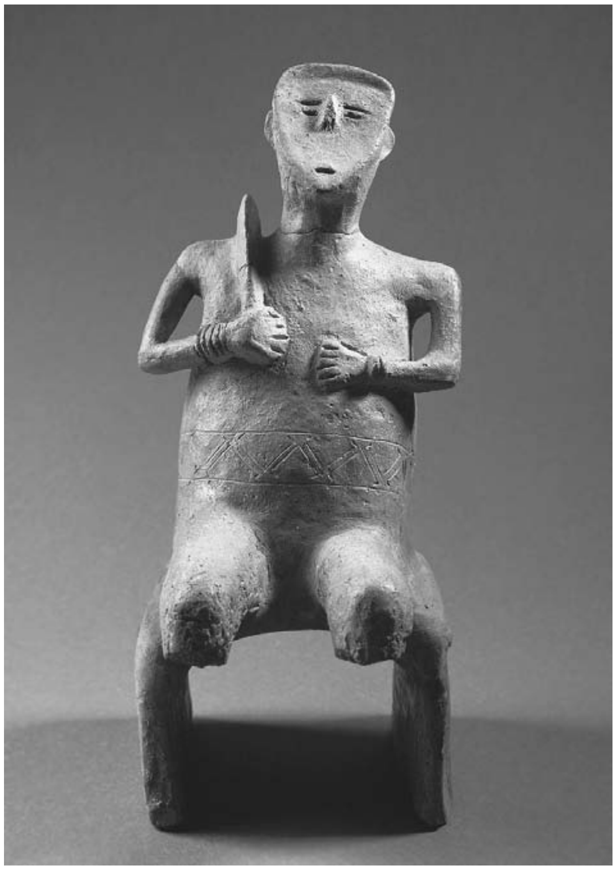

Fig. 1. Neolithic "sickle god" figurine from the Hungarian site of Szegvár-Tüzköves, Tisza culture, c. 5000 B.C. © GIANNI DAGLI ORTI/CORBIS. REPRODUCED BY PERMISSION.

LATE NEOLITHIC: CULTURAL AREAS

During the Late Neolithic in southeastern Europe settlement systems developed in association with specific sites that continued to be occupied or reoccupied for hundreds or sometimes thousands of years. The frequent reoccupation of specific sites sometimes resulted in the formation of stratigraphically superimposed habitation layers that grew several meters high. These types of sites—commonly called "tells"—are typical of the period, but they certainly are not the only kinds of settlements in the region. In one synthesis of the Late Neolithic in eastern Hungary, entitled *The Late Neolithic of the Tisza Region,* for example, Nándor Kalicz and Pál Raczky placed Late Neolithic site types into three different categories—formal tell settlements, tell-like mounds, and flat settlements. Even this classification is simply shorthand for differentiating sites with various vertical stratigraphic layers into analytical units that basically refer to how long and how frequently each site was occupied and reoccupied.

On a larger scale and almost certainly in relation to the development of these more formalized, highly structured local settlement systems, the Late Neolithic saw the crystallization of more discretely defined regional groups across the landscape. By and large these regional groups are distinguished essentially by differences in ceramic assemblages, but in some areas, such as eastern Hungary, the distinctions extend beyond ceramics to settlement organization and even to subsistence practices. This pattern of regional variation differs dramatically from the patterns of the earlier Neolithic and the Copper Age, both of which are characterized by large-scale regional homogeneity, with very similar house forms, ceramic traditions, and settlement layouts extending over very large geographic areas.

In and around the Thessalian Plain in northern Greece, which had substantial occupation throughout the Neolithic and saw the development of tell sites earlier than the northern Balkans, the Late Neolithic is interpreted largely through the extensive excavations at the site of Dimini, dating to the end of the sixth millennium B.C. Habitation continued at certain other sites, such as Sesklo, a tell that had been established at the end of the Early Neolithic. New sites also began to appear in fresh areas, such as Sitagroi in Thrace.

North of Greece, in south-central Bulgaria, the Karanovo tell, which shows occupation levels dating to the beginning of the sixth millennium B.C., is one of the best-published sites in the region. For years it has been the main site through which all relative regional stratigraphic sequences have been established. Throughout the twentieth century archaeologists used the 12 meters of cultural occupation layers at Karanovo not only to link internal phasing relationships in southeastern Europe but also to develop the relationships of the phases in southeastern Europe relative to those in Anatolia and farther east.

The stratigraphic layers at the Karanovo tell have been divided into six major levels. The earliest phases (I–III) generally correspond to the Early and Middle Neolithic of the region. Phases IV and V conform roughly to the Late Neolithic and phase VI to the Early Copper Age. Findings at other multiphase—or "multicomponent"—tell sites in the region, such as Azmak, located just to the west of Karanovo, have not been published fully, but they suggest that successive, though not necessarily continuous, reoccupation throughout the Neolithic was a common phenomenon.

Farther north, in the former Yugoslavia, the tell of Vinča long has dominated the attention of the archaeological world. Located in northern Serbia, the site was occupied from the Middle Neolithic through the beginning of the Copper Age. There the stratigraphic levels have been divided into four main phases. Level A corresponds more or less to the Middle Neolithic and levels B and C to the Late Neolithic. Level D is associated with the Early Copper Age. The Vinča culture extended over most of Serbia and parts of Bosnia and Croatia and into the Banat region of southwestern Romania. As in northern Greece, Macedonia, and parts of Bulgaria, more sites seem to have been established in regions that previously had been sparsely inhabited.

In the Carpathian Basin two cultural trajectories that succeeded the Middle Neolithic Linear Pottery culture developed on either side of the Danube River about 5000 B.C. In the eastern basin, in the area known as the Great Hungarian Plain, Late Neolithic societies along the Tisza River began to separate into the much smaller regional cultural groups (called Tisza, Herpály, and Csőszhalom) that were distributed in different regions of the plain. The subdivision of the plain into three discrete cultural groups occurred gradually throughout the Late Neolithic.

West of the Danube, in Transdanubia, Late Neolithic settlements are assigned to the earlier phases of the Lengyel culture (Lengyel I and II). Unlike the eastern Carpathian Basin, where a relatively abrupt break is apparent in the cultural sequence between the Late Neolithic Tisza-Herpály-Csőszhalom complex and the succeeding Early Copper Age Tiszapolgár culture, sites of the Lengyel culture exhibited much more continuity into the Copper Age (Lengyel III). Whereas the societies east of the Danube seem to have witnessed a somewhat abrupt transformation that affected several aspects of social organization at the beginning of the Copper Age (about 4500 B.C.), those west of the Danube acquired social characteristics associated with the Copper Age over a much longer time.

LATE NEOLITHIC: ECONOMIC AND SOCIAL ORGANIZATION

Economically the various Late Neolithic groups continued the generalized farming, herding, hunting, fishing, gathering subsistence patterns that had been established earlier in the period. There was a great deal of variation in different regions, probably relating to the local conditions of the microregions. Late Neolithic societies throughout the region relied primarily on domestic plants and animals, most of which were exploited at even the earliest Neolithic sites in southeastern Europe and the Near East. The principal domestic plants were varieties of wheat and barley, with lentils, bitter vetch, chickpeas, and flax occurring in lesser quantities. The main domestic animals were cattle, sheep, goats, and pigs. During the Late Neolithic these animals seem to have been used primarily for meat rather than for milk, cheese, and other "secondary" products.

While the Late Neolithic villagers of southeastern Europe relied predominantly upon these domestic resources for subsistence, they also continued to make use of wild resources available in the local environment. These resources included large wild animals, such as roe deer, red deer, and wild boar, as well as smaller mammals, such as wild hare. In addition they availed themselves of aquatic (fish) and estuarine (birds) resources.

Two types of wheat (emmer and einkorn) and hulled barley were grown in this region in Late Neolithic times. These and other forms of wheat and barley have appeared in varying amounts at sites across the region and were complemented by legumes, which served not only to supplement a diet based primarily on cereals but also to increase the nitrogen content of the soil. In northern Greece, in Late Neolithic contexts at Sesklo, emmer wheat prevailed with einkorn also found in significant quantities. In the Late Neolithic at that site there also were wild figs, grapevines, almonds, and oats. Emmer wheat has been found in the botanical remains from Late Neolithic Dimini, along with einkorn wheat, six-row barley, naked barley, lentils, peas, fava beans, bitter vetch, chickpeas, grass peas, and wild grapevines and almonds. Similar botanical remains were discovered in Late Neolithic contexts at Karanovo in Bulgaria, Anza in Macedonia, Obre in Bosnia-Herzegovina, and Gomolava in Serbia. In the central and northern Balkans and in the Hungarian Plain wild apples also occur in very small numbers.

Faunal assemblages in the north tend to have somewhat higher numbers of wild animal bones, a pattern that seems to hark back to the earliest Neolithic in the region. Although there was a great deal of regional variation, the occupants of the southern Balkans kept more sheep and goats (ovicaprids) during the Late Neolithic than did the villagers of the northern Balkans and the Carpathian Basin, where more cattle were exploited. For example, 50–85 percent of the bones in faunal assemblages at sites in northern Serbia, southwestern Romania, and eastern Hungary represent domestic animals, the vast majority of which are cattle. Throughout the Neolithic assemblages in northern Greece, by contrast, there are many more domestic animals, primarily sheep and goats.

The relative increase in cattle in the northern Balkans toward the end of the Neolithic is related to a tendency to utilize animals not only for their primary products, such as meat, fur, and bone, but also for their secondary products, such as milk, cheese, and traction for plowing. The precise timing of this Secondary Products Revolution, a term coined by Andrew Sherratt, remains the subject of much debate, because it has significant implications for the development of economic systems in prehistoric Europe.

Within Late Neolithic settlements in the region, most socioeconomic activities—from subsistence activities to pottery making—seem to have been carried out by the members of individual households. Marshall Sahlins called this pattern the "domestic mode of production," and it predominates in tribal societies, within which social status and political clout usually are based not on hereditary relationships (ascribed ranking) but on the proven ability of each potential leader to earn that status (achieved ranking) within a social network.

Despite the lack of evidence for hereditary social ranking in the period, the layout of settlements and the organization of burial practices at various sites indicate complexly structured social relationships. For example, Dimini in northern Greece was divided into groups of houses arranged around courtyards, suggesting that the social group that occupied the settlement was subdivided into smaller units. A similar pattern is evident at the massive (roughly 50 hectares) site of Makriyalos, where several large rectangular buildings were constructed, probably to serve as gathering places for diverse segments of the population. Farther north, at Selevac and at the smaller site of Divostin (phase II) in Serbia, the distribution of houses across the settlements suggest that the settlements similarly were divided into smaller social units.

In eastern Hungary, Polgár-Csőszhalom on the upper Tisza is a large site with a multiditched mound—called a "rondel"—located at the western edge of a very large horizontal settlement. At least five ditches and palisades enclosed an area about 180 meters in diameter with perhaps fifteen burned houses at the center. The floor of one building (house 9) yielded an assemblage of miniature statuettes, clay sun disks, and footed bowls and a pit that produced 259 copper bead fragments, copper wire fragments, and bone tubes. The ashy fill that surrounded the disarticulated copper and bone artifacts led the director of the project, Pál Raczky, to hypothesize that this was a sacrificial pit and that the central area of the roundel served as a sacred precinct or sanctuary.

Alongside the roundel, running roughly east-west, was a horizontal settlement covering an area of some 28 hectares, with several timber-framed longhouses (measuring 8–12 × 4–5 meters) organized into compounds that contained cylindrical wells and small clusters of graves. The settlement is divided internally into discrete groups that probably reflect independent social units, and the roundel feature suggests that this site, like other tells on the Hungarian Plain, probably also functioned as a regional economic and ideological center.

Throughout the Neolithic period burials tended to occur in and around settlements, frequently in small groups or clusters, which most researchers assume were related to some sort of social unit. Cremation burials at Dimini, dating to the late sixth millennium B.C., have been found under floors and near hearths, while primary and secondary burials were discovered in ditches that surrounded the site of Makriyalos in Macedonia. In the early fifth millennium B.C., at Gomolava (associated with the Vinča culture), nearly thirty people, mostly males, were buried in an unused part of the settlement. To the north, on the Great Hungarian Plain, intramural burials also occur within and around the settlements at tell sites, such as on the roundel at Polgár-Csőszhalom and at Hódmezvásárhely-Gorzsa, Berettyóújfalu-Herpály, and Vészt-Mágor. Burials also are found at horizontal settlements, such as the flat settlement at Polgár-Csőszhalom and at Öcsöd-Kováshalom.

Late Neolithic sites, especially tells, frequently were enclosed with extensive systems of ditches and walls that may have served many functions, from fortifications for defense to symbolic features that separated the site from its hinterland. Whatever the purposes of such features, they represent a significant time investment in the construction of the settlements, which attests to the durability and long-term habitation of specific spots in the landscape. Makriyalos in western Macedonia had three concentric ditches, while later sites in the Lower Danube, such as Polyanitsa and Ovcharovo, had a single substantial wall that surrounded the settlement. Farther north, in the Great Hungarian Plain, the settlement at Polgár-Csőszhalom had a fortified roundel reminiscent of those at Lengyel sites in Transdanubia, while such sites as Hódmezvásárhely-Gorzsa and Öcsöd-Kováshalom were encompassed by large ditches that were rebuilt to encircle the settlement as it expanded.

Neolithic tells in southeastern Europe were reoccupied for hundreds or even thousands of years. It is likely that they served as centers for ideological and economic interaction, but their importance has been drastically overemphasized, primarily because, for a very long time, they were the only sites to have been investigated. As survey and excavation around these sites, and at other, non-tell settlements, increased in later years, it became clear that the tells frequently formed the tethering points for social interactions among different types of settlements within the various regionally discrete cultural groups.

COPPER AGE: CULTURAL AREAS

The beginning of the Copper Age, about 4500 B.C., is characterized by several technological and socioeconomic changes throughout central and southeastern Europe. From the Carpathian Basin to the Aegean Sea, several trends suggest that the area underwent a social transformation at this time. These trends include a dramatic increase in the production and distribution of tools fashioned from smelted and native copper sources; a tendency toward larger, more homogeneous stylistic provinces or cultural areas; a bias toward smaller and more numerous settlements throughout the landscape; the establishment of formal cemeteries; and the restructuring of the long-distance trade networks that had characterized the region throughout the Neolithic. In addition to these overall patterns it also is assumed that the impact of the Secondary Products Revolution began to affect economic systems seriously at about this time.

In northern Greece the Final Neolithic period extended from c. 4500 B.C. to 3300 B.C., when it led into the Early Bronze Age. Throughout northern Greece there seems to have been a decrease in the number of sites inhabited during this time, which corresponds more or less to the later occupation at Sitagroi (phase III) and the construction of large surrounding walls at Pefkakia and Mandalo.

In Bulgaria the Early Chalcolithic corresponds with level VI at the Karanovo tell. There, as in eastern Hungary, there seems to have been an increase in site numbers at this time, perhaps associated with the foundation of more non-tell settlements. During the fourth millennium B.C. in south-central Bulgaria—the Transition or Hiatus period—there was an overall decline in the numbers of sites. The sites in the northeastern area of the country and in southern Romania were associated with the Gumelnia culture until about 4000 B.C., then with the Krivodol-Salcua complex, and finally with the Cernavoda culture, ending in about 3000 B.C.

Throughout most of the former Yugoslavia the time period from about 4500 to 3800 B.C. is associated with level D at the Vinča tell and then with the Bubanj-Hum culture. In northernmost Serbia, western Romania, and eastern Hungary the time span from c. 4500 to 3800 B.C. is associated with the Tiszapolgár culture, which gave way directly to the Bodrogkeresztúr culture. Throughout the western Balkans, the Carpathian Basin, and westward, the Baden culture extended over a large region at the end of the Copper Age (beginning about 3300 B.C.). Curiously the western half of the Carpathian Basin experienced a much less drastic break from the Late Neolithic, with Lengyel culture (Lengyel III) settlement sites exhibiting a great deal of continuity throughout the Early Copper Age. After about 4000 B.C. sites in Transdanubia show evidence of a relationship to the Balaton-Lasinja cultural complex.

COPPER AGE: ECONOMIC AND SOCIAL ORGANIZATION

It is difficult, from the archaeological record, to identify precisely the factors responsible for the changes that occurred throughout southeastern Europe about 4500 B.C. However, it seems that there were two major contributing factors, first the widespread use of copper, not only for trinkets but also as a source of raw material for producing much more massive tools, and, second, the extensive effects of the Secondary Products Revolution.

Despite the abrupt disruption of trade networks in several areas, which would imply that the use of copper flourished very early in the Copper Age, the actual quantity of production began to increase significantly only after 4000 B.C. Large copper tools appeared slightly earlier in Bulgaria than elsewhere, toward the end of the fifth millennium B.C. While copper mines definitively dated to this period are known from Bulgaria, eastern Serbia, and Thrace, the spatial and social contexts of the various steps associated with the manufacture of large tools in the Copper Age remain a mystery. Very meager evidence from such sites as Selevac in Serbia indicates that, even during the Late Neolithic, copper smelting may have occurred in domestic contexts. By the end of the Copper Age such sites as Vučedol in Croatia experienced an almost industrial level of production.

Although the precise timing remains unclear, most archaeologists agree that the advent of the Secondary Products Revolution had a major impact on economic systems during the Copper Age. The primary evidence for the revolution derives from faunal assemblages, which indicate that many domestic animals were kept alive longer so they could be used for secondary products.

In northern Greece and throughout most of the central Balkans significant continuity is evident on settlements from the Late Neolithic into the Early Copper Age. In the eastern Carpathian Basin most Copper Age settlements are quite small (less than 1 hectare) and are not associated with Late Neolithic tells. Although Copper Age settlements are present at some tell sites, such as Vészt-Mágor, almost without exception the Copper Age stratigraphic levels on tell sites are separated from those of the Late Neolithic by buried soil horizons that indicate a hiatus in occupation.

During the fourth millennium B.C. the number of sites declined dramatically in most of the region. The majority of tells were abandoned at this time, including most of those in Bulgaria and southern Romania. On the Great Hungarian Plain site numbers decreased substantially during the Middle Copper Age (Bodrogkeresztúr culture) and again during the Late Copper Age, which is known almost exclusively from burials.

The later fifth millennium B.C. also witnessed the establishment of the first formal cemeteries independent of settlements in southeastern Europe. This trend suggests that there was a reorganization in the burial ritual, which throughout the Neolithic took place within settlements. During the Copper Age, by contrast, several large cemeteries appeared across the region. Frequently these cemeteries were isolated in the landscape and were not associated with specific settlements, suggesting that they probably were used by several different settlements. Thus whereas Neolithic burial rites tended to focus primarily on small social groups, probably households and families, the emergence of independent Early Copper Age cemeteries in the region indicates that burial rituals may have served to integrate inhabitants of several different villages.

This shift from intramural burial to formal cemeteries seems to have been made primarily in the eastern Carpathian Basin around 4500 B.C. and slightly earlier in northern Bulgaria, at the beginning of the fifth millennium B.C. In northern Greece a formal cemetery containing cremation burials was established several hundred meters from the tell settlement of Platia Magoula Zarkou later in the fifth millennium B.C. In the Lower Danube large cemeteries associated with the Hamangia culture, such as Cernavoda and Durankulak, each produced hundreds of burials dating to the beginning of the fifth millennium B.C. Although these cemeteries were associated with contemporary settlements, later cemeteries in northeastern Bulgaria, such as Varna, and on the Great Hungarian Plain, such as Tiszapolgár-Basatanya, were not connected directly with settlement sites. The establishment of formal cemeteries continued throughout the Copper Age. On the Great Hungarian Plain during the later fourth millennium B.C. people of the Baden culture sometimes were buried with cattle, as at the large cemeteries of Alsónémedi and Budakalász.

At the end of the fourth millennium a new form of burial, under large mounds of earth called *kurgans,* became common across the northern part of southeastern Europe from the Lower Danube to the Carpathian Basin. These burials have earlier parallels in the east, in Moldova and the Ukraine, and such scholars as Marija Gimbutas have associated them with the first wave of influence of Indo-European speakers in Europe. Other researchers, such as Colin Renfrew, have contended that the spread of Indo-European occurred at the beginning of the Neolithic. While the *kurgan* burials of the Late Copper Age certainly have parallels to the east that might indicate a sort of demic migration into the region, they remain very poorly understood. Only once the tradition of *kurgan* burial can be associated with specific settlement phases will the understanding of the social dynamics of the later Copper Age become clear.

THE END OF THE NEOLITHIC IN SOUTHEASTERN EUROPE

The changes that occurred at the end of the Neolithic in southeastern Europe created the cultural framework for the social trajectories of various societies during the Bronze Age, when the first convincing evidence for the development of hereditary social ranking in the region is found. From the establishment and eventual abandonment of tell sites to the founding of formal cemeteries and the major impacts of the Secondary Products Revolution, the end of the Neolithic in southeastern Europe witnessed a social transformation that had dramatic effects on economic, political, and ideological aspects of life for years to come.

See also **Early Metallurgy in Southeastern Europe** (*vol. 1, part 4*); **Early Copper Mines at Rudna Glava and Ai Bunar** (*vol. 1, part 4*); **Milk, Wool, and Traction: Secondary Animal Products** (*vol. 1, part 4*); **Varna** (*vol. 1, part 4*); **Ovcharovo** (*vol. 1, part 4*); **The Early and Middle Bronze Ages in Temperate Southeastern Europe** (*vol. 2, part 5*).

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VARNA

Varna is a fifth millennium B.C. cemetery located on the Bulgarian Black Sea coast. Excavated in the 1970s and 1980s by Ivan Ivanov of the Varna Museum, the cemetery radically changed the understanding of the social structure of Late Neolithic southeastern Europe. No absolute dates are available; correlation with contemporary dated sites suggests that Varna was in use between 4900 and 4400 B.C.

EXTRAVAGANT GRAVE GOODS

Discovered by chance by a farmer plowing his fields in 1972, Varna contains almost three hundred burials. It is one of the largest cemeteries in southeastern Europe from this period, and its graves contain some of the most extravagant assemblages of goods for any period of European prehistory. Although pottery vessels are the most common inclusion, the concentrations of gold, copper, and shell are particularly striking. Ceramic vessels aside, two types of objects dominate the finds: tools and body ornaments.

The three thousand gold objects (which together weigh more than 6 kilograms) from Varna represent the first use of gold metallurgy anywhere in the world. At Varna gold was fashioned into more than thirty shapes, ranging from hammered sheet plates, convex circular disks, individual solid or cinched beads, and small rolled loops to large doughnut-shaped bracelets and arm rings. Diadems, lip studs, and earrings are matched by more erotic and gendered objects, such as a sheet-gold penis sheath with open head and holes at the base for attachment to the body. All of these objects were used as body ornaments, attached to skin, hair, or clothing or, like the bracelets, worn as jewelry. Some reference to animals is clear from the horned sheet-gold clothing appliqués found in one burial and the solid gold animal astragalus found in another.

Exceptionally, sheet gold was used to cover axe heads and scepter handles. A few pots had designs painted on with a gold solution. Colin Renfrew has argued that the use of sheet gold to cover objects that were made of less exotic materials, such as stone or wood, created the illusion of a large solid gold axe or scepter. The effort expended on this work proves that gold was a highly valued material in the fifth millennium B.C. *Spondylus* and *Dentalium* shell also was used to make ornaments, particularly beads, pendants, rings, and bracelets.

A very different range of objects was made from the other major exotic material—copper. Whereas gold and shell were fashioned into body ornaments and jewelry, copper was used to make tools. Most striking are massive axes, adzes, and chisels, although smaller objects, such as awls, also were present. The significance of the copper tools is in the extravagance of their size and the infrequent evidence that they were used before deposition in the graves. Another category of unused tool placed in the Varna burials consists of extraordinarily long flint blades. Deposition of superblades complements that of the large copper tools; both are extravagant objects, the products of specialist knowledge, skill, and experience, the association with which would have advertised specific elements of the deceased individual's identity.

Although extraordinary in number when taken together, the exotic and lavish Varna grave goods are concentrated in disproportionately few burials. Of the 211 graves that were undisturbed and for which published data exist, 170 contained 10 or fewer objects, and 23 contained no grave goods at all. Overall, the most common grave good was pottery, which appeared in 80 percent of burials. Only 18 graves (a mere 8.5 percent of the entire cemetery) contained the extraordinarily large assemblages of exotic pieces; some of these burials had hundreds of gold items.

Incomplete site publication prevents firm conclusions about grave-good association with different ages or sexes, but patterns do emerge. Varna has burials of men, women, and children as well as some graves with large numbers of goods but no skeletons. The excessive concentrations of grave goods, however, occur almost exclusively in the adult male graves or in the bodiless burials. For example, in grave number 43 a man about 40 to 50 years old was buried with the following objects: 890 gold beads, 42 round gold appliqués, 16 gold rings, 11 gold lip plugs or earplugs, 10 other gold appliqués, 6 sheet-gold rings for covering an axe handle, 5 sheet-gold rings for covering a bow, a *Spondylus* bracelet with 2 pieces of sheet-gold covering, 2 convex gold disks positioned over the deceased's knees, a stone axe scepter with four sheet-gold shaft coverings, 2 flat gold plates at the deceased's waist, a gold penis sheath, 4 gold arm rings, 3 copper axes, a copper chisel, a copper awl, a copper point, a flint point, 3 flint blades (one of which was a superblade 39 centimeters long), 2 stone axes, 2 bone points, and 4 ceramic pots and a lid. Similarly extraordinary assemblages come from many of the bodiless graves.

CONSEQUENCES FOR RECONSTRUCTING SOCIAL STRUCTURE

Unusually for the region, the cemetery at Varna is not associated with a nearby settlement tell. Together with the lack of complete publication, it is difficult to assess the site's contribution to the understanding of contemporary Balkan social structure in the fifth millennium B.C. Finds from smaller cemeteries at other sites, such as Golyamo Delchevo, Vinitsa, and Devniya, have been published more fully and provide comparative contexts for interpretation. At these sites two important patterns are evident.

First, as at Varna grave-good distribution is uneven, with more grave goods deposited with men's bodies than with women's and more with adults than with children. As at Varna, in terms of the number of grave goods, bodiless graves are more similar to men's than to women's or children's burials. The distribution of copper objects in these cemeteries reinforces the age and sex distinction: more were placed with men (and bodiless burials) than with women and more with adults than with children. Thus in terms of grave-good assemblages there was a clear distinction among certain individuals, with some men being inhumed with disproportionately large numbers of objects and with a much higher proportion of exotic objects.

Against this pattern of distinction among individuals within cemeteries runs a second, apparently contradictory pattern. Although there are exceptions, across individual cemeteries most bodies were placed in common positions (crouched on their sides or lying on their backs with legs straight) with their heads pointing in the same cardinal direction. It appears that, while grave assemblages expressed differences among individuals, similarities in body positioning signified membership within a common social group. This contradiction is best understood in terms of the contemporary relationship between the place of death (that is, the extramural cemetery) and the place of living (the settlement village).

In the fifth millennium B.C. the ceremonies and deposition of bodies with special objects started to concentrate in special places away from village houses and activities. This was different from what had happened in previous millennia, when burials were placed within the boundaries of a village, often under the floors of houses or in nearby pits. The shift to an extramural burial ground, within sight of the village but physically distinct from it, provided a place for death and its display that was separate from the day-to-day reality of life that took place in the village. Death had become a very public, extremely visually provocative ceremony, during which people illuminated the identities of particular, predominantly male members of the community.

While Varna's size, the scale of grave-good deposition, and the lack of an associated settlement tell make this site different from the inland cemeteries, all of the cemeteries, Varna included, shared similar principles that directed the ceremony and props of death and the role that events of burial played in publicly expressing individual status. Burial was the big stage, and on it the leading characters of local life played out their prominent (as well as supporting) roles. Furthermore it is in the light of the role that mortuary ceremony played in public expressions of status and hierarchy that the purpose of the bodiless graves becomes clear. Traditionally these burials are termed "cenotaphs" and are interpreted as symbolic burials of local residents who died far away from their homes. It is much more likely that bodiless burials are the remains of political events enacted when elites and local authorities needed to use mortuary ceremony to make highly visible, public statements about social structure but when no member of the community needed burying.

SIGNIFICANCE OF VARNA IN THE INTERPRETATION OF EUROPEAN PREHISTORY

The spectacular finds from Varna and their clear disproportionate distributions focusing on adult males and cenotaphs had an irreversible impact on the existing interpretation of southeastern European prehistory. The Balkan Neolithic no longer could be reconstructed as egalitarian in political makeup or as the home to mother goddess–worshipping, peaceful, sharing, matriarchal early farming communities. It was immediately clear that these traditional interpretations were bankrupt. Because of the Varna material, but also because of the finds from many other sites and various reinterpretations of older excavations, the Neolithic of southeastern Europe is understood as a dynamic, pulsating period in which society was riven with conflict and tension and in which tremendous efforts were invested in proposing and maintaining competing versions of reality.

See also **Transition to Farming in the Balkans** (*vol. 1, part 3*); **Early Metallurgy in Southeastern Europe** (*vol. 1, part 4*).

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DOUGLASS W. BAILEY

OVCHAROVO

Ovcharovo, a Bulgarian settlement tell and cemetery dating from the fifth millennium B.C., was excavated in the early 1970s under the direction of Henrietta Todorova of the Archaeological Institute of the Bulgarian Academy of Sciences. Positioned at the eastern edge of a small streambed, close to both adjacent arable land and forested uplands, the site was a large, multilayer settlement, typical for this period in the Lower Danube region.

Ovcharovo is significant in that it remains the only completely excavated settlement with fully published Late Neolithic material from the north Balkans. Other contemporary sites in the region, such as Polyanitsa, Golyamo Delchevo, and Vinitsa in Bulgaria, and Gumelniţa and Căşcioarele in southern Romania, either have been excavated incompletely or have not been published fully. The intentional burning of houses in Ovcharovo's later phases conserved large assemblages of material, preserved in situ, unlike abandoned houses that have been emptied of useful contents. Multinational interdisciplinary studies, especially of flora and fauna but also of radiocarbon dates, further establish Ovcharovo as an exception to the methods applied to sites in this region.

Within the 6-meter height of the tell thirteen major building horizons were identified, although recent reanalysis of the site has questioned inherent assumptions of the homogeneity across each building phase and the contiguity between each (assumed) successive phase. At least one major hiatus in occupation occurred. The site was occupied during the final stage of the Late Neolithic Ovcharovo culture (building horizon II), the early and middle Eneolithic Polyanitsa culture (horizons III–VII), and the late Eneolithic Kodzhaderman–Gumelniţa-Karanovo VI culture (horizons XI–XIII). Radiocarbon analyses of seeds and also of large wooden beams document site use from 4900 to 4300 B.C.

A center for long-term habitation, as evidenced by repeated repair and rebuilding of buildings, Ovcharovo was the focus for a range of domestic and agricultural activities, especially large-scale field cultivation of wheat and barley and the herding of cattle, sheep, and goats. Domestic animals always outnumbered wild ones; among the domesticated species, cattle, sheep, and goats were in the majority. Several houses had large silos (3 by 4 meters) that contained significant quantities of carbonized cereal grain; most houses had large, lidded storage pots (up to 20 liters), grinding stones, and ovens. Spindle whorls and loom weights (almost two hundred) document textile production, and the mortality patterns of cattle suggest that they provided traction for plowing or for transportation.

Individual settlement horizons (each covering an area c. 40 by 50 meters) consisted of half a dozen or more buildings, each with several rooms. Walls were made from large posts set into the ground around which were intertwined smaller branches and twigs that, in turn, were covered with a mixture of mud, clay, grasses, and other plants. In some buildings of the earlier phases, wooden planks were used to make floors, roofs, or both, and it is possible

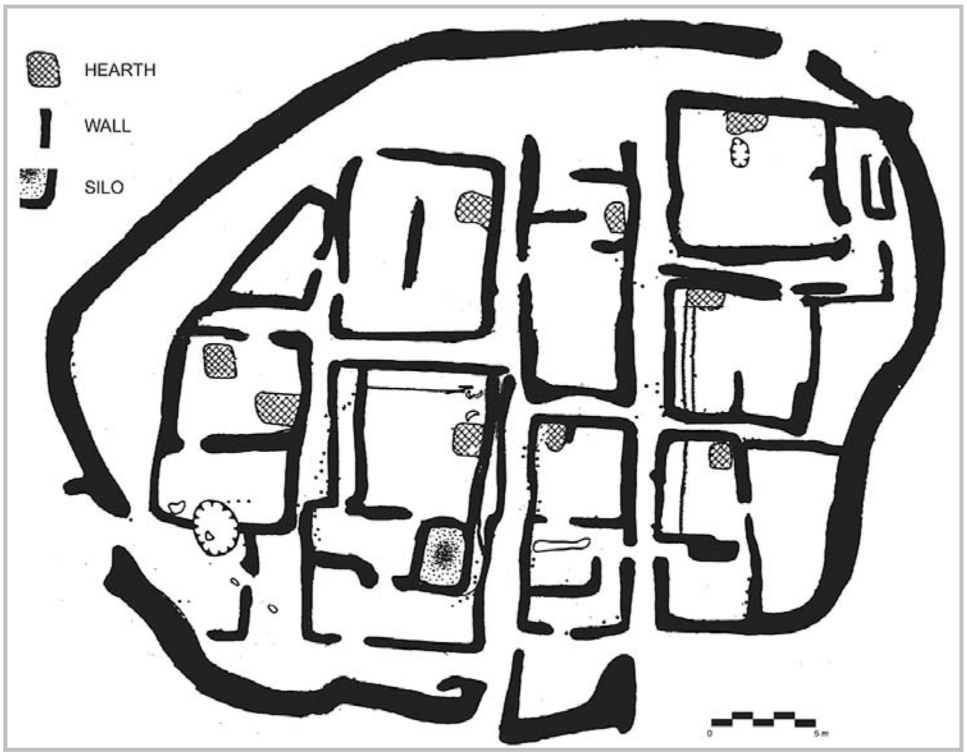

Fig. 1. Site plan of Ovcharovo. Courtesy of Douglass W. Bailey after Todorova et al. 1983. Reproduced by permission.

that some structures had a second story. Buildings shared a common orientation (north-south by east-west) and a similarity in size, although some were particularly large (up to 10 by 10 meters). Most had one or more internal rooms. Almost all had large ovens or hearths, grinding stones, clay platform benches, large quantities of bone, stone, and horn tools (many of which were suitable for digging or working the soil), and ceramic vessels. Almost one hundred ceramic anthropomorphic figurines were found, as were many house models and a few zoomorphic figurines.

Post-excavation interpretation of the floor plans of the buildings has had a major impact on our understanding of social organization for this region in this period. Douglass Bailey and John Chapman have used spatial data from site plans to reconstruct life at the tell, highlighting an increase over time in privacy, exclusion, and incorporation. Many houses had several internal rooms, and particular parts of houses had specific economic functions or social values. At the village level a perimeter bank demarcated the area deemed appropriate for habitation. The very small amount of space left open from construction suggests not only that settlement space was highly valued but also that most activities took place within the closed, private places of individual buildings and involved small groups of people. These reinterpretations of the spatial record have contributed to larger discussions of the rise of the house and the household as the primary social institution in Balkan life during the sixth and fifth millennia B.C.

The evidence for large-scale cultivation and the cramped internal organization of village and house space suggest that complex rules and mechanisms for organizing labor and its products structured life at Ovcharovo. Conflict, tension, and disagreement would have been inevitable. Attempts to resolve tension or at the least to project authority and leadership are clear in the contemporary emergence of a new set of expressive objects (especially jewelry but also pottery of increasingly complex form and brilliant decoration). Novelty in material form was complemented by new raw materials (copper, gold, marine shells, and graphite). The ceremonial deposition of these objects in the burials of particular individuals in extramural cemeteries (another novel element for this period in this region) was one attempt to resolve conflict and to promote preferred social relationships of power.

Questions of site origin and abandonment have attracted traditional answers. These have been attributed, respectively, to the immigration of culture groups that already were used to settled village life and violent invasions from the northeast. Work on similar sites in southern Romania indicates that settling down to permanent village life more likely was linked to gradual geomorphic stabilization of river valley floodplains. Additional work at the contemporary Bulgarian tell at Podgoritsa suggests that the end of occupation of sites such as Ovcharovo may be tied to rises in the water table and consequent losses of arable land at the end of the fifth millennium B.C. Whatever the causes of tell origin and abandonment at Ovcharovo, the same pattern is evident in these times across the northern Balkans (i.e., north of the Stara Planina mountains and south of the Carpathians).

See also **Late Neolithic/Copper Age Southeastern Europe** (*vol. 1, part 4*).

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DOUGLASS W. BAILEY

COPPER AGE CYPRUS

The sequence of small-scale settlements that characterized society on Cyprus, the third-largest Mediterranean island, from the fifth to the third millennium B.C. is divided into Late Neolithic and Chalcolithic periods.

LATE NEOLITHIC CYPRUS

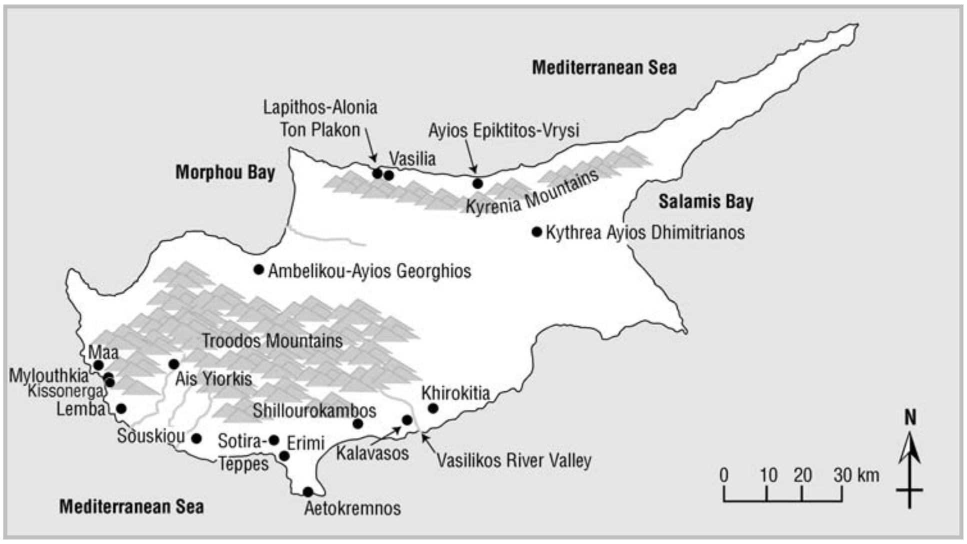
Following a lengthy period with virtually no evidence for settlement, Cyprus was inhabited by small, neatly organized villages comprising subrectilinear houses crowded inside surrounding enclosure walls and ditches. They are the Late Neolithic communities that emerged c. 4500 B.C. and went on to form Copper Age society from about 3800 to 2400 B.C. These Late Neolithic people may have originated among indigenous survivors of Aceramic Neolithic groups, or they may have come from the adjacent mainland, or a combination of both. Their hoe-based agricultural society often is referred to as the Sotira culture, named after a hilltop village in the southern foothills that provides evidence for an important series of habitations and simple pit burials in an extramural graveyard.

In contrast to the exposed position of Sotira, other settlements, such as Ayios Epiktitos–Vrysi on the north coast or Philia-Drakos A in the center of the island, had significant underground components. Subterranean houses at Vrysi nestled in deep hollows, and a web of tunnels underpinned the settlement at Philia. The island was sparsely populated in the Late Neolithic, and the absence of weaponry or threatening animals implies the existence of other reasons for recurrent defenses and subterranean features. Houses eventually were built beyond the village enclosure walls at several settlements, and thus the population grew noticeably.

The Neolithic islanders remained unaffected by contacts with the outside world, but the widespread occurrence of beads and pendants of picrolite, a soft blue-green stone primarily from a single riverine source near Sotira, is evidence of exchanges among the islanders. Their most remarkable product, however, was pottery executed in a vivacious painted style in the north and a monochrome version in the south. While the red paint of the monochrome pottery was still wet, potters combed away the paint in multiple sinuous bands to reveal the white slip beneath. These two major styles of c. 4500 B.C. represent some of the earliest pottery from an island that was to become renowned for its inventive ceramic traditions.

EARLY CHALCOLITHIC CYPRUS

The Late Neolithic villages were not rebuilt after c. 4000 B.C., and when stone houses reappear some five hundred years later, they are uniformly circular in plan and are established at new locations. According to the excavator Porphyrios Dikaios, Sotira was abandoned because of an earthquake, and scholars have used this alleged devastation to account for population dislocations throughout the island. Earthquakes, however, tend to have localized effects, and another possibility for the transformation concerns demography. Late Neolithic villages, as already mentioned, tended to increase in size. Rather than developing into an urban society, expanding



Selected sites of Copper Age Cyprus.

populations gradually established new small settlements, especially in the west of the island. Woodland clearance for these foundations led to a tradition of building in timber and daub, with structures occasionally sheltering at the top of curvilinear pits. Unlike earlier and later stone counterparts, these timber-frame structures have not survived well, so the Early Chalcolithic is poorly known.

Another reason sometimes adduced for the changes after 4000 B.C. is environmental deterioration. There is little unequivocal evidence for this decline, and traces of localized erosion may be due to human interference. Woodland clearance by new settlers would have led rapidly to erosion. Another possibility is that people increasingly adopted hunting and became more mobile. The faunal remains from one site indicate that some 75 percent of the meat intake came from fallow deer. At Kissonerga-Mosphilia, however, flimsy timber shelters surrounded large bottle-shaped storage pits, which, in all probability, were communal grain silos. Sites yield a wide spectrum of domesticated crops, so occupants had not become exclusively mobile hunters who avoided a sedentary existence. Our impoverished information of this phase stems from the fact that more fragile aboveground timber structures largely have been swept away by pervasive Mediterranean erosion.

Two sites, Kissonerga-Mylouthkia in the west and the Kalavasos complex along the eastern lip of the Vasilikos Valley, have produced traces of circular timber structures and anthropomorphic figurines in stone and clay. These innovations become absolutely typical of the Copper Age and so, despite the general poverty of information, the Early Chalcolithic was a formative juncture. Radiocarbon dates place these developments between 3900 and 3600 B.C.

Some circular buildings at Mylouthkia were erected inside spacious pits, in two instances with associated human remains. They lack the conventional hearths and flat floors of later aboveground buildings, so it is unlikely that they were pit houses. Pits clearly were used for varied activities, and they were not all simply the receptacles for rubbish from site maintenance. The dead also were inserted into the fills of a ditch, which surrounded at least part of this site. In one case, a headless adult lay upon a stone dish encrusted with red ochre, which in turn was placed over a large saddle quern with its stone rubber. In sum, there are enough hints from this period to suggest that it was significant in the development of the island's prehistory.

Mylouthkia shows that the Late Neolithic tradition of enclosing sites continued into the Copper Age. Figurative art also demonstrates continuity. Before c. 4000 B.C., occasional depictions are extremely simple, flattened cylinders with grooves suggesting a phallus. In the early centuries of the fourth millennium B.C., these cylinders become more rounded, with opposing, short, armlike projections and breasts. Ceramic examples often are painted all over with linear designs. Stone carvers at this time also employed blue-green picrolite to execute the first of a genre that, in its more fully developed form, became one of the most famous expressions of Cypriot prehistoric art, the cruciform figurine.

MIDDLE CHALCOLITHIC CYPRUS

The classic site of the Cypriot Copper Age is Erimi, located beside the Kouris River on the southern coast. During the 1930s, its 5.5-meter-deep stratigraphy disclosed a gradual change from timber to stone buildings. Broadly speaking, this trend is still valid for the Early to Middle Chalcolithic period, from c. 3900 to 2800 B.C. Notable in its later phases are circular stone-based structures, cruciform figurines, and some metalwork. Thus, this period as a whole sometimes is referred to as the time of the Erimi culture. Excavations at Erimi consisted only of a small sounding. More informative insight on major developments within village polities was gained from Kissonerga-Mosphilia periods 2–3B. This western site is much larger than other settlements, although it does not seem to have been a center for redistribution.

The Development of Independent Households. Earlier timber shelters, with grain silos and external food preparation installations at Kissonerga, were replaced by stone buildings in such a way that areas previously used for communal storage were appropriated into the building space. Public facilities were enclosed and made private. Instead of pits, which would be awkward inside a house, large storage pots were introduced to store foodstuffs. Social changes thus had an impact on technology. Sequential construction of freestanding circular buildings in the same location also points to the development of property rights and inheritance. From these changes it may be inferred that the sharing ethos of earlier times was giving way to more autonomy within society.

These novel buildings, dating to c. 3300 B.C., epitomized the standard house design of the Copper Age, one found in all lowland regions of the island. With an average diameter of some 7 meters, the single-room structures were separated in terms of function into four segments. Houses often were abandoned, with their contents left intact, so it is possible to reconstruct what happened in these segments. Access was under a porch and through the south-facing entrance, where one entered the relative darkness of the room. Two brighter areas would have attracted the eyes first. In the central area was a raised, white-plastered, circular hearth that contained a small fire. On the right there was a gleaming, white-paved segment bordered by two low ridges that radiated from the central hearth. Some wall benches are preserved here. This may have been a reception or sleeping room. Burials, presumably of household members, were found just outside the building, beside this elaborate segment. Only adult females and children seem to have been buried beside the houses in this period.

The remaining segments were for storage and work. On the left as one entered were stocks of tools, such as stone axes, hammerstones, and grinders. At the back were storage pots and cooking facilities. Although internal space was not partitioned, the recurrent patterning means that people enacted their daily lives in a similar manner in all the island villages. Where houses were destroyed suddenly, it is clear from concentrations of equipment in the middle of the floor that much work was carried out around the central hearth, a natural focus of all these buildings. Destruction by fire may have been deliberate; at Mylouthkia, for example, the body of a juvenile was found inside a burned structure, and there had been no attempt either to remove him for burial or to retrieve the hundreds of serviceable items that lay in the debris.

Expressions of Social Divisions. Copper Age Cyprus flourished around 3000 B.C., the last period before external contacts modified the island-bound identity of society. During this era, buildings became elaborate; metalwork, ornately painted pottery, the most exquisite figurines, small statuary, and zoomorphs in the shape of centaurs appear; and possible foreign imports were introduced into a cemetery at Souskiou, a southwestern complex. The occurrence of richly endowed cemeteries is exceptional because burial was conventionally within settlements. Society was becoming more heterogeneous.

It is only at Kissonerga-Mosphilia Period 3B that archaeologists gain some idea of village organization. Its inhabitants moved into an open area of the site, where they fashioned a newly imagined community, spatially unrestricted by preexisting buildings. They created two sectors. In one, the high sector, they erected a group of imposing structures demarcated from the rest of the settlement by a stone-paved track and a perimeter wall with a shallow ditch. Apart from their exceptional size and careful construction, buildings here were distinguished by the use of calcarenite stones, which were transported some distance to the site by humans, for there were no pack animals on the island. Human haulage on this scale and repavings of a public track suggest that an authority existed to mobilize labor for the benefit of the group that lived in the high sector. The floor plaster of the eastern segments of the buildings was very hard and thickly laid on aggregate or gravel foundation. For the first time, walls partitioned internal space into rooms. As a consequence of this elaboration, interpersonal relations changed, with more formal segregation of activities: reception and sleeping areas were divorced from work and storage zones.

The structures of this high sector formed a circle about 25 meters in diameter around an open space that contained the remains of numerous earth ovens. Sealed food was cooked for a day or so on top of heated stones at the base of these oven pits. On the western side of the sector stood the "Red Building," so called for one of its red painted floors and the red inlays embedded in its white-plastered walls. Although part of the structure is missing, its standard plan indicates that its interior was about 130 square meters, the largest known prehistoric building in Cyprus. In the reception and sleeping segment were some thirty-three pots, including capacious serving bowls, their interiors painted with swirling and other designs. These luxury presentation vessels no doubt impressed guests and others at feasts, suggested by the proliferation of adjacent earth ovens. Comparable containers in houses outside the high sector are smaller and far less ostentatious.

Among the earth ovens were pits with deliberately deposited special objects. One of these contained a remarkable assemblage of about fifty pieces associated with a ceramic building model covered by two large bowls, each carefully split in half. Some nonfunerary ritual was enacted in a public arena here, as evidenced by the intentional arrangement of the objects, several of which were mutilated. Moreover, the decorative symbolism on the walls of the building model was concealed by application of a post-firing opaque coating.

The building model is a unique expression of Cypriot art c. 3000 B.C. On its circular floor is a raised central hearth with two ridges radiating to the wall, exactly as in excavated houses. The door pivots in a socket and loop. Above the red-framed entrance are two rows of deliberately broken projections. The external walls are painted with stepped bands and rectangles placed obliquely, with internal checkerboard panels, a polelike motif fringed with festoons, and ascending sets of rectilinear elements.

Packed in and around the model were numerous objects, many purposely broken. They include eight pottery figurines, ten stone figurines, one anthropomorphic vessel, a model four-legged stool, nineteen white stone objects (mostly pestles), a pristine triton shell, and a bone needle. Almost all figurines depict females, and most were seated on stools. In one case, the painted head and arms of a baby emerge between the legs of a standard, but ornate figure. Given the similar posture of most female representations of the period, they probably are birth figures rather than goddesses or generalized fertility idols. The whole assemblage may have served didactic roles, used at initiation and other life-cycle rites. Its association with a building model symbolizes the strong connection between the life histories of houses and females in Chalcolithic society.

In terms of the spatial organization of Kissonerga 3B, cooking, feasts, and ceremonies related to the formal "killing" of objects that carried strong ideological messages distinguished the high sector. The central open space was suitable for a communal gathering, and so it was an arena for the communication of symbolic distinctions between different parts of the local population. In terms of chronology, the destruction and burial of all these objects happened a little before a major transition in Copper Age Cyprus.

LATE CHALCOLITHIC CYPRUS

The centuries between c. 2800 and 2400 B.C. are crucial for assessments of the nature of indigenous society before and during some of the most pro-

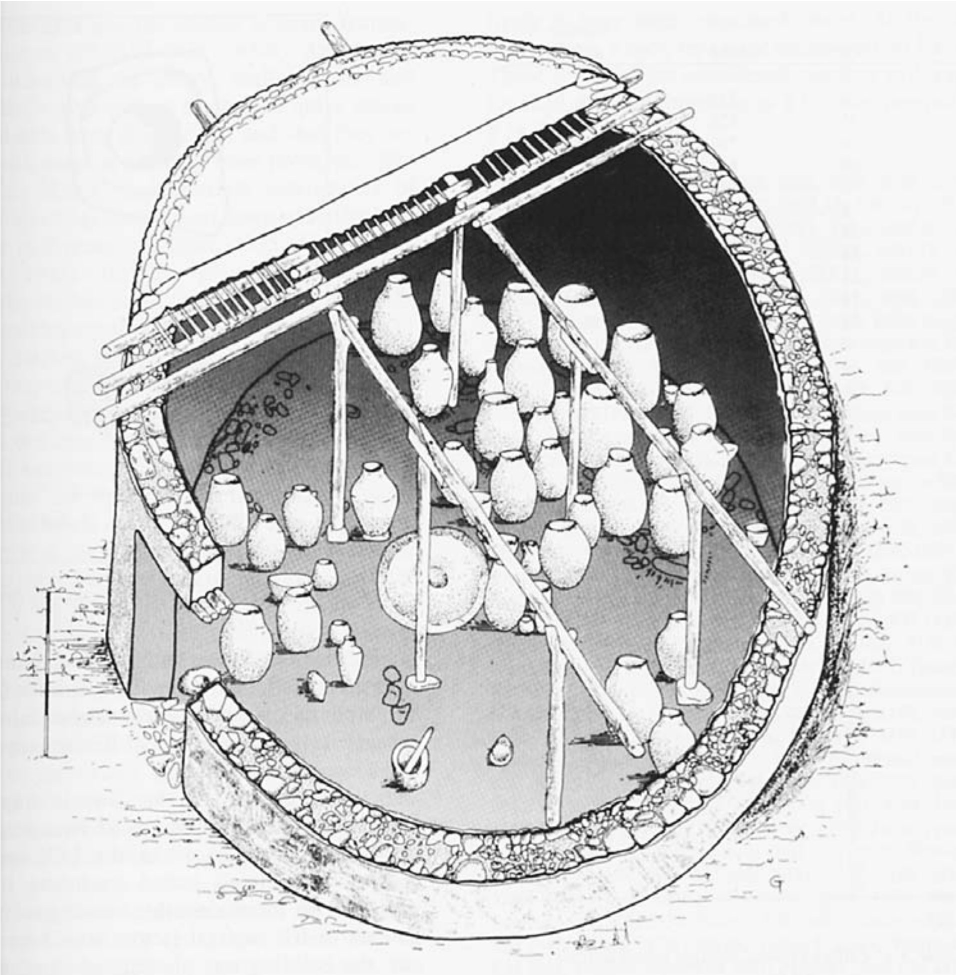


Fig. 1. Reconstruction of the Pithos House at Kissonerga, c. 2500 B.C. LEMBA ARCHAEOLOGICAL RESEARCH CENTRE. REPRODUCED BY PERMISSION.

found changes in the prehistory of Cyprus, ones that ushered in the Early Bronze Age. So dramatic are these transformations that it is difficult to isolate more than a few vestiges of Copper Age cultures in succeeding periods. Opinion is divided as to whether the process was induced by migrants, by aspiring local leaders, or by a combination of the two.

Developments on the island in the early to middle third millennium B.C. were poorly understood until, once again, Kissonerga-Mosphilia provided varied and detailed information. Settlements of Kissonerga Period 4 were built on top of the abandoned Middle Chalcolithic high and low sectors. There were two phases, an earlier one of dispersed structures, including the unusually well equipped Pithos House, named after the thirty storage vessels found inside, and a successor with three clusters of houses (fig. 1). Although all the houses conformed to the circular types of the Copper Age, there are sharp differences with the preceding age.

From the outset, the new community rejected the cruciform birth figurine that was such a key feature of society before 3000 B.C. The removal of these important symbols implies a radical transformation of sociopolitical organization. Power became identified more directly with control of subsistence and other resources. This is seen most clearly in the concentration of storage and commodities in the Pithos House. Copper slag and metal products were found here, together with a rudimentary oil press. The residents, therefore, had privileged access to metal and olive oil. Later, these were the twin pillars of Cypriot Bronze Age political and economic power. The multiple sources of authority in one residence point to an early instance of overt economic management of people, labor, and surpluses rather than the benign coordination and redistribution of resources.

There are signs that changes took place together with islanders' increasing involvement with the outside world, contemporary with Old Kingdom Egypt (2686–2181 B.C.). This contact phase is typified by the deployment of new fashions and knowledge to sharpen power differentials and not by the importation of significant quantities of long-distance exchange items. They include the appearance of stamp seals and pottery traditions, perhaps betraying specific drinking customs, from Anatolia. The new spurred annular pendant of shell is of a type known in northern Syria. From the mainland of the Levant or Egypt came exotic faience beads.

Cyprus by then was engaged with long-distance trade routes between the Near East and the Aegean. This was mainly an eastern initiative that conveyed items by maritime routes along southern Anatolia. Coastal islanders had access to esoteric knowledge and were exposed to more complex polities. Often, where contact occurs between groups of different sociopolitical and economic complexity, it brings about significant transformations in less "developed" societies. This change may have occurred on the island. For example, males increasingly appeared in the burial record, chambers for multiple burials were introduced, children were demoted to impoverished and poorly defined pits and scoops, and a discrete mortuary enclosure inside Kissonerga was used to provide an internal focus for maintaining social differences by reference to the dead.

There were undoubtedly other circumstances that fuelled instability in Cyprus in the mid-third millennium B.C. Population growth and environmental degradation, for example, led to resource stress. One result was intensification of production, a feature documented by the diversification and specialization of crop-processing equipment as well as the use of larger tools. Disequilibrium may account for the destruction and abandonment of the small compound-like village of Lemba, also in the west. Pressures on resources contributed to eventual system collapse.

It was at this juncture, c. 2500 B.C., the more explicitly Anatolian features appeared on the island. They constitute a phenomenon known as the Philia, named after a cemetery in the central region. It is possible that people with radically new traditions, such as farming with ox-drawn plows, coexisted with more conventional Copper Age groups in what is, after all, a regionally divided island. Only at Kissonerga is there a sequence of occupation in which the Philia follows the Chalcolithic; the Philia stage, however, was poorly preserved, and the site soon was abandoned. Very few Philia settlements replace the many recorded Late Chalcolithic sites, and so debate continues about the exact interaction between the two groups and what became of the people of Copper Age Cyprus.

See also **Bronze Age Cyprus** (*vol. 2, part 5*).

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EDGAR PELTENBURG

LATE NEOLITHIC/COPPER AGE EASTERN EUROPE

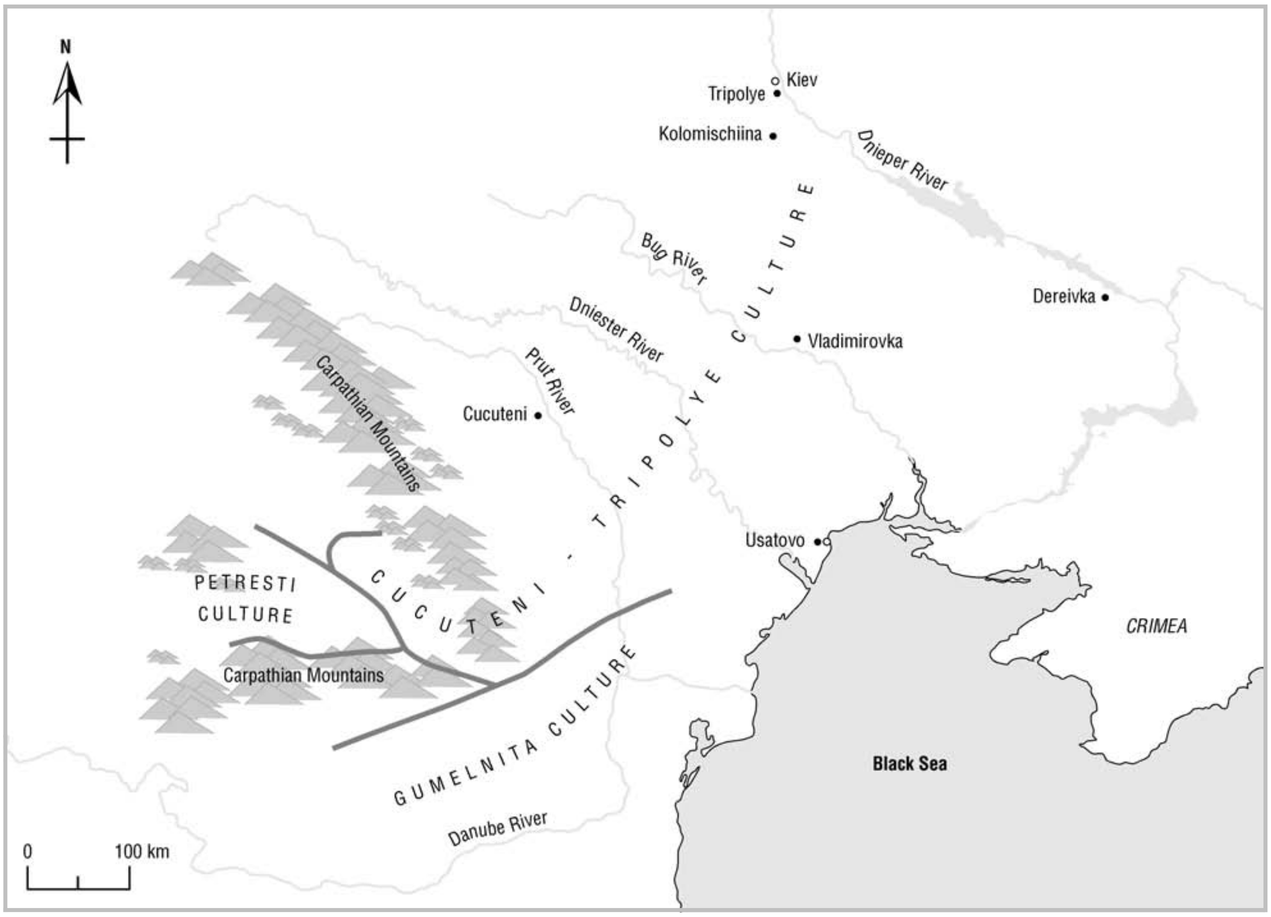
FOLLOWED BY FEATURE ESSAYS ON:

Between 5000 B.C. and 2500 B.C. the area east of the Carpathians and north of the Black Sea was populated by a diverse collection of societies with economies based on farming and herding. This discussion focuses on the territory of the modern-day nation of Ukraine, although it includes adjacent areas as well. Central to this discussion are several principal Late Neolithic/Copper Age (sometimes called "Eneolithic") cultures of this region: the Cucuteni-Tripolye, the Sredny Stog, and the Pit Grave (also known as Yamnaya) cultures.

Throughout this region, various researchers see different patterns of culture development, which are cited herein. While the later stages of the Dnieper-Donets culture are considered, these communities are discussed primarily in the context of their role as the indigenous precursors to the Sredny Stog and Tripolye cultures, which occupied the region after c. 5000–4500 B.C. Tripolye is, in effect, the same cultural group as Cucuteni, named after the type site of Cucuteni, located in the valley of the middle Prut in Romania. The culture in Ukraine and Moldova is named after the type site of Tripolye, situated to the south of Kiev.

In considering these communities, an additional and complicating factor comes into play in the periodization (or the attribution to cultural period) of the Neolithic and Copper Age communities. This stems from the fact that groups that have a characteristically Neolithic economy exist alongside groups with what is effectively a Copper Age economy. This dichotomy is particularly evidenced in the areas to the west and east of the Dnieper and also to the northern and southern areas of eastern Europe. The communities occupying the regions to the north of east-central Europe retain a predominantly fisher-hunter-gatherer economy, with poorly developed pottery styles, across eastern Europe, the Urals, and Siberia and into the Baikal region during much of the period studied.

The areas to the south developed varying expressions of Neolithic and evolved Copper Age economies, although in the case of the Dnieper-Donets communities, elements of the economies and material culture of both the northern and southern regions are in evidence. In the Late Neolithic, the spread of Corded Ware pottery is associated with assemblages of battle-axes, beakers, and amphorae. In northeastern Europe the integration of Corded Ware ceramics was accompanied by limited numbers of domesticates within the prevailing hunting economies and the intensification of eco-



Distribution of civilizations and selected Cucuteni-Tripolye sites. ADAPTED FROM DUMITRESCU 1964.

nomic and cultural interactions across Europe. The distribution of Corded Ware assemblages extends from Holland in the west, across northern and central Europe to the Upper Volga and Middle Dnieper in the east.

The Corded Ware assemblages are associated with a shift toward the increased exploitation of domesticated animals and highly dispersed settlement patterns. Plow agriculture is attested and a wider range of soils in differing environments are being exploited. While early researchers have attributed the widespread appearance of the Corded Ware assemblages with an invasion of nomadic pastoralists from the south Russian steppes, the assemblage, characterized by Corded Ware pottery and battle-axes in burials, is most likely indicative of changing roles of the individual in society. Earlier communities emphasized the group identity; the Corded Ware assemblages indicate a status-related emphasis on males, the rise of the individual, and an emphasis on personal wealth and status. In addition, the assemblages reflect the widespread movement of prestige items through trade and/or exchange across large areas of Europe during the later Neolithic.

It should be noted that in the absence of radiocarbon dating for many sites, associations and chronologies often are developed on the basis of artifact typology. This method has been shown to be of questionable value upon occasion. Our consideration of the Late Neolithic/Copper Age cultures of eastern Europe includes later investigations. While presenting interesting overviews and a reconsideration of the Late Neolithic/Copper Age sequences, even the newer studies sometimes are marred somewhat by the evident lack of detail resulting from limitations in the radiocarbon dating of sites, which is clearly a significant problem in the context of complex cultural developments.

ENVIRONMENTAL BACKGROUND

In terms of geography this region of the Russian Plain, dissected by broad river valleys, is characterized by low relief. The Russian Plain rarely rises higher than 200 meters above sea level and is drained by large rivers, such as the Vistula, Dnieper, and Dniester, which flow into the Baltic and Black Seas. In general, the rivers that drain the southwestern part of the countries of the former Soviet Union have a low gradient. The exception is the point where these rivers cross swells in the underlying solid geology, which result in the formation of rapids at such locations as Kuibyshev on the Volga and Dnepropetrovsk on the Dnieper. At these places the underlying geology also has an impact upon the direction of the rivers' flow, causing the rivers to shift from their general southeastern direction toward the southwest. The "elbows" of the Dnieper, Don, and Donets are particularly noteworthy in this respect.

The region experiences a Continental climate, being semiarid in its southern areas. In the steppe zone, which extends from west to east between the Carpathians and the Caucasus for some 1,000 kilometers and 600–700 kilometers northward from the Crimean peninsula, the soils are characterized as black earth chernozems on loess. These loess soils formed from fine, wind-blown material in the arid and cool climatic zones to the south of the ice sheets that had expanded southward across the Russian Plain during the Pleistocene period, before c. 10,000 years ago.

On the northern margins of the loess zone, the soils that formed under the mixed-oak woodlands and open grasslands of the forest steppe are well drained and fertile but more varied, as the result of physiographic, climatic, and biological factors. During the period from about 4000 to 2000 B.C., a climatic optimum led to the expansion of broad-leaved forest. This actually had a negative effect on the soils of this zone, resulting in reduced soil productivity. It also has been argued that the loess soils to the south of the forest-steppe zone were very prone to depletion and erosion once the vegetation cover was removed. Arguing against this negative view is the fact that these soils have been shown to be excellent for wheat cultivation, becoming depleted only in modern times through overexploitation.

It was in this region, with mixed broad-leaved forests to the north and steppe to the south, that the Dnieper-Donets culture developed. The nature of the landscape, with poor water resources away from the major rivers and their tributaries, would tend to result in a focus of activity toward the river valleys. This certainly appears to have been the case with the earlier Dnieper-Donets communities, who clearly exploited the resource-rich river valleys throughout their development in the later Mesolithic and Neolithic periods, between c. 7500 and 4500 B.C. It has been suggested that vegetable foods would have constituted about 30–40 percent of the diets of these earlier populations, with many of the potentially edible wild plants species concentrated in wetland habitats, such as the rivers, lakes, and coastlines of Europe.

DNIEPER-DONETS AND THE MARIUPOL-TYPE CEMETERIES

About two hundred sites and an equivalent number of radiocarbon determinations are used in dating the Neolithic and Copper Age cultures of Ukraine. The Dnieper-Donets culture/Mariupol-type cemeteries continued until c. 4500–4000 B.C., and, as such, their development fully overlapped the Tripolye periods A1 and A2 through to the B1–2 transition between c. 5500 and 4000 B.C. These cemeteries are named after the "type" site of Mariupol, which was excavated in southern Ukraine, to the north of the Sea of Azov. They are attributed to the Dnieper-Donets culture. Chronologically, the Mariupol-type cemetery series also slightly overlapped the later Sredny Stog cultures, between c. 4500 and 4000 B.C., on the basis of a few dates from the Mariupol-type cemetery of Nikolskoye.

There is evidence from later-stage Dnieper-Donets sites to suggest that these communities were using domesticated plants and animals, either through exchange with adjacent Tripolye culture groups or through active agropastoralism. Indications of settlement are sparse, however, represented by limited remains of semi-subterranean huts. Direct evidence for culture contacts and exchange comes from the Dnieper-Donets cemetery of Nikolskoye, which has been dated to between 5400 and 3900 B.C. and holds an imported Tripolye pot. Similarly, Tripolye pottery forms have been recovered from the Dnieper-Donets settlement site of Pustynka 5. In addition to ceramics, the cemetery of Nikolskoye has numerous miniature copper beads, a copper pendant, and a gold pendant associated with the later stages of burial; these finds have clear associations with the Tripolye culture. Thus, we have solid evidence for contact between the later-stage Dnieper-Donets communities and the incoming farming cultures.

Despite what may have been mutually beneficial trade-and-exchange networks, it appears that the northeastward expansion of Tripolye and the northward expansion of the Sredny Stog groups were directly influential in marginalizing the indigenous Dnieper-Donets community. At the end of their existence, the latter culture groups apparently were relegated to an area about one third of the size of their original territory in the northern regions of the Dnieper-Pripyat basins. Thus, after c. 4400 B.C. two principal cultures are thought to have occupied southern Ukraine—Tripolye and the Sredny Stog groups—with the Pit-Comb culture populating northeastern Ukraine and the Lower Mikhailovka culture inhabiting the lower Dnieper southward to the Crimean peninsula.

THE PIT-COMB POTTERY CULTURE

Another important development at this time (c. 4500 B.C.) is the appearance of the Pit-Comb pottery culture in northeastern Ukraine and the North European Plain. In its early stage this culture, made up of fisher-hunter-gatherers, had affinities with groups in the region of the Volga and Oka Rivers; there is no sign of the use or knowledge of domesticates. Although there are no cemeteries of this culture in the Ukraine, evidence from the Volga-Oka drainage system indicates that the group buried their dead in a fashion similar to that of the Dnieper-Donets communities. The dead were laid on their backs and buried with grave goods comprising animal tooth pendants and flint implements.

The Pit-Comb pottery culture, having developed between about 4500 and 2800 B.C., overlapped chronologically with the middle and later periods of the Dnieper-Donets culture, stages B and C of the Tripolye culture, and the Globular Amphora, Funnel Beaker, and Sredny Stog cultures. The Pit-Comb culture occupied the northern and northeastern regions of Ukraine and adjacent areas and also was located in areas where Dnieper-Donets culture sites, such as Kozlovka, Poltava, and Alexandria, were situated. As with most sites in the Ukrainian region, the Pit-Comb culture sites focused on the river regions, around the Desna, Siem, southern Donets, Worskla, Psla, and Suly Rivers, which include tributaries in the upper Dnieper system.

It appears that the only pottery forms associated with this culture are point-based jars with mineral tempers decorated with horizontal rows of pits. Occasionally, the patterning has an alternating pit-and-comb decoration—hence the name Pit-Comb culture. Artifacts made of bone include barbed harpoon points, arrowheads, adzes, and fishhooks; the flint and stone inventory comprise scrapers for processing hides, knives, chisels and awls, arrowheads, and axes.

THE CUCUTENI-TRIPOLYE CULTURE

The Cucuteni-Tripolye culture has been dated on the basis of some sixty-five radiocarbon determinations from thirty-five sites between 5500 and 2300 B.C. The Tripolye culture, named after the site of Tripolye to the west of the Dnieper River (Ukraine), about 20 kilometers south of Kiev, has been referred to as one of the most important Neolithic cultures of eastern Europe. This culture expanded eastward from Romania into Ukraine, to occupy the forest-steppe zone to the west of the Dnieper River. About a thousand sites have been attributed to this culture. While Tripolye is considered part of a single cultural entity, along with the Cucuteni culture, differing regional research initiatives and varying degrees of investigation of culture sites have resulted in the development of two discrete chronologies for each culture, Tripolye in Ukraine and Cucuteni in Romania. Here the name "Cucuteni-Tripolye" is used in discussing general characteristics of the larger entity, and "Tripolye" alone refers specifically to sites and their chronology in Ukraine.

The economy of the Cucuteni-Tripolye culture was mixed, with both the exploitation of domesticated plants and animals and the gathering of wild plants and hunting of wild animals. Among the material recovered from the fired clay used in the floors of Cucuteni-Tripolye dwellings, imprints of hulled wheat, naked six-row barley, and hulled barley have been recovered, although the latter was only rarely

Fig. 1. Binocular-shaped Tripolye vessel, Ukraine, c. 3500–3000 B.C. THE STATE HERMITAGE MUSEUM, ST. PETERSBURG. REPRODUCED BY PERMISSION.

represented. Other species include bread wheat and, occasionally, broomcorn millet, along with pea, bitter vetch, pulses, and grapes. At Majdanetskoe, located between the Southern Bug and Dnieper Rivers and dating to 3650–3000 B.C., peas formed perhaps 75 percent of the plant remains recovered during excavations. Wild plant species identified from Cucuteni-Tripolye sites attest to woodland food collecting: among them, cornelian cherry, plum, hawthorn, pear, and wild grapes. In addition, edge gloss on a harvesting tool from Mirnoje might testify to intensive collecting activities.

Domesticated animals included cattle, sheep, goats, and pigs, and remains of wild animals represented red deer, roe deer, wild pig, moose, and horse. Fishing, too, appears to have been an important element in the subsistence economies of earlier Cucuteni-Tripolye communities. Moreover, while domesticates often outnumber wild species, there is evidence that the hunted animals could have represented up to 60 percent of the animals eaten at certain Cucuteni-Tripolye sites. Thus, while Cucuteni-Tripolye is considered a farming culture, the economy remained mixed throughout its existence, although the emphasis on hunting varied in the latest periods.

At numerous early Tripolye sites, such as Klishchev yar (3990–3770 B.C.) and Soroki-Ozero (3970–3510 B.C.), there are indications that cattle breeding was an important element of the economic activity of these communities. Conversely, at Kolomischiina II in stage BII of Tripolye, wild animals constituted about 79.5 percent of the fauna, while the stage CI site of Kolomischiina I had 80 percent wild animals in its faunal assemblage. At the later-stage sites in the steppe zone, sheep and goats seemed dominant over cattle and horses among the domesticated faunas.

In its earliest stages the Cucuteni-Tripolye settlements have signs of two-storied dwellings, probably housing a single family. Settlements initially were located in the river valleys of the region, perhaps representing acculturation of existing groups. Expansion of settlement into the loess lands away from the river valleys might indicate the movement of Cucuteni-Tripolye farming groups into adjacent regions. Such a strategy would be logical, in that local knowledge certainly would have made the occupation of a new region easier and more viable than uninformed expansion.

There is no evidence for cemeteries in the early to middle stages of Tripolye, although some houses have been found to have people buried beneath their floors. Excavations at the late-stage cemetery of Vykhvatintsy on the middle Dnieper showed that the dead were buried in a contracted position on their left sides, usually with their heads to the east or northeast.

Early settlement sites were quite small, basically comprising small hamlets of perhaps a dozen houses. The maximum expression of settlement size is reached at such sites as Vesely Kut (150 hectares in area) and Majdanetskoe (stage CI, c. 3790–3000 B.C.) which was 200 hectares in area and contained in excess of two thousand dwellings and storage buildings. Fortifications of two-story buildings have been inferred. Although it was thought at first that fortification was in response to a threat from such steppe groups as the Sredny Stog to the east, it is apparent that some internal conflict between Tripolye groups, in terms of competition for resources, may have played a part in these developments. The occurrence of burial mounds over Tripolye sites seems to have been a later, post-Tripolye phenomenon in certain cases. The superimposition of burials over

Tripolye sites might represent the symbolic reclamation of territory by subsequent culture groups.

The investigations at sites such as Kolomischiina have indicated that smaller buildings may have functioned as stores or dedicated production areas for pottery or grain processing. Building 7 at Kolomischiina, for example, is a small enclosure, roughly 24 square meters, with about twenty vessels and no evidence for a hearth, which suggests that this building was simply a storage hut. The layout of the houses indicates that while they were large, they were not necessarily used exclusively for habitation. Areas of clay flooring show evidence of grain-processing activities. Whereas there is clear evidence for an expansion of population into the later middle phase of Tripolye, estimates of population size would need to account for the areas of these "houses" that were given over to grain processing and other storage activities.

On the basis of calculations of settlement sites like Kolomischiina I, which may have had about five hundred inhabitants, or eighty families, it has been suggested that Tripolye culture sites would have needed 250 hectares of arable land under cultivation to sustain the population, with another 250 hectares lying fallow. The mean population density is thought to have been about nineteen persons per square kilometer. The fact that not all of the structures at such sites as Kolomischiina I would have functioned as dwellings has led researchers to conclude that this estimate represents a maximum population density after c. 3600 B.C. in the territory of the Tripolye culture in Ukraine.

Throughout its development, the Cucuteni-Tripolye culture produced fine pottery forms and clay anthropomorphic figurines. Pottery forms varied and included vases, beakers, bowls, binocular vases, and hollow stands. Pottery decoration developed toward a trichrome style characterized by an orange pottery painted with black-and-white patterns, as the culture expanded into Moldova. The anthropomorphic figurines varied in design but generally were of a female form, less than 100 millimeters tall, with stylized legs, buttocks, chest, head, and face, in either a standing or a semireclining position. The female figurines have been interpreted as a symbol for fertility, as grains of wheat and barley have been recovered from the clays of many of these figurines from Luka-Vrublivetska, which is dated to c. 4950–4550 B.C.

Increasing climatic aridity after c. 3500–3200 B.C. is believed to have caused instability in the Tripolye farming economy, leading to economic diversification. Many sites exhibit declines in ceramic production and house building. After c. 3320 B.C. in the middle Dnieper area, a shift in economy toward stockbreeding is evident in one variant of this culture. Discrete groups within the Tripolye culture expanded their ranges within the territory of Ukraine during the latter period, and significant elite burials are evident, perhaps suggesting the development of military-oriented chiefdoms.

THE SREDNY STOG CULTURE

In general, Sredny Stog and its component subcultures are thought to have overlapped the end of Tripolye period A, c. 4500 B.C., through to Tripolye stage C2, c. 3200–2800 B.C. Some one hundred settlements are known from this culture. These settlements contrast with Tripolye culture sites in that there is a lack of defense, with dwelling sites and cemeteries being open and located in the forested river valleys on the west side of the middle Dnieper and eastward to the Donets and lower Don.

In the Sredny Stog economy stockbreeding originally was thought to have been important, with the horse dominating assemblages, but this earlier hypothesis was revised in light of newer investigations. It now appears that the evidence from such sites as Dereivka testifies to the hunting of horse as opposed to its domestication; coincidentally this species also has been identified in low numbers on Tripolye A period sites between 5500 and 4500 B.C.

In its earliest stage, c. 4500–4300 B.C., Cucuteni-Tripolye imports are found on Sredny Stog sites, reinforcing the fact that exchange was occurring. More dramatic evidence for contact has been recovered from the middle-stage Tripolye site of Nezvizko 3. At this site, an aged man of a physical type similar to that of Sredny Stog people and buried in a style resembling that of Sredny Stog burials, was found to have facial injuries inflicted by a stone axe. These injuries were not the immediate cause of death, however, as study of the skeleton suggested that this person survived for perhaps ten to fifteen years after the injuries were inflicted. It has been suggested that he might reflect the intermingling of Cucuteni-Tripolye and Sredny Stog populations.

The development of the Sredny Stog culture has been viewed as a result of the migration of pastoralists into the Dnieper and northern regions of the Black Sea. Various models exist, however, for the development of the Sredny Stog culture, which in its latter stage is characterized by a Corded Ware pottery stage. An alternative hypothesis is that this culture arose from the local Neolithic groups in the Azov and lower Don regions. Other researchers see its genesis in the Dnieper region, again as a direct derivative of earlier Neolithic traditions. As these various arguments suggest, the identification of Sredny Stog as a discrete entity that developed between c. 4500 and 2800 B.C. could be and has been questioned by the studies of different researchers. This lack of agreement stems from the fact that the sites used to define this culture are datable to different periods and have inconsistencies in terms of their associated artifact inventories.

Perhaps foremost among the sites used to define the Sredny Stog culture is the settlement of Dereivka, which dates to 4500–3800 B.C. This settlement is located on the right bank of the Omelnik, a tributary of the Dnieper, and is the most impressive site within the Sredny Stog culture complex, being about 2,000 square meters in area and defined by a possible fence or palisade structure. A shell dump comprising *Unio* and *Palludino* shells delineates this fence or palisade. In effect, this deposit represents a midden, with stones, ash, broken pottery of rounded or point-based form, and a range of artifacts throughout the layers. The Dereivka "complex" has produced some twenty-three thousand finds.

The evidence from the stratigraphy at this site suggests that it may have been subject to periodic reoccupation over a considerable period of time. This is particularly evident at structure 3, where a hearth was identified overlying its north wall. This structure, located immediately east of house 1, has been referred to as a "domestic activity complex." This feature may have been a more superficial structure, however, possibly a temporary fishing hut, as circular formations of stone, probably used for post packing, were located throughout its interior. The identification of this structure as a temporary dwelling used during fishing expeditions is supported by the finds of about twenty ceramic, violin-shaped net sinkers (found nowhere else at the site), a bone fishhook, and heaps of scales and fish bones in the hearth. The evidence clearly indicates that the inhabitants of the site repaired their fishing gear and processed their catch of such species as perch, roach, carp, and pike at this location.

This site has many house structures that are rectangular in shape, with the largest measuring 13 by 6 meters in area. Semi-subterranian houses have been identified at Alexandria in the Donets region, and surface dwellings comparable to those at Dereivka have been recovered at Konstantinovka on the lower Don. At Dereivka, house 2, situated on the southern side of the site, is a rectangular building with two hearths. Clay figurines were recovered from the northwestern corner of this building. They comprised a large fragment of a female statuette and a second piece resembling the head of an anthropomorphic image.

Under the north wall of the house was the ritual interment of a dog. This animal was buried in a large pit beneath the occupation horizon; it had been positioned on its side with its legs extended and its head pointing forward. According to the excavator of this site, this interment represents the cult of guardian animals, a common practice among the Copper and Bronze Age cultures of Tripolye, Yamnaya, and Corded Ware. One of the other pits at this site held a figurine of a boar and a fragment of a second object, two fragments of statuettes, and two bridle cheekpieces made from antler.

The associated cemetery has been placed at between 4400 and 4000 B.C. on the basis of a radiocarbon determination from burial 5. Other researchers have suggested a later date, c. 3500 B.C., for this site. Among the artifacts associated with the burials at Dereivka are copper beads and a red clay bowl of Tripolye type. The dating of Dereivka to Tripolye B2–C1, as opposed to stage C2, would be consistent with the radiocarbon dating of both the settlement and the cemetery site. Other Sredny Stog cemeteries feature equivalent burial practices, with people laid on their backs and with their legs flexed in small grave groups of two to five individuals, separated from other groups in the cemeteries. Single interments usually are covered with red ochre. These small burial groupings are believed to represent discrete family or kin-based groups, the identity of which remained significant even after death.

At Dereivka, horse remains made up more than half of the fauna at the site, and the presence of antler cheekpieces has been cited as an indication of the early domestication and riding of horses. Research has shown, however, that this phenomenon was, in fact, a much later activity and not contemporary with the Copper Age phase of activity at Dereivka. It appears that the economy of the Sredny Stog culture was mixed, with a combination of stockbreeding, including sheep and goats, cattle, and pigs; agriculture; and hunting and fishing. Some processing of plant foods is implied by the presence of querns and grinders at Dereivka, although it should be remembered that the processing of wild plant remains took place from a very early time in this region. The range of wild animals hunted encompassed red and roe deer, moose, wild boar, beaver, otter, badger, wolf, and fox.

The pottery of the Sredny Stog culture exhibits a new decorative motif after c. 4000 B.C., when cord ornament is used to decorate the pots. Stone tools associated with the economic activities of Sredny Stog groups include knives, scrapers, arrowheads and spearheads, with antler tools including hammers and mattocks as evidenced at Dereivka.

It has been reported that the Sredny Stog culture groups differed economically from such cultures as the Cucuteni-Tripolye, in that they were steppe cattle breeders who used point-based pottery and had only superficial settlements (as opposed to the concentrated habitations of the Cucuteni-Tripolye culture). They did bury their dead in a fashion similar to that of the Cucuteni-Tripolye groups, in that they buried their dead in the flexed position. However, the burial ritual differs in relation to specific positioning as Sredny Stog burials were interred on their backs, whereas the Tripolye burials were positioned on their sides with their hands placed near their faces.

In the region between the lower Dnieper and Crimea, a third significant culture group, the Lower Mikhailovka, has been identified. This culture group coincided chronologically with the Corded Ware stage of the Sredny Stog culture. At Mikhailovka the settlement remains of the Lower Mikhailovka group have been shown to underlie those of the Yamnaya culture.

The evidence recovered from such sites as Mikhailovka on the Dnieper indicates that this was a cattle-breeding steppe culture with a well-defined artifact inventory. Although faunal remains are sparse, it appears that cattle, sheep and goats, horses, pigs, and dogs, alongside hunting, made up the subsistence base of this culture. Pottery forms were mainly flat-based, dark in color, poorly decorated, and burnished. Imports of Tripolye painted pottery in Lower Mikhailovka burials support a Tripolye B2–C2 age between 4000 and 2800 B.C. or, more precisely, between 3700 and 3000 B.C. The burial ritual comprised interment in the supine position or with the knees drawn up toward the body, the use of ochre, and the erection of *kurgans* (burial mounds), with cists and stele used in burial constructions. Burial goods are not numerous, but finds of pottery, copper awls, and shell ornaments have been recovered.

One particularly interesting element of the ritual activities associated with the Lower Mikhailovka culture is the existence of altars or offering places associated with the *kurgans,* which have been found beneath the mounds. The evidence suggests that ritual deposits were created either before or during the burial ceremony. In this context pottery finds associated with the burials have been interpreted as representing the remains of the funeral feast which formed an integral part of the burial ritual.

THE PIT GRAVE CULTURE (YAMNAYA)

By the end of the Copper Age, most of the Pontic-Caspian region was occupied by the Pit Grave (Yamnaya) culture, which has been described as one of the major cultural-historical entities of prehistoric Europe. The early Pit Grave culture groups initially settled in the steppe zone of eastern Europe c. 3000–2900 B.C., either absorbing or displacing such indigenous groups as the Tripolye and post-Mariupol populations. (The Russian term for "pit grave" is *Yamnye pogrebeniia,* derived from *yama,* which literally means "pit.") Researchers in this region have suggested that Yamnaya may have differing origins; the Volga region and the Dnieper (Sredny Stog) are possible heartlands for this culture, along with the region to the southeast, in the Caucasus.

Whatever the mechanisms of its initial development, it is clear that by c. 2500–2000 B.C. the Pit

Grave culture encompassed the steppe and forest steppe from the Urals in the east to the Lower Danube in the west. In general, the subsistence base of this culture is believed to have focused primarily on pastoralism. There is evidence of cultivated plants, derived from imprints on ceramics and from physical remains from such sites as Mikhailovka 3. The evidence is sparse, but it usually is accepted that agriculture formed an integral element of subsistence strategies.

The full expression of the *kurgan* tradition is associated with the Pit Grave culture after c. 2500 B.C. Despite the proliferation of *kurgans* in Ukraine and the northern Pontic steppe region, less than fifteen settlement sites are known; where there is evidence of settlement activity, it often takes the form of insubstantial camps, probably reflecting the nomadic pastoralism that dominated the economy of the steppe at that time. Faunal species exploited by the Yamnaya culture groups include such domesticates as cattle, sheep and goats, horses, and pigs. A broad range of wild animal remains comprise red deer, aurochs, wild boar, onager (wild ass), and steppe antelope (saiga), alongside smaller species, such as beaver, fox, otter, and hare.

As noted, exceptions to the described settlement pattern exist, especially at Mikhailovka on the lower Dnieper. The Yamnaya culture settlement evidence at this site comprises two phases of activity, the earliest of which occupied an area of about 1,500 square meters. James Mallory has noted that at this site there were both semi-subterranean and surface structures, along with large quantities of ceramics, tools, and faunal remains. The second phase of Yamnaya settlement saw expansion of this site to cover about 1.5 hectares and its fortification with ditches and stone walls.

The suggestion has been made that the *kurgans* erected by this culture functioned not only as grave mounds but possibly also as fixed points in the barren steppe, which could assist in guiding movement through the landscape. They also served to emphasize communal and familial links with the ancestors, and as such they reinforced communal rights to the land through the longevity of association afforded by ancestral ties.

As might be anticipated in a society where the economy was based on pastoralism, cattle formed an integral part of the rituals revolving around the burial of the ancestors, and many faunal remains come from burial contexts. The dead were laid on their backs, with the legs flexed and the head oriented to the east or northeast, and covered with ochre. Some extended supine burials, as noted for the Neolithic Dnieper-Donets culture, have been identified in the Danube-Dniester interfluve. Of particular interest are the signs of amputation of the hands or feet of the buried persons. Although this rite has no parallels elsewhere in the Yamnaya cultural area, it is a characteristic of Late Glacial/Early Holocene cemeteries at the Dnieper Rapids, such as Voloshkoe, which dates to c. 10,400–9200 B.C.

Additional Yamnaya and later-stage burials have been recovered from excavations of the *kurgan* mounds. Yamnaya burials within the mounds often number between fifteen and thirty interments, suggesting family or group or tribal burial grounds. The graves are deep shafts, either square or rectangular in shape and often lined with timber; the burials are found in chambers, usually covered with logs. The existence of barrow mounds before the establishment of the Pit Grave culture (Yamnaya) and their reuse by Pit Grave people show that the first *kurgans* were in evidence from stage BII/CI at such sites as Vishnevoe. Early-stage Yamnaya burials often are unaccompanied by grave goods, but later examples have produced a wide range of artifacts, such as copper and flint knives, boar tusk pendants and beads, and such tools as scrapers, axes, and sickle blades. Other finds of equipment and tools associated with this culture include flint, bone, and antler tools, among them, mattocks and harpoons, and such weapons as daggers, stone battle-axes and maces, and arrowheads. Copper knives, chisels, awls, and adzes appear to have been produced locally.

While the economic activities of the Yamnaya groups were structured to accommodate prevailing natural conditions, with mixed farming in open, forested river valleys and stockbreeding in the open steppe zone, one of the most significant factors in the development of these mobile economies was the invention of wheeled transport. James P. Mallory has noted that evidence for both two- and four-wheeled carts or wagons has been recovered from Yamnaya burials, such as the Storozhevaya cemetery near Dnepropetrovsk on the Dnieper. Other finds of carts have been made at Staryi Kodak (lower Dnieper) and north of the Sea of Azov at Akkermen. Horse riding also is documented at this time. The "head and hooves" burials of the crania and lower limbs of sheep and, occasionally, horses are encountered. This ritual has been interpreted as a cult activity because the remains have been recovered in situations that indicate that they were placed over the buried person, as part of the burial ritual. Finally, it has been suggested that the extensive adoption of the Pit Grave tradition might reflect the ultimate expression of societal modification aimed at counteracting the climatic changes responsible for the deterioration of such groups as the Cucuteni-Tripolye culture. This modification took the form of a reorientation of subsistence economies and settlement patterns in order to avoid the impacts of worsening climate in relation to the previous agricultural economies employed by the Tripolye culture groups.

See also **Ritual and Ideology** (*vol. 1, part 1*); **Kolomischiina** (*vol. 1, part 4*); **Bronze Age Herders of the Eurasian Steppes** (*vol. 2, part 5*).

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MALCOLM LILLIE

DOMESTICATION OF THE HORSE

Who was the first human to jump on the back of a wild horse? When did the first successful ride happen—that astonishing moment when some adolescent first hung on to a horse's mane and galloped through the village while everyone stared as if he (or she?) had begun to fly? That moment, irretrievably lost, changed history. Today horses are such an accepted part of the culture that all transportation technologies—even rocket engines—are still measured in horsepower. Horses, unlike other domesticated animals, are more important for transportation than as a source of milk, meat, or fibers. The domestication of the horse was both a zoological and a technological innovation, which is one reason the study of horse domestication is so complicated. Certain discoveries hold out the hope that we might eventually understand this seminal event much better.

WHERE WERE HORSES FIRST DOMESTICATED?

In 2001 geneticists at Uppsala University (Sweden) established that modern domestic horses have such wide variation in their mitochondrial DNA that they could not have descended from a single ancestor or small group of ancestors that lived in one place within the past ten thousand years. Similar studies conducted on modern domestic sheep (*Ovis aries*) and European/Near Eastern cattle (*Bos taurus*) had quite different results—these species are so homogeneous in their genetic makeup that they almost certainly *are* the descendants of single ancestors that lived recently. A single pair of wild sheep and only a few bull and cow pairs became the ancestors of almost all of our millions of modern domesticates—thus it is worthwhile investigating where those ancestral pairs were brought into a domesticated way of life.

Modern horses, though, are mongrels by comparison, probably because wild horses continued to interbreed with domesticated stock until modern times. Horse keepers encouraged the incorporation of new domesticates from previously isolated wild horse populations, whereas cattle and sheepherders did not. Breeding with wild horses was thought to enhance some of the qualities desired in domesticated horses—strength, speed, intelligence, and competitiveness—while most of these same qualities are undesirable in domesticated cattle and sheep. The contrast in character testifies to the very different demands humans have placed on horses, but it should not derail the search for the place where domestication took place. The earliest domesticated horses must have lived somewhere. One can accept that the genetic history of the modern horse is quite complicated without abandoning the search for the beginning of the story.

The first people to think seriously about the benefits of keeping, feeding, and raising tamed horses must have been familiar with wild horses. They had to have lived in a place where humans spent a lot of time hunting wild horses and studying their behavior. The geographic area where this was possible contracted significantly about ten thousand to fifteen thousand years ago, when the modern era of warm climate began and arctic steppe tundra—a favorable environment for Ice Age horses—was replaced by dense forest over much of the Northern Hemisphere. The horses of North America became extinct as the climate shifted, for reasons that are still poorly understood.

In Europe and Asia large herds of wild horses survived only in the steppes in the center of the Eurasian continent, leaving smaller populations isolated in pockets of naturally open pasture (marsh-grass meadows, alpine meadows, and arid *mesetas*) in Europe, Anatolia (modern Turkey), and the Caucasus Mountains. In these places, however, horses never became an important part of the human food quest over the long term—there were not enough wild horses left outside the steppe environment to make focusing on them worthwhile. In Anatolia, for example, small populations of wild horses survived long enough to be hunted occasionally by the Neolithic occupants of Çatal Hüyük and other farming villages in about 7400–6200 B.C., but they were hunted out during the Neolithic. In Western Europe horse bones account for more than 5 percent of the animals hunted at only a few early postglacial sites. Only in the Eurasian steppes were there large postglacial wild horse populations, and in steppe archaeological sites postglacial humans regularly hunted wild horses for more than half of their meat diet. For this reason alone one should look first to the Eurasian steppes for evidence of the earliest domestication.

Three equid species were hunted in the Ukrainian and Russian steppes north of the Black and Caspian Seas between 8,000 and 5,500 B.C. In the Caspian Depression, at such Mesolithic sites as Burovaya 53, Je-Kalgan, and Istai IV, garbage dumps dated before 5500 B.C. contain almost exclusively the bones of the horse and the onager, *Equus hemionus.* The latter is a fleet-footed animal smaller than a horse and larger than an ass, native to dry steppe and semidesert environments. Onagers were then very successful; their natural range extended from the Caspian steppes across Iran and into the Near East. Hunters in the arid Caspian steppes specialized in horse and onager hunting into the late sixth millennium B.C., at sites such as Dzhangar and Kair-Shak III. A second equid, *Equus hydruntinus,* was hunted in the slightly moister environment of the Black Sea steppes, where its bones are found in Mesolithic sites at Girzhevo and Matveev Kurgan, dated to the late seventh millennium B.C. This small, gracile animal, which then lived from the Black Sea steppes westward into Bulgaria and Romania, became extinct before 3000 B.C.

The true horse, *Equus caballus,* was more adaptable; it ranged across both the Caspian Depression and the Black Sea steppes, and it survived in both environments long after both *E. hemionus* and *E. hydruntinus* were hunted out. Horse bones were more than 50 percent of the identified animal bones at Girzhevo and Matveev Kurgan, a pattern that was repeated at Ivanovskaya on the Samara River, an eastern tributary of the Volga, and in Neolithic sites in the southern foothills of the Ural Mountains. All these sites were relatively small. Small camps imply that the hunters lived and hunted in small groups, probably using ambush techniques rather than large communal drives. Their taste for the flesh of wild equids created a familiarity with them and their habits that later would make the domestication of the horse possible.

WHY WERE HORSES DOMESTICATED?

The first domesticated animals north of the Black and Caspian Seas were introduced by farmers of the Criş culture who migrated from the broad Lower Danube Valley into the forested eastern Carpathian foothills, spilling into the Seret and Prut River valleys about 5800–5600 B.C. The ownership of cattle and sheep made possible an entirely new political economy in the region. Domesticated animals constituted capital that could be loaned, offered at public ceremonies, and given as gifts. The connection between animals and power would become the foundation on which new forms of ritual and politics would develop among steppe societies. Between 5400 and 5200 B.C. cattle and sheep were adopted by the Dnieper-Donets culture (also known as the Mariupol culture, after the cemetery of Mariupol) in the steppe valleys of the Dnieper and Donets Rivers north of the Black Sea. By 5200–5000 B.C. the people of the Volga-Ural steppes, far to the east, had begun raising cattle and sheep as well. An economic boundary formed at the eastern and northern edges of the Volga-Ural steppes; beyond this frontier, the native foragers rejected domesticated animals for another 2,500 years.

The techniques of cattle herding would have suggested obvious possibilities to anyone familiar with horses. Both cattle and horse bands follow the lead of a dominant female. The cowherd needs only to control that female to control the whole herd—a technique easily applied to horses. A dominant male, the bull or the stallion, normally guards the wild band, a job taken by a human in a domestic herd. Thus, males present a similar management problem in both species, and they have the same iconic status as symbols of virility and strength. When people who depended on equid hunting began to keep domesticated cattle, it would not have been long before someone tried to apply cattle management techniques to horses.

What was the incentive to tame horses if the people who did it already had cattle and sheep? The first horse tamers would not have been able to predict the ultimate advantages of leaping onto the back of a fast, powerful, and aggressive creature naturally more inclined to fight or run from humans than to carry them. Horses, however, are easier to feed through the winter than cattle or sheep. Cattle and sheep push snow aside with their noses, whereas horses use their hooves. In deep or continuous snow the noses of cattle and sheep become bloody and sore, and if they are not provided with fodder they will stand and starve in a field where there is ample winter forage just beneath their feet. Horses will paw ice and snow away with their hard hooves and feed themselves. They are supremely well adapted to the cold grasslands of our planet, where they evolved. People who lived in cold grasslands with domesticated cattle and sheep soon would have seen the advantage in keeping horses, if just for a cheap supply of winter-season meat. It is possible that this phase of horse keeping, when horses were primarily a source of meat, began as early as 5000 B.C. in the Pontic-Caspian steppes.

WHEN WERE HORSES DOMESTICATED?

The cemetery of Khvalynsk, located in the Russian steppes on the west bank of the Volga River, between Saratov and Samara, contained the graves of more than two hundred people and dated to about 5000–4500 B.C. During this first period of stockbreeding in the steppes, domesticated animals were sacrificed to accompany the dead. Animal sacrifices were placed in graves, at the edges of grave openings, and on the ground above filled-in graves at Khvalynsk. Igor Vasiliev, the excavator, reported a minimum of sixty-one sheep, twenty-one cattle, and eleven horses as sacrifices. Most of these animals were represented by just the leg bones, but seventeen sheep and nine cattle still had parts of both the head and the lower leg bones—probably the remains of hides with the head and feet still attached. Only cattle, sheep, and horses were offered in the Khvalynsk funeral sacrifices—except for one deposit, containing a single bird. Three graves held the bones of horses combined with cattle or sheep or both.

The ritual grouping of horses with cattle and sheep would be explained most easily if horses were *managed* like cattle and sheep, tamed and controlled by human herders. At the related cemetery of S'yezzhe on the Samara River, an above-grave ritual deposit contained red ochre, broken pottery, shell beads, a bone harpoon, and the skulls and lower leg bones of two horses. Two figurines of horses carved on flat pieces of bone were placed near this red-ochre-stained deposit. Similar funeral deposits of horse bones and carved horse images have been found at other contemporary cemeteries in the western steppes (Varfolomievka and Lipovi Ovrag). Symbolically, horses were treated in the burials like domesticated cattle and sheep—they occupied the same ritual category as livestock. It thus seems likely that horses already were domesticated or on the way to domestication by about 5000–4500 B.C. in the steppes north of the Black and Caspian Seas.

THE ORIGIN OF HORSEBACK RIDING

It is difficult to distinguish the bones of early domesticated horses from those of their wild cousins. Contemporary feral populations differ in bodily form in different environments—Chincoteague ponies are smaller than Nevada mustangs, for example. The leg bones of postglacial horses from southeastern Europe or Germany tended to be a little thicker than those of typical steppe horses, but the whole range in leg thickness can be found in one archaeological site, as at La Adam cave in the Dobruja region of Romania. It is thus difficult to identify a morphological variant that clearly indicates domestication and that cannot be ascribed to the regional environment or interregional movement of wild horse populations.

It has been doubly difficult to distinguish the bones of a mount from those of a horse merely eaten for dinner. Riding leaves few traces on horse bones—only six thoracic vertebrae are known to show riding-related pathologic features, and these bones rarely are preserved at archaeological sites. A bit, however, leaves marks on the teeth, and teeth usually survive very well. Bits are used only to guide horses from behind, to drive or to ride. They are not useful if the horse is pulled from the front, as packhorses are, so evidence for bit use implies riding or driving.

Most horses that have been ridden or driven frequently with a bit—90 percent in a study of modern bitted horses—show bit wear on their lower second premolars (P_2s). A well-positioned bit is supposed to sit on the tongue and gums in the space between the front and back teeth, called the "bars" of the mouth. But X-ray photographs taken at the University of Saskatchewan (Canada) show that a horse can use its tongue to elevate and retract the bit, pushing it back into the grip of its premolars. The horse has to force the bit back into its cheeks, which prevent the bit from moving back farther than the front half of the P_2. Thus, all wear from bit chewing is concentrated on one part of one tooth (the P_2), unlike the wear from chewing anything else.

A metal bit creates distinctive abrasions on the enamel of the P_2, usually concentrated on the first cusp; it also wears down a bevel or facet on the front (mesial) corner of the tooth, also usually on the first cusp. Horses that chew on a rope or leather mouthpiece, like those probably used for the oldest bits, show the same wear facet in the same place, but its surface is smooth and polished, not abraded. Measurement of the depth of the wear facet easily distinguishes populations of bitted horses from horses who have never worn bits. Horses that have not been bitted do not have a wear facet on the mesial corner of the P_2. In our study of such horses, the median measurement of the dip on the mesial corner of the tooth was only 0.5 millimeters. We regard a 3-millimeter-deep facet as the threshold for identifying bit wear in archaeological cases. If several mature horses, three years old or older, from a single archaeological site have mesial bevels of 3 millimeters or more on their P_2s, it is evidence either for numerous cases of a very rare natural pathological condition or for the use of bits.

The oldest archaeological collection of numerous horse P_2s with wear facets in excess of 3 millimeters is from the site of Botai in northern Kazakhstan. Botai was a settlement of specialized horse hunters who seem to have ridden horses to hunt horses, a peculiar practice that existed only in northern Kazakhstan during the period 3500–3000 B.C. Sites of the Botai type and of the related Tersek type contain 65–99.9 percent horse bones, indicating that the meat diet came almost exclusively from horses. Five of the nineteen measurable P_2s studied at Botai, representing at least three different horses, had significant bevel measurements: two of 3 millimeters, one of 3.5 millimeters, one of 4 millimeters, and one of 6 millimeters. A 3-millimeter wear facet was also found on one P_2 from a Tersek site very much like Botai, Kozhai 1, in the steppes just west of Botai, dated to the same period. One can be reasonably certain that some Botai and Tersek horses were bitted and ridden.

Dogs and horses were the only domesticated animals these people had—the Botai-Tersek communities essentially were mounted foragers. They possessed no cattle or sheep, no wheeled vehicles, and no bronze metallurgy—all things that their Yamnaya culture neighbors in the Volga-Ural steppes to the west had during the same period. Botai-Tersek sites have large and well-studied collections of horse bones, but that does not mean that riding actually began there. It is likely that Botai-Tersek people acquired domesticated horses and the idea of riding them from their western neighbors, who had been managing domesticated cattle and sheep, and probably horses, for fifteen hundred years before 3500 B.C.

The appearance of riding at Botai suggests that other cultures of the Eurasian steppes were riding horses by about 3500–3000 B.C.—and probably earlier. A man on foot can herd about two hundred sheep with a good herding dog. A man on horseback can herd about five hundred. Riding greatly increased the efficiency and productivity of herding economies and probably was used also in tribal raiding, long before riders were organized and armed in a way that finally made them effective against urban armies.

THE SPREAD OF HORSEBACK RIDING

Riding was not a sport of kings before 1000 B.C. In fact, an adviser to one Near Eastern king, Zimri-Lim of Mari, warned him in about 1770 B.C. that he should not dishonor his kingship by riding horses; instead, he should ride in a chariot. Teams of elegantly outfitted horses drew chariots into battle as early as 1800–1900 B.C. in the Near East and Anatolia, and it was in this capacity that horses first were used widely by royalty. Horses initially appeared in small numbers in Anatolia and Iran around 3000 B.C., perhaps imported to breed with asses to produce mules, which were stronger than asses and better suited than horses to the hot Near Eastern climate. The earliest artistic images of horses appeared in about 2300–2000 B.C.; they showed horses alone or men riding on horseback. The identity of these riders or their function is not known, but riding was not adopted by Near Eastern elites, and it was not used in state-level warfare.

Between about 2800 and 2000 B.C. ponderous four-wheeled battlewagons were used in Near Eastern warfare. They were pulled by asses (*Equus asinus*) or onagers (*E. hemionus*), native equids but smaller and weaker than horses. The chariot was a light, two-wheeled vehicle designed specifically for speed, made possible by the invention of the spoked wheel, which greatly reduced its weight. Chariots could take advantage of the superior speed of horses, which began to be imported in large numbers when the chariot was invented, about 2000 B.C. It is not clear where chariots were invented—they appeared in graves in the Eurasian steppes around 2000 B.C. and could have spread from there through the Iranian Elamites into Mesopotamia during the Third Dynasty of Ur. Alternatively, they might have been invented in the Near East and spread northward into the steppes. Regardless of their origin, chariots were expensive to make, the horses that pulled them were exotic foreign beasts, and both chariot teams and drivers needed long training, so horse-drawn chariots were automatic signals of status and wealth. Once they appeared, elite chariot corps dominated warfare between the kings of the Near East for centuries.

The effective use of cavalry in urban, state-level warfare depended on three tactical and technical innovations: the organization of large bodies of riders into units that attacked and retreated on command; the invention of the short, recurved compound bow, which made it easier to shoot from a moving horse; and the development of molds to cast metal arrowheads of standard weight and size, which made archery more accurate. These three innovations came together in the western Eurasian steppes in about 1000 B.C., perhaps as a result of contact between tribal steppe riders and state-level military organizations in the Near East or the Caucasus Mountains. Within a few centuries cavalry replaced chariots on the battlefields of the Near East and the western Eurasian steppes. Warfare and world history were changed forever.

See also **Warfare and Conquest** (*vol. 1, part 1*); **Milk, Wool, and Traction: Secondary Animal Products**

(*vol. 1, part 3*); **Late Neolithic/Copper Age Eastern Europe** (*vol. 1, part 4*).

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DAVID W. ANTHONY

KOLOMISCHIINA

The Tripolye culture site of Kolomischiina is located to the west of the Dnieper River, near the modern village of Halepye, about 35 kilometers south of Kiev, Ukraine.

Tripolye culture settlements within the modern boundary of Ukraine number about one thousand. The sites vary in size from about 4 to 400 hectares, and at the smaller end of the range they consist of small hamlets of a dozen or so houses. The site of Vladimirovka, on the right bank of the river Siniukha (a tributary of the southern Bug River), has five concentric rings encompassing 162 houses on a site that covered an area of about 900 by 800 meters. Larger settlements have houses and associated structures numbering in the hundreds, and at the Ukrainian site of Majdanets'ke, some twelve hundred to seventeen hundred buildings, or perhaps more, have been identified through aerial photographic and site surveys.

On the basis of about sixty-five radiocarbon determinations the entire span of the Tripolye culture is known to encompass the period c. 5500–2300 B.C. During the middle and later phases of Tripolye culture development, between c. 4500–3500 B.C., settlements were located either on the floodplains of the region's rivers or on promontories formed by higher terraces of these rivers. Though undated in absolute terms, the settlement of Kolomischiina is placed in the Tripolye periods B–C1, between c. 4500–3000 B.C., and the site is located on a typical promontory. Tripolye settlement sites in Ukraine, predictably, were usually located close to a spring or water source.

Kolomischiina is a relatively small settlement, consisting of thirty-nine buildings arranged in two concentric circles. Despite its small size, this settlement layout would still have provided a measure of defense for the inhabitants.

The area covered by the site known as Kolomischiina is defined by the dimensions of the outer ring of buildings, which consisted of thirty-one structures in a circle (or more accurately, an ellipse) of 160 by 170 meters diameter. An inner circle had a diameter of 70 by 75 meters, and contained eight structures. The houses all have their entrances facing toward the center of the site. Larger settlements of the Tripolye culture in Ukraine have been defined as covering 250 hectares (Dobrovody), 270 hectares (Majdanets'ke), and up to a maximum of 3.5 by 1.5 kilometers (Talljanky).

Despite its modest size, Kolomischiina is a significant site in the history of the investigations into the nature of Tripolye occupation sites. Prior to the implementation of the "Tripolean expedition" in 1934, a series of archaeological surveys and excavations aimed at enhancing knowledge of the Tripolye culture in the Ukraine; excavations of Tripolye culture sites had been of only limited scope, encompassing either trench or small area excavations. Due to the limitations imposed by these investigations,

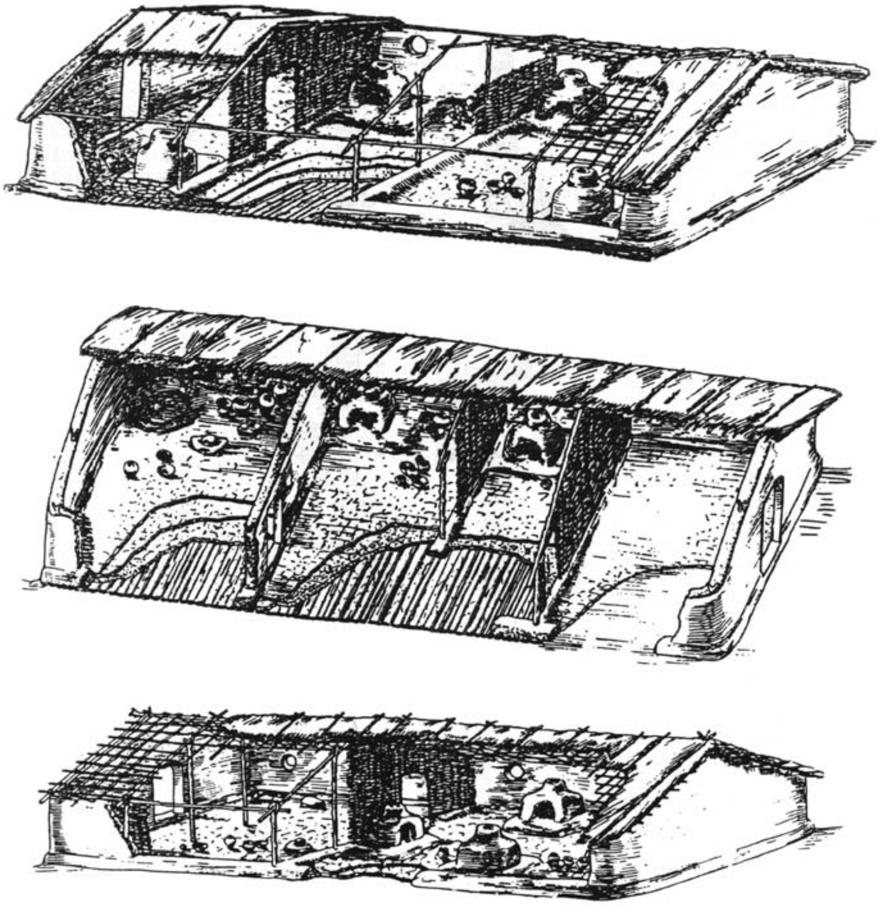

Fig. 1. Longhouse construction at Kolomischiina I: dwellings 24 (upper), 11 (middle), and 2 (lower). FROM PASSEK AND KRICHEVSKYI 1946.

many conclusions relating to the precise nature and function of these sites remained tentative and unconfirmed. This was especially the case in relation to the interpretation of the fired clay or plaster platforms found on settlement sites. Earlier excavators had concluded that these features were ritual in nature. The new excavations at Kolomischiina confirmed that these platforms (*ploshchadki* in Russian) did in fact represent the foundations of rectangular houses or buildings built on the ground surface. This building technique contrasts to that of earlier periods, where the houses were "sunk" about 0.9–1.0 meter below the ground level.

During the excavations at Kolomischiina about 13,000 square meters of the site were excavated over a five-year period. The excavations indicated that the central area of the settlement may have been used for stock keeping and possibly as a site for festivals or ceremonies. Concentrations of animal bone, pottery, and plaster were found in proximity to the dwellings or structures. In the northeastern part of the settlement a thick cultural layer (possibly middens)—comprising *Unio* shells, the bones of both wild and domesticated animals, and fish remains, along with similar material to that found closer to the dwellings, such as pottery fragments, pieces of plaster, and some broken tools and fragments of clay figurines—were excavated. The clay figurines featured various domesticated animals and human figures, primarily females. Pottery was decorated either with various incised impressions and stamps or, in later periods, with the application of paint motifs using white or black paint in spiral forms and with the application of red, black, and brown colors. Regional variability in pottery decoration is evident in the north and eastern areas of the Tripolye cultures distribution.

T. S. Passek interpreted the *ploshchadki* at Kolomischiina as large rectangular houses built of wattle and daub supported on a framework of wooden posts, with many ovens or kilns. These houses or structures were rectangular in plan, up to 30 meters long and 5–8 meters wide, and often about 100–120 square meters in area. Of the thirty-six dwellings at Kolomischiina, twenty-two were constructed in the above style. The structures had floors constructed from wood and clay, the latter mixed with chaff (chopped hay or straw). The fired clay was laid out in long, rectangular "rolls" or "bricks," with the gaps between them sealed by unfired clay.

Although this layer often covered the whole floor area, in certain buildings—such as building N1 at Kolomischiina—it only covered a part of the house. The clay floors are interpreted as being used in those parts of the dwellings that were used for the drying, preparation, and storage of grain.

The fired clay floors also provided a base, which was reinforced by additional layers of up to 0.2 meter in thickness, for the ovens and kilns of the large houses. The additional clay plates raised the ovens above the floor by up to 0.3 meter. At Kolomischiina these structures were shown to be rectangular in shape, about 2 by 1.8 meters or 2.0 by 2.2 meters and between 1.6 and 2.0 meters in height, and with the front walls painted red. It appears that the larger houses were portioned off, so that individual family units had their own designated living space. In each of these "apartments" the group had its own oven, grinding stones, storage vessels, and food preparation and eating vessels.

Clay models of houses have been recovered from sites such as Kolomischiina II (on the middle Dnieper River), and these reflect the general form of the houses exposed through excavation. Other clay models from Novye Rusešty and Rassokhovatka suggest that some Tripolye houses may have been two-story structures. The expansion of settlement indicates expansion of population into the latter stages of the Tripolye culture. The settlement of Kolomischiina, as discussed above, is placed in the Tripolye periods B–C1, between c. 4500–3000 B.C.: a time when the economy, population and material culture inventory of this culture reached its zenith.

See also **Slavs and the Early Slav Culture** (*vol. 2, part 7*).

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Malcolm Lillie

LATE NEOLITHIC/COPPER AGE CENTRAL EUROPE

FOLLOWED BY FEATURE ESSAYS ON:

The central European Late Neolithic begins with the appearance of the Lengyel and Rössen cultures around 4800–4700 B.C. and ends with the introduction of bronze metallurgy around 2200 B.C., spanning approximately twenty-five hundred years. Not all archaeologists subscribe to this definition, however. In Hungary the Neolithic is considered to have ended when copper-using societies appeared (4700–4600 B.C.), and a distinct Copper Age, or Chalcolithic, is recognized. These were Neolithic farming and stock-raising societies that used a new metal technology; thus, in this survey, the Copper Age is included in the Late Neolithic.

Since central Europe (Austria, the Czech Republic, Germany, Hungary, Poland, and Slovakia) is a vast area with many geographic and climatic conditions, Neolithic peoples, taking advantage of their own local resources, varied in their economic adaptations: farming, herding, and trading. Their individual cultural developments, of course, were as unique as those of any selection of cultures today. It can be assumed that those cultures that shared traits were linked in some way: language, ethnicity, history, or myth. Owing to this link, several cultures are named for their unique material culture, especially in terms of ceramic types. Hence, we have the "Funnel Beaker," "Globular Amphora," "Corded Ware," and "Bell Beaker" cultures. Other cultures are named after regions or sites they inhabited, for example, Lengyel.

There was considerable cultural homogeneity in house form, settlement organization, and subsistence practice among Early Neolithic farming societies in central Europe. In contrast, the Late Neolithic is a period of increasing cultural diversity and complexity. While there were continuities from the Early Neolithic, changes can be observed in economy, settlement, society, rituals, and beliefs. These adaptations include technological advances, the appearance of settlement hierarchies, the mining of flint, agricultural innovations, and ecological changes. Wagons, simple plows, horse riding, metallurgy, and wool production made their first appearance in central Europe at this time.

The greater number of settlements and larger cemeteries suggest a slight increase in population at the beginning of the period. A few centuries later some regions had population densities that were never achieved during the Early Neolithic. Areas occupied by hunters and gatherers decreased or disappeared as farmers moved into zones previously inhabited by foragers. There is also more evidence of warfare. The Late Neolithic societies exhibited

B.C.	Hungary	Eastern Slovakia	Western Slovakia	Austria	Czech Republic
2000					
2500				Bell Beaker	Bell Beaker
3000	Vučedol-Zók	↑	↑		Corded Ware
3500	Baden	Baden	Baden Bajč-Retz	Baden Bajč-Retz	Baden
	Bodrogkeresztúr	Bodrogkeresztúr			
4000					Funnel Beaker
4500	Tiszapolgár Tisza	Tiszapolgár	Lengyel	Lengyel Stroke Ornamented	Lengyel Stroke Ornamented
5000	Szakálhát	Bükk			
5500	Linear Pottery	Linear Pottery	Linear Pottery	Linear Pottery	Linear Pottery
6000	Körös				

Simplified chronological sequence for Austria, Czech Republic, Hungary, and Slovakia.

more variation and complexity in social and political organization than was evident in the Early Neolithic. Burial and settlement data suggest that some small, egalitarian societies may have been transformed into those with inherited social inequality. These are perhaps best termed ranked societies or simple chiefdoms, in which status and authority differentiated some individuals or families from others. We base this conclusion on the settlement data and the small number and size of the Funnel Beaker culture (4200–3500 B.C.) burial mounds in Poland. These structures usually contain one or two individuals, and we assume that only high-status persons were selected for interment in these mounds.

CHRONOLOGY AND CULTURAL SEQUENCE

For brevity's sake, the range of cultural variation is underemphasized in this survey, and the chronological scheme is simplified. The earliest major Late Neolithic cultures in central Europe were the Lengyel and Rössen. A few hundred years later, the Funnel Beaker (sometimes called, in German, the TRB or Trichterbecher culture) and Tiszapolgár cultures made their appearance. The disappearance of the Lengyel and Rössen cultures, however, does not mean that local populations were replaced or eliminated. Archaeologists have subdivided these cultures into various phases and regional groups. For example, the Funnel Beaker culture in eastern Germany comprises the Baalberge, Salzmünde, Walternienburg, and Bernburg groups. In north-central Poland, the Lengyel-type culture is called the Brześć Kujawski group.

Remains of the Lengyel culture are found in lower Austria, the Czech Republic, Slovakia, Poland, Hungary, and northern Croatia, but Funnel Beaker settlements were not limited to central Europe. They existed in Poland, the northwestern Ukraine, the Czech Republic, Slovakia, lower Austria, northern Germany, the Netherlands, Denmark, southern Sweden, and even, to a small extent, southern Norway. In central Europe the earliest Funnel Beaker material dates to c. 4300–4200 B.C., whereas Funnel Beaker settlements in Scandinavia (4100–4000 B.C.) represent the earliest Neolithic occupations in northern Europe. In the latter part of the fourth millennium B.C. different cultures, such as Globular Amphora (3100–2500 B.C.) and Baden (3500–2900 B.C.), start to dominate the central European landscape. Globular Amphora sites are present in eastern Germany, the Czech Republic, Poland, and northwestern Ukraine; Baden culture sites occur in Hungary, northwestern Romania,

B.C.	Southern Germany	Northern Germany	Southern Poland	Northern Poland
2000				
	Bell Beaker		Bell Beaker	
2500				
	Corded Ware	Corded Ware	Corded Ware	Corded Ware
3000				
		Globular Amphora	Globular Amphora	Globular Amphora
3500	Horgen		Baden	
4000		Funnel Beaker	Funnel Beaker	Funnel Beaker
	Michelsberg			
4500				
	Rössen		Lengyel	Lengyel
5000	Stroke Ornamented	Rössen	Stroke Ornamented	Stroke Ornamented
		Linear Pottery		Linear Pottery
5500	Linear Pottery		Linear Pottery	

Simplified chronological sequence for Germany and Poland.

Serbia, Slovakia, the Czech Republic, eastern Austria, and southern Poland.

A little later, around 3000–2900 B.C., the Corded Ware (also called Single Grave or Battle-Axe) culture spread over an enormous territory, from the Rhine in the west to the upper Volga in the east and from Finland to the Alps. By 2700 B.C. the Bell Beaker culture appeared in western and central Europe, but in some western European countries it is placed in the Early Bronze Age. In some regions of central Europe Late Neolithic cultures overlap geographically and chronologically with one another. For example, the late Lengyel was contemporaneous in northern Poland with the earliest Funnel Beaker.

MAJOR INNOVATIONS IN THE LATE NEOLITHIC

By 3500–3000 B.C. plows, wagons, copper metallurgy, horse riding, wool production, and the milking of cows, goats, and sheep were present in central Europe. These innovations had repercussions in economy, warfare, transportation, gender relations, and beliefs. When and where these numerous innovations first appeared is the subject of archaeological debate. Dairying may have occurred as early as 5000 B.C. Milk can be consumed sour, fermented, or processed into a wide variety of products, such as cheese; these products evade the problem of lactose intolerance, as little lactose remains in them. Domesticated horses were present in central Europe around 4000 B.C., and by 3500–3000 B.C. people were riding them. Horse riding gave people the ability to cover long distances in a relatively short period of time. Moreover, the riding of horses influenced warfare; riders could plunder or attack communities far away from home.

The first wagons appeared in central Europe around 3500 B.C. At Bronocice in Poland, a vessel incised with wagon motifs was found in a late Funnel Beaker culture pit, which was dated to 3400 B.C. (fig. 1). What was the function of the earliest oxen-pulled wagons? Besides their practical purposes, such as transporting harvested crops, fodder, and firewood, it has been suggested that they had ritual or religious purposes. The first use of simple plows occurred around 4000–3500 B.C., as is indicated by marks found under Funnel Beaker mounds. Even simple ox-drawn plows could turn the earth to a greater depth than could digging sticks, thereby enabling greater crop yields. The plow probably facilitated the expansion of farming from the zones of easily worked soils cultivated during the Early Neolithic. Plows and wagons also represented a labor-saving technology, making many tasks easier and faster. Copper mining and smelting were conducted in the Carpathians by 4500 B.C. The first copper artifacts were made by hammering smelted copper;

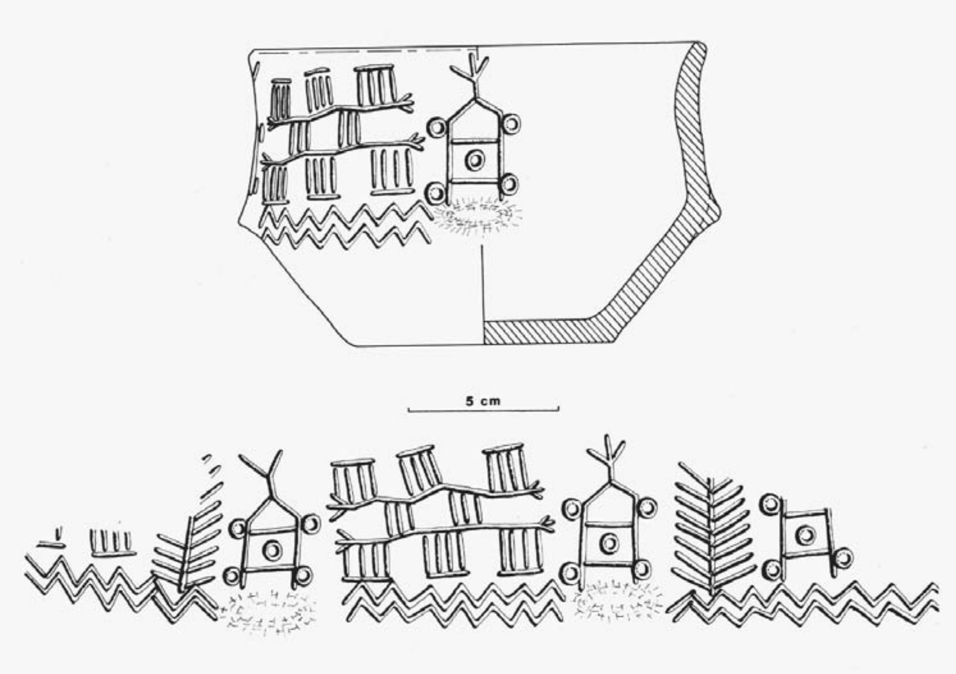

Fig. 1. Funnel Beaker vessel with a wagon motif, Bronocice, southeast Poland. COURTESY OF SARUNAS MILISAUSKAS. REPRODUCED BY PERMISSION.

later, the melted metal was cast into various forms, such as axes with shaft holes.

SETTLEMENT

Lengyel, Rössen, and Funnel Beaker settlement organization included large and small sites. Unlike those of the preceding Early Neolithic period, Lengyel settlements more frequently were located at higher elevations in Hungary, Slovakia, and the Czech Republic. Settlement systems in north-central Poland consisted of large residential sites with smaller satellite sites. Large Lengyel settlements, such as Zengövarkony in Hungary, Svodin and Žlkovce in Slovakia, Těšetice-Kyjovice in Moravia, and Friebritz and Falkenstein in Austria, range in size from 20 to 30 hectares. Smaller sites had areas of several hectares, for example, Nowa Huta in Poland. The Lengyel and Rössen peoples built trapezoidal longhouses and also rectangular structures. Longhouses were found at the Lengyel sites of Brześć Kujawski and Osłonki in Poland, Jelšovce in Slovakia, Postoloprty in the Czech Republic, and the Rössen site of Inden I in Germany. At Brześć Kujawski approximately fifty houses were excavated. The trapezoidal Lengyel houses range in length from 15 to 40 meters and in width from 6 to 10 meters. Longhouse construction and other domestic needs, such as firewood, required large quantities of wood.

Tiszapolgár culture (4500–4000 B.C.) sites typically are small, 0.5–1.0 hectares. The houses are likewise small, 5–6 meters in length. There is variation, however, in Funnel Beaker settlement patterns in the loess lands of central Europe and on the North European Plain. In southeastern Poland and northwestern Ukraine, small, medium, and large Funnel Beaker sites are found. Some Funnel Beaker settlements, such as Bronocice in Poland, grew in size and complexity. The large sites located at high elevations yield a great variety of archaeological materials and usually are spaced several kilometers from one another. It is possible that they politically dominated the smaller sites in the region. Funnel Beaker house sizes vary. In central Europe we find both large and small rectangular houses constructed of a framework of posts with mud-daubed walls.

Around 3500–3000 B.C. most large settlements disappeared in central Europe. Some archaeologists suggest that war and incursions of pastoralists from eastern Europe contributed to the collapse of large settlements, although local developments, such as ecological changes, also have been proposed. There is very little domestic architectural data from Globular Amphora, Corded Ware, and Bell Beaker sites, in contrast to the wealth of such information from Lengyel and Rössen sites. Most of our information about these cultures comes from burials. Seasonal Globular Amphora settlements were 0.1–0.5 hectares in area, whereas the rare permanent settlements had areas of 1.0 hectare or more and contained a few small square or trapezoidal houses, 10–55 square meters in area.

With the appearance of the Corded Ware culture (2900–2400 B.C.), mound burials started to dominate the landscape, and seasonal camps and rare permanent settlements are also found. Remains of rectangular wooden houses have been discovered in the Bay Coast (Haffküstenkulyur or Rzucewo) Group of the Corded Ware culture along the east Baltic coast, but for other groups we have very poor evidence for any structures. Archaeologists have long speculated about Globular Amphora and Corded Ware identities, using the stylistic attributes of pottery and stone tools to distinguish language and ethnic groups. Some archaeologists have equated these cultures with Indo-European–speaking peoples. Since cultural traits such as burial mounds, cord-ornamented pottery, and battle-axes occur in both the Corded Ware and the Pit Grave (Yamnaya) cultures, some archaeologists believe that the Corded Ware peoples were immigrant descendants from Pit Grave populations in southern Russia and Ukraine.

ECONOMY

Lengyel, Rössen, and Funnel Beaker peoples continued to practice a mixed farming economy based on cereals and domestic animals. More upland areas in the loess regions of central Europe were exploited for farming. Wheat was the most important cereal in the diet of Lengyel and Rössen populations, but garden plants, such as lentils and field peas, also were cultivated. The major domestic animals were cattle, pigs, and sheep and goats, but cattle predominate at most sites. People also kept domesticated dogs, and remains of domesticated horses occur after 4000 B.C. Fishing, hunting, and the collecting of wild plants, seeds, and nuts also were practiced. Wild plants were used for food, medicine, and basket making. At some Lengyel sites the bones of wild animals make up 50–60 percent of the faunal sample.

Such simple agriculture must have had its good and bad years, and in the latter years hunting and gathering may have meant the difference between survival and starvation. Wild game supplied the Late Neolithic people with meat as well as raw materials for tools, clothing, and ornaments. It is difficult to demonstrate the role that hunting played in gender and social relations. Possibly, men hunted large animals, such as aurochs, while both sexes and children hunted or snared small game and birds. The killing of aurochs gave the hunter greater prestige than the killing of roe deer.

The importance of herding animals was greater in the economies of the Globular Amphora, Baden, and Corded Ware cultures. Because archaeologists have found only a little settlement data at Globular Amphora and Corded Ware sites, they speculate that these cultures, possibly nomadic, depended chiefly on herds of domesticated animals. However, it is difficult to establish such pastoralism on the basis of archaeological finds. Globular Amphora and Corded Ware burials often contain the remains of domesticated animals, such as cattle and pigs. Since pigs are not herded animals, the high frequency of their finds in the Globular Amphora burials suggests a nonpastoral economy, assuming such frequencies reasonably reflect their day-to-day subsistence significance.

By 4000 B.C. large areas of central Europe had been cleared of forests. In some areas forest steppe environments developed, which may have encouraged more widespread herding of domestic animals. In central Europe cattle and sheep could have been pastured in the spring, summer, and fall, but they would have been stalled and fed during the winter. It is possible that seasonal movement of herds was practiced. Regional Corded Ware groups differed in their economic adaptations. In Switzerland they were mainly agriculturists, whereas along the eastern Baltic coast they depended heavily on seal hunting. In southern Poland they were transhumant herders.

TRADE

There was extensive exchange of raw materials, manufactured items, and ideas between various Late Neolithic communities. Not all communities were self-sufficient in raw materials, such as flint. For example, in central Europe, Jurassic flint from the Kraków area in Poland, flint from the vicinity of Rügen in Germany, banded flint from the Krzemionki Opatowskie region in Poland, and Świeciechów flint from the Annopol area in Poland were exchanged between the Funnel Beaker settlements. These flint varieties traveled hundreds of kilometers from their geological sources. Lengyel communities traded flint, stone, copper, shells, obsidian, and salt in briquettes, weighing 0.5–1.0 kilograms. Thus, trade allowed communities to obtain products that were not available locally.

Rivers likely were important as trade routes, since land travel was difficult. Copper ornaments, beads, spirals, and disks occur in Lengyel burials. Copper artifacts found in north-central Poland came from sources at least 500 kilometers away in the Carpathians. Such traded artifacts had little utilitarian purpose, but they may have displayed and justified the wealth or social standing of some individuals. Individuals and families did not accumulate them for generations; instead, many were deposited in burials.

FLINT MINING AND SALT EXPLOITATION

The human body requires salt, and it is assumed that the wild meat diets of Palaeolithic and Mesolithic groups supplied sufficient amounts. Reliance by Neolithic farmers on cereals with low salt content made it necessary to add salt to food. The earliest known exploitation of salt was carried out by the Lengyel people, who took it from springs, such as the ones in the Wieliczka region of southeastern Poland. The evidence consists of salt-making vessels and the results of chemical analyses of vessels for traces of salt. In the Saale valley of eastern Germany, some Late Neolithic sites have yielded vessels used in salt making.

The demand for flint products, such as axes for woodworking, warfare, and ritual activities, led to extensive mining of good flint sources, such as Kleinhems in Germany, Mauer in Austria, and Krzemionki Opatowskie in Poland. The latter site was one of the largest mines, producing the banded flint that Funnel Beaker peoples were the first to utilize. The peak period of flint mining here occurred during the Globular Amphora occupation. Approximately a thousand shafts, 4–11 meters deep, extended through an area 4 kilometers long by 30–120 meters wide. Mining tools, such as antler picks and stone hammers, were found in this area. Thousands of flint axes and chisels were produced here. The frequent occurrence of banded flint axes in Globular Amphora burials indicates not only their utilitarian application but also their importance as symbols in the belief system and their value as goods in the social system. Banded flint axes were distributed by exchange as far away as 600 kilometers from Krzemionki Opatowskie.

WARFARE

Evidence for Late Neolithic warfare includes such artifacts as arrowheads and battle-axes, skeletal material bearing signs of inflicted wounds, and fortified settlements. There is more evidence for conflict during this period, since V-section ditches and palisades surrounded numerous settlements, although not all such enclosures were constructed only for defense purposes. Many were multifunctional; they also were used for rituals and ceremonials as well as the keeping of domestic animals. Some sites, such as the one at Makrotřasy in the Czech Republic, may have had astronomical significance.

The construction of enclosures indicates that households and communities cooperated in communal labor. Ditches at Lengyel sites, such as Hluboké Mašůvky in the Czech Republic, Žlkovce in Slovakia, and Falkenstein and Wetzleindorf in Austria, enclosed large areas, 5–12 hectares. In Slovakia and the Czech Republic most fortifications were located within settlements. The extremely large enclosed area, 30 hectares, at Svodin in Slovakia, contained two fortifications belonging to different occupations, while the houses were outside the enclosure.

Burial data suggest that it was men who were involved in fighting. Antler axes and arrowheads, which could have been used as weapons, usually are associated with men's burials, as at Brześć Kujawski in Poland. The hypothesized herding economy of the Corded Ware culture (2900–2400 B.C.) and the presence of battle-axes at their sites are interpreted as evidence for warfare. Herded animals are a mobile resource, and they would have been relatively easy to steal. Cattle raiding may have caused a warlike value system to develop at this time.

MORTUARY DATA

The Late Neolithic burial patterns varied widely. The Lengyel, Rössen, and Tiszapolgár peoples buried their dead in cemeteries or in and around their settlements. Lengyel cemeteries were found at Zengövárkony in Hungary, Svodin in Slovakia, and Aszód in Hungary. At Svodin 161 graves were excavated. In other regions, such as Kujavia in Poland, Lengyel burials containing men, women, and children were dispersed within settlements. Ancestors continued to live symbolically in the same settlement, never separated from the living. Most of the dead were buried in flexed positions in pits, with the skeleton oriented east-west, and most graves held a single person. When double burials are found they usually contain a woman and a child. Cremations are rare.

The Funnel Beaker peoples practiced different burial rites. Impressive tombs occur in northern Germany and northern Poland, reminding one of the megalithic tradition. Funnel Beaker burial mounds of the Kujavian type in northern Poland were constructed of stone and earth, with a trapezoidal ground plan and range of 25–150 meters in length, 4–10 meters in width at the broader end, and 3–5 meters in width at the narrower end. Large stones were placed around the perimeter of these mounds, which usually held one or two people. Men and women typically received different mortuary treatment. At the Tiszapolgár cemetery men were buried with flint tools, weapons, and copper tools, and their burials were richer than those of women were. Pottery was associated mainly with women.

There is considerable variation in Globular Amphora burial practices. The most characteristic burials are stone cist graves, 2.5–6.0 meters long and 1.0–2.0 meters wide, dug into the ground with mounds of stone and earth erected over them. There also are graves without stone construction and some lined with wood. In northern Germany existing Funnel Beaker megalithic structures frequently were used for burials. The dead were buried in a contracted position, generally no more than five people to one grave. Completely articulated skeletons are rare; disarticulated individuals are common. It may be that the recently deceased were placed in trees or on scaffolds, and only when the flesh had been removed or had decayed were they interred. The most common grave goods are pottery vessels, flint axes, and animal remains, especially the lower jaws of wild or domesticated pigs.

Corded Ware mortuary sites include mounds and flat (moundless) graves. Some of the flat graves originally may have had mounds that were subsequently destroyed by historic farming activity. A pit would have been dug into the ground and a mound of dirt piled above it. This mound most frequently contained a single skeleton in a contracted position. The builders of Corded Ware mounds emphasized their location in the landscape by selecting the highest local elevations. They presumably stood as symbols of death rituals for many years. Mounds also could have symbolized a community's claim to a landscape or the higher social status of the persons interred in them.

HEALTH AND PALAEOPATHOLOGY

Palaeopathological studies of human skeletons have supplied information about diseases, anomalies, and degenerative processes. At the Tiszapolgár cemetery in Hungary, some skeletons had the following diseases, pathological conditions, and injuries: paralysis of arms, deformation of the skull, osteoporosis, neurosis of the spinal cord, fractures of the spine, head wounds, brain tumors, stiff spine, and arthritis. Among the Tiszapolgár people many disabled or diseased adults survived only through the help of their fellows. Life expectancy of the Tiszapolgár people was roughly thirty years. Of the fifty-four people assigned to the early phase at the Tiszapolgár cemetery, ten had an estimated age of fifty or more; thus a person had an 18.5 percent chance of surviving to age fifty. Half of the children died by the age of twelve. The length of extended adult skeletons averaged 170 centimeters for males and 160 centimeters for females, but the stature of living individuals probably was several centimeters greater.

RITUAL

Most information about ritual behavior is derived from human and animal figurines, anthropomorphic and zoomorphic pottery, burials, and structures that could have served sacred purposes. All Late Neolithic cultures performed various burial rituals. Fired clay figurines, especially of women, are often considered to have been used in rituals. There are many interpretations of figurines. They have been considered educational aids, representations of people or ancestral figures, dolls, or vehicles of healing and magical powers. Human and animal figurines are not numerous in north-central Europe; they are more prevalent in southern regions, such as Hungary.

There are two types of early Lengyel vessels that could have been used in rituals. The first depicted animals and humans figuratively; the second incorporated representations of body parts, such as the nose, on the outer surface of the vessel. Lengyel sites known as rondels, that is, circular ditched enclosures with openings at four opposing points, probably were used for ceremonials. Most information on Globular Amphora and Corded Ware ritual comes from burials. The numerous pig bones in Globular Amphora burials suggest that animals played an important role in mortuary rituals or feasts. Cattle burials also are associated with the Globular Amphora and Baden cultures. These burials may reflect the importance of domestic animals in economy and rituals and as symbols of wealth and social prestige. The drinking of alcoholic beverages, such as beer and mead (produced by fermenting honey and water), probably occurred during ritual activities. Baden pottery types, represented in cups, beakers, and other vessels with handles, reflect the increasing diversity of beverages consumed.

See also **Long Barrow Cemeteries in Neolithic Europe** (*vol. 1, part 3*); **Brześć Kujawski** (*vol. 1, part 4*); **Rondels of the Carpathians** (*vol. 1, part 4*); **Corded Ware from East to West** (*vol. 1, part 4*).

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SARUNAS MILISAUSKAS

BRZEŚĆ KUJAWSKI

Brześć Kujawski (pronounced "brzheshch koo-YAV-sky") is one of several large Neolithic settlements that flourished between about 4500 and 4000 B.C. on the lowlands of north-central Poland. The settlements are found primarily in the region known as Kujavia located to the west of the Vistula River, an area of low, rolling terrain with many streams, lakes, and marshes. Brześć Kujawski and similar sites are important because they represent the first large agricultural settlements on the lowlands of northern Europe and for their presence on the frontier between farming societies to the south and the foraging peoples to the north.

Agriculture had come to Kujavia a thousand years earlier, as indicated by the appearance of settlements of the Linear Pottery culture, but it developed very slowly as the farmers adjusted to the new terrain and soils. The Linear Pottery settlements existed as small frontier outposts among the indigenous Mesolithic hunter-gatherers. After several centuries, large Neolithic settlements sprang up at Brześć Kujawski, Osłonki, Krusza Zamkowa, and several other locations about 4500 B.C. They clearly descended from Linear Pottery antecedents, but they belonged to a later Neolithic group known as the Lengyel culture, named after a site in Hungary. Even within the Lengyel culture, however, Brześć Kujawski and its neighbors are distinctive and are known as the "Brześć Kujawski Group."

The Neolithic settlement at Brześć Kujawski was discovered in 1933 by farmers digging gravel from deposits beneath their fields on a low ridge of land bordering Lake Smętowo. While digging, they found artifacts and skeletons. Luckily, an archaeologist named Konrad Jażdżewski (1908–1985) was working nearby, and when he learned of these discoveries he came to investigate. He immediately recognized that this was potentially an important find and began excavations. Over the next six years, he cleared the topsoil from more than 10,000 square meters, exposing one of the largest Neolithic settlements discovered before World War II.

Jażdżewski noticed that one of the most apparent Lengyel features at Brześć Kujawski was the long narrow trenches dug into the clay and gravel subsoil, sometimes reaching a meter or more below the surface. These trenches formed trapezoidal outlines 20 to 30 meters long, 5 to 6 meters wide at one end and 2 to 3 meters at the other. Clearly, these were structures of some sort because there were indications that the trenches had held upright posts. Among these trapezoidal enclosures were large pits with very irregular bottoms dug into the clay subsoil.

At the time, the prevailing belief was that Neolithic people lived in the pits, which were thought to have been roofed over with flimsy shelters. But what were the trapezoidal post structures? Archaeologists who had recently excavated Linear Pottery post structures at Köln-Lindenthal in Germany had proposed that they might have been barns or granaries. They could not imagine people living in them. But one of Jażdżewski's workers remarked that if he had to live in one of the muddy clay pits, he would break his legs slipping around in it. Jażdżewski concluded that the Lengyel timber structures at Brześć Kujawski really were Neolithic houses and that the pits served some other purpose.

Eventually this view prevailed, and archaeologists now know that the big pits in fact were the places where clay was dug for plastering the walls of houses built with timber posts set into foundation trenches. At Brześć Kujawski, more than fifty such houses have been found, both during Jażdżewski's excavations in the 1930s and during further excavations by Ryszard Grygiel and Peter Bogucki in the 1970s and 1980s. They are oriented along an axis running northwest-southeast, with the wide end toward the southeast. The reason for this orientation of the houses or for their trapezoidal shape is not clear. Many of their outlines overlap, indicating that they were built and rebuilt at different times. Burned clay plaster in the filling of the foundation trenches indicates that a number of the houses were destroyed by fire. The nearby clay pits were filled up with debris, animal bones, charred seeds, and artifacts like broken pieces of pottery. Other pits were used for storage or as the locations of workshops (fig. 1).

Scattered among the houses at Brześć Kujawski are also nearly sixty graves. Most graves contain skeletons that are in a crouched position with their arms drawn up to the chest. Males always lie on their right side and the females on their left, with their heads pointing toward the south or southeast. Archaeologists do not know the reason for this practice, but clearly it reflected an important fundamental belief. Accompanying the skeletons are artifacts. Many of the male graves have flint blades or axes made from large deer antlers, whereas female graves often contain copper ornaments, shell beads, and bone arm-rings.

The copper artifacts found at Brześć Kujawski and similar sites in Kujavia represent the earliest known use of copper in this part of Europe, around 4400 B.C. Although the source of the copper has not yet been established, it was probably either in the Alps or in the Balkans, hundreds of kilometers away. It was smelted and then hammered into ribbon, not cast. From the copper ribbon, metalworkers made beads, pendants, and head ornaments.

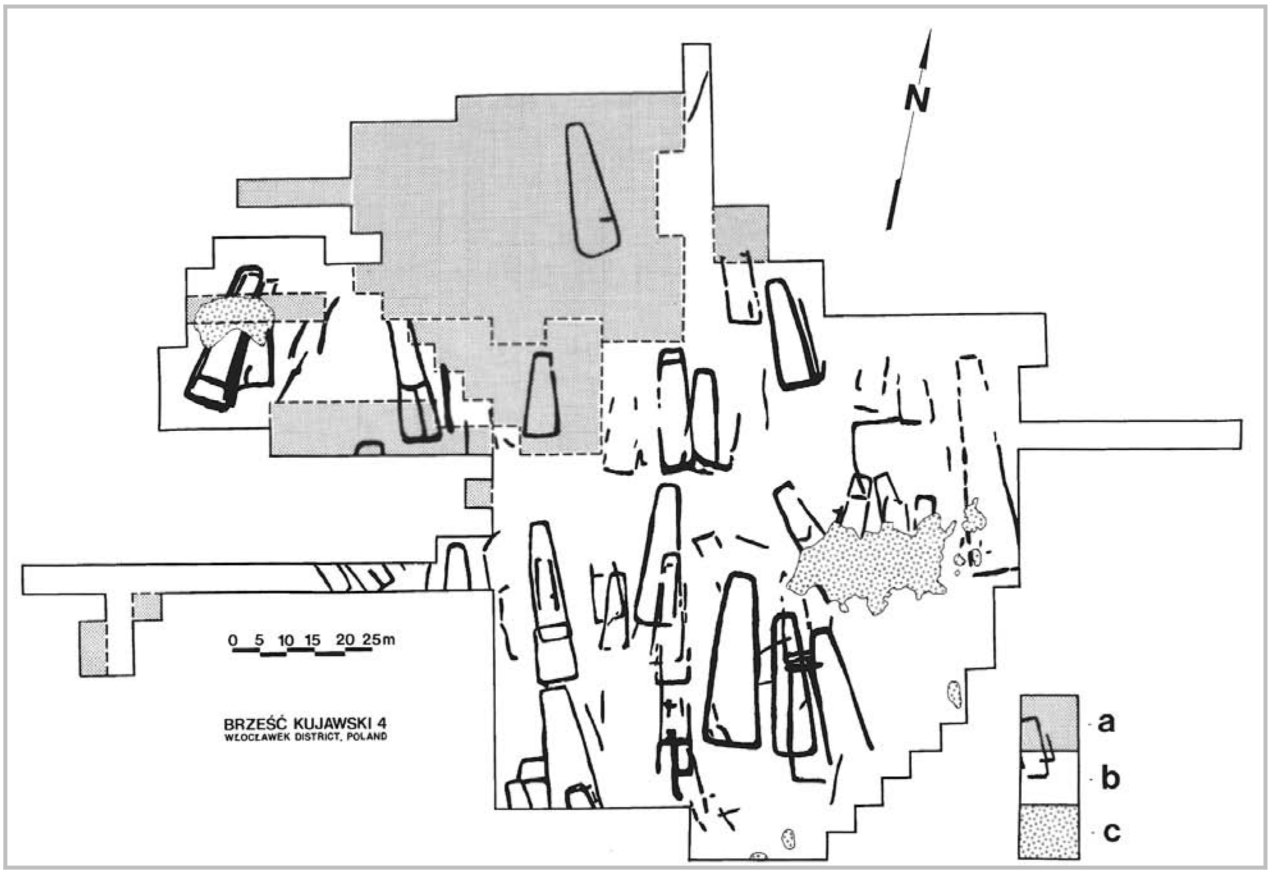

Fig. 1. Plan of excavated area at Brześć Kujawski, site 4, showing outlines of Neolithic longhouses. A = areas excavated, 1976–1984; B = areas excavated, 1933–1939; C = areas disturbed by gravel digging. COURTESY OF PETER BOGUCKI. REPRODUCED BY PERMISSION.

Some burials had lavish displays of copper, whereas others had none (fig. 2). After a short time, the copper supply was cut off, and the latest burials at Brześć Kujawski do not contain such ornaments.

The inhabitants of Brześć Kujawski and its neighboring settlements also acquired flint from sources more than 200 kilometers away in southern Poland. When they really needed a sharp edge they used "chocolate" flint (with a deep brown color) and Jurassic flint from these distant quarries. In addition, they made stone axes by grinding local stones into shape. Antler axes were made by breaking off the base of a thick beam of red deer antler, then grinding it to make an edge. Experiments done in Denmark indicate that such antler axes could have been used for cutting soft wood. It is also possible that they were used in the killing and butchering of livestock.

The rubbish deposits at Brześć Kujawski have yielded the bones of domestic cattle, sheep, goats, and pigs, along with the remains of wild animals like red deer, roe deer, wild horses, and beavers. Most of the bones belong to domestic livestock, while the wild animals appear to have been hunted only occasionally. The beavers were caught for their pelts. In addition, archaeologists have recovered the bones from fish like perch and pike, several types of waterfowl, and the shells of turtles. Carbonized grain is mostly emmer wheat.

About 10 kilometers west of Brześć Kujawski is the settlement of Osłonki (pronounced os-WON-key), excavated by Ryszard Grygiel and Peter Bogucki in 1989–1994. Like Brześć Kujawski, Osłonki is located on a low crest of land surrounded on three sides by water. In addition to thirty longhouses and eighty rich graves like those at Brześć

Fig. 2. Neolithic burials at Brześć Kujawski showing orientation of skeletons with heads toward the south-southeast. The larger skeleton of the male is lying on its right side, females on their left sides. COURTESY OF PETER BOGUCKI. REPRODUCED BY PERMISSION.

Kujawski, the excavators found traces of a substantial fortification ditch that protected the settlement on its side where there was not a natural water barrier. At the moment, no similar earthwork is known from a site of the Brześć Kujawski Group. Across a lake basin from Osłonki is another Neolithic settlement at Miechowice with additional graves and longhouses.

On the basis of the discoveries at the settlements of the Brześć Kujawski Group, researchers have been able to reconstruct the Neolithic society that flourished in this part of the North European Plain between 4500 and 4000 B.C. Each longhouse was occupied by a household whose members farmed, kept livestock, and hunted when the opportunity presented itself. The deceased inhabitants of each household were buried near the house, so it is clear that a sense of continuity across generations was important. Some households were able to acquire copper and flint from distant sources, thus demonstrating success in conducting their affairs, but such prestige was fleeting. The consistent orientation of the bodies in the graves reflects deeply held common values.

In the end, the intensive pattern of land use for farming, herding, and hunting that supported settlements like Brześć Kujawski and Osłonki was not sustainable, and these sites were abandoned. Instead of concentrations of houses occupied for a long period of time, subsequent inhabitants of this region spread themselves more widely across the landscape in shorter-lived settlements. Yet echoes of the Brześć Kujawski longhouses can be seen in the trapezoidal shape of the Kujavian long barrows of the Funnel Beaker culture built between 3900 and 3400 B.C.

See also **First Farmers of Central Europe** (*vol. 1, part 3*); **Long Barrow Cemeteries in Neolithic Europe** (*vol. 1, part 3*); **Late Neolithic/Copper Age Central Europe** (*vol. 1, part 4*); **Consequences of Farming in Southern Scandinavia** (*vol. 1, part 4*).

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PETER BOGUCKI

RONDELS OF THE CARPATHIANS

The rondels—earthworks comprising very formal, circular arrangements of banks, ditches, and timber palisades—remain the most enigmatic structures of the central European Neolithic. The first such enclosure was discovered at Krpy, in Bohemia, in 1885 but it was not until the late 1970s, mainly through excavations in Moravia and Slovakia, that rondels were recognized as an important class of Middle Neolithic site. Most of these sites are known from aerial reconnaissance, with only a handful having been excavated. Their limited distribution, a relatively narrow horizon of use, and rather enigmatic evidence about their function all ensure that the rondels continue to be the subject of heated debate.

The distribution of the rondels is one of their curious features; they are found in a relatively small area of central Europe, from Bavaria in the west to Slovakia in the east, with just a few outliers known in Hungary. Apart from several Bavarian examples, most of the rondels lie to the north of that very important prehistoric communication route, the River Danube.

However, this known distribution is changing dramatically. The political changes of the late 1980s in central Europe have permitted aerial reconnaissance of previously unexplored areas. An intensive flying program in Saxony, for example, has identified many new rondels, extending their distribution farther to the north; many more sites may well come to light in the future.

Examples excavated by the end of the twentieth century suggested that rondels were built and used for a very short period. They are associated with the Late *Stichbandkeramik* IVa–Lengyel Ia–Oberlauterbach cultural groups. The available radiocarbon dates fall between 4800 and 4500 B.C., with the majority centering on 4700 B.C. Thus the phenomenon seems to have had a very brief existence, lasting perhaps barely more than a century and a half and involving only a few generations.

The ditches are arranged concentrically and vary in number from one to five (fig. 1). In the classic form there are four opposed narrow entrances that tend to be oriented on the cardinal points. Often there are concentric timber palisades within, or occasionally outside, the ditches, which respect the arrangement of other features. It is this very formal circular layout that, although differing in detail from one site to the next, nevertheless seems to adhere to a preconceived overall plan and thus distinguishes the rondels from other earlier and later Neolithic enclosures.

The ditches were V-shaped in section, up to 5 meters deep and 8 meters wide. Sometimes they were re-cut: segments of ditches near the entrances at Künzing-Unternberg, in Bavaria, were renewed four times (on four separate occasions). But generally the ditches were filled up quickly, with the profiles displaying characteristic thin bands of dark and light soil. The poverty of cultural materials further confirms that the ditches stood open for only a brief time.

The ditch circuit usually has four openings allowing access to the interior. Sometimes the entrances are formalized by the turning of the ditch terminals outward (Svodín and Bučany in Slovakia, Bylany in Bohemia) or inward (Hornsburg 3 in Austria); occasionally the terminals join the outer and the inner ditch together (Kothingeichendorf and Künzing-Unternberg in Bavaria or Friebritz 2 in Austria). They may be narrowed further by means of palisades, creating a clearly focused passageway to the interior. The timber palisades, usually one or two in number, follow the circular shape defined by the ditches, delimiting a similar but smaller area inside. Palisades have also been encountered outside the ditches (Těšetice-Kyjovice in Moravia).

Few features in the interior of the rondels can be associated with their use. The traces of a small rectangular building at Bučany, Slovakia, are quite

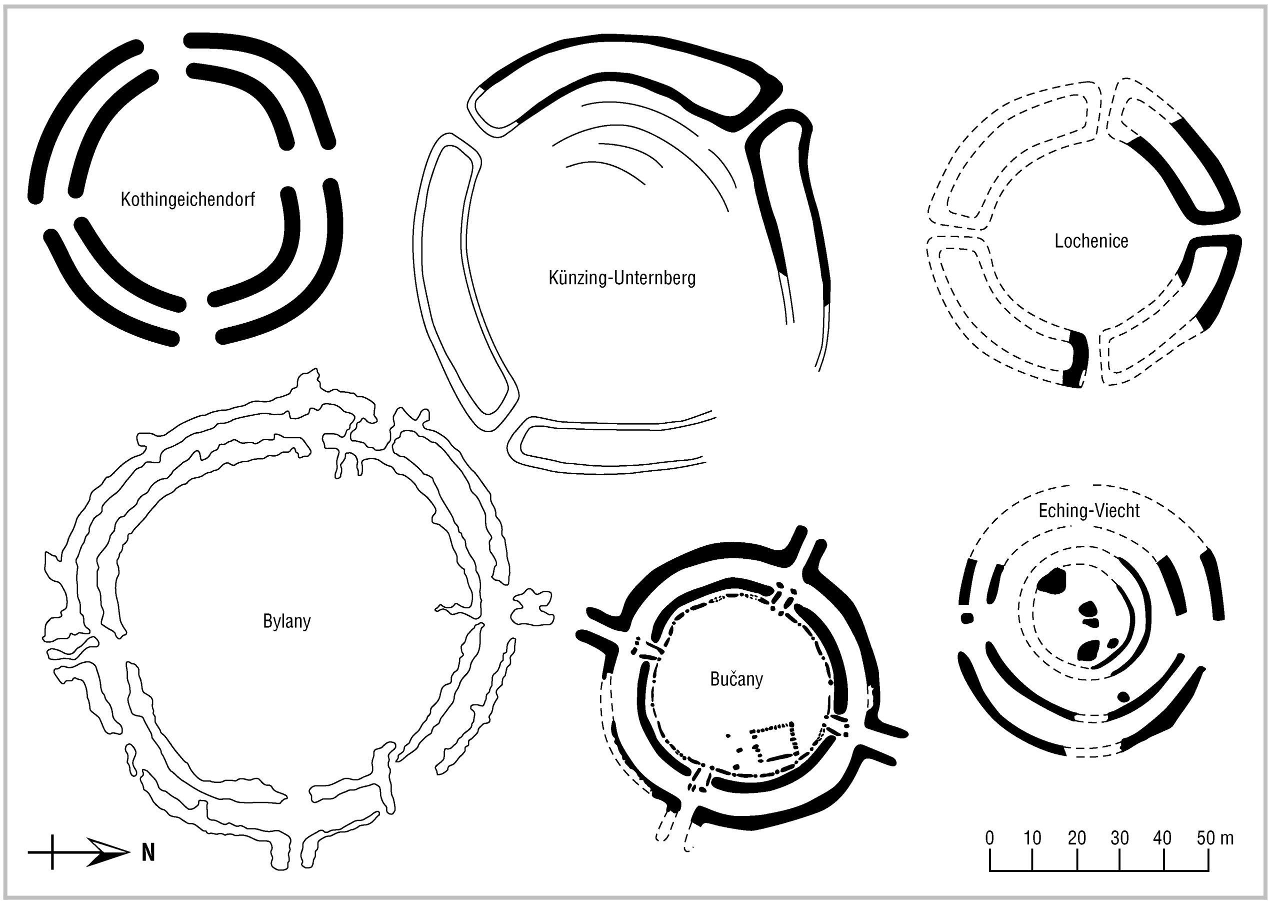

Fig. 1. Plans of rondels from the Middle and Upper Danube area. ADAPTED FROM PODBORSKÝ 1988.

exceptional. At Bylany, Bohemia, there were several carefully constructed pits, which may represent graves or places of special offering. Similar features were found at Těšetice-Kyjovice, Moravia, where one pit contained fragments of painted pottery and a human skull. Generally, however, the interiors of the rondels seem to be free of other contemporary structures.

Attempts at classification of the rondels have included the number of ditches (single-, double-, and multiple-ditched enclosure), the geometry of the layout (from circular to flattened), and the number and construction of entrances. The size seems to be an important factor as it may not only indicate the number of people allowed into the interior but, more significantly, reflect the manpower that communities could muster in order to carry out the construction.

Some archaeologists have argued that rondels are defensive in nature and that the ditches and palisades should be seen as features of fortification; the Slovakian rondels, for example, have been interpreted as fortified settlements by J. Pavúk. But although many rondel enclosures were, indeed, located in areas that were settled, there is no evidence of any contemporary settlement within the enclosures themselves. The possible presence of one building inside the Bučany rondel is hardly sufficient to interpret it as a defensive settlement. Similarly, settlement traces to the outside of the enclosing ditches (at Svodín in Slovakia, Těšetice-Kyjovice in Moravia, and, at a somewhat greater distance, at Bylany in Bohemia) are not suggestive of defenses.

Effectively, there is little archaeological evidence that could indicate the rondels' function. The purpose of digging ditches and piling up earthen banks to enclose a small area of the open landscape may appear difficult to comprehend to the modern mind. It is perhaps for this reason that most scholars tend to lean toward interpretations involving cult and ritual activities. That these sites do not appear to have been maintained after their initial construction, but rather were allowed to become ruined, suggests that it was the construction rather than any prolonged activities in the interior that may have been of primary importance. Indeed, on a number of sites, a new rondel was built either on the same spot (Svodín) or very close by (Bylany), as if to emphasize the importance of engaging in further construction.

The short duration of this phenomenon—a century and a half at the most—as well as its clearly limited cultural associations suggest that the creation of the rondels was a response to the very specific needs faced at that time by the communities within the Carpathian Basin. Such needs could have been economic, social, political, or possibly even environmental, or a combination of all these factors. Within the cult and ceremonial sphere, arguments range from some sort of environmental catastrophe that necessitated the monitoring of meteorological and astronomical events, via the creation of communal centers devoted to ceremonies of thanksgiving for prosperous societies, to an increased need for previously dispersed communities to come together, at least for communal and ritual purposes.

See also **Bylany** (*vol. 1, part 3*).

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MAGDALENA S. MIDGLEY

NEOLITHIC LAKE DWELLINGS IN THE ALPINE REGION

FOLLOWED BY FEATURE ESSAYS ON:

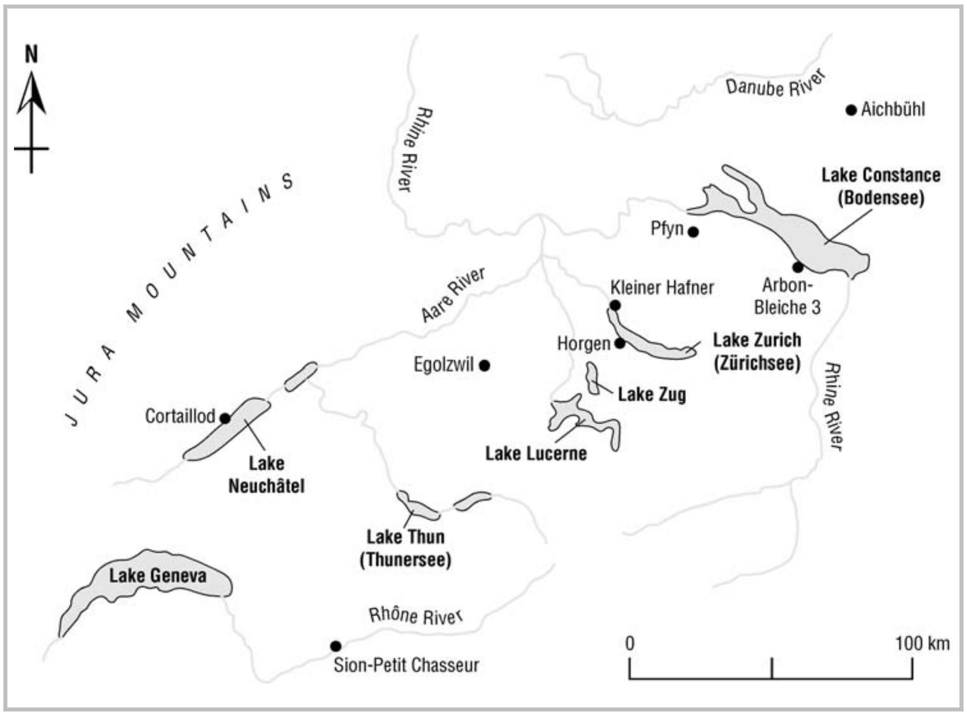
Neolithic lake dwellings of circum-alpine central Europe are found in Switzerland and southern Germany (mostly around Lake Constance), Bavaria, northeastern France, northern Italy, western Austria, Slovenia, Croatia, Albania, and Greece. These Neolithic and Bronze Age settlements, with their spectacularly preserved wooden and organic objects lying beneath the water table, are found near modern lakeshores or in peaty areas. Most of these Neolithic settlement layers are located in the Swiss midlands between the Jura mountain range and the Alps on the major lakes. Intensive highway and railroad construction between 1960 and 2000 in Switzerland, often along lakeshores or crossing peaty ground, brought to light many prehistoric settlements. Continuous development projects in big cities like Zurich, located on lakes, also resulted in the discovery of new lake dwelling sites.

What did these lake dwellings look like? Archaeologists can find an answer to this question by looking at modern waterside dwellings in Southeast Asia and West Africa, but these villages normally are situated along riverbanks, not by lakes. Most such houses are constructed on high wooden posts because of seasonal variations in river levels. This might be one of several reasons that prehistoric lake dwellings sometimes were built above the ground, although ground-level houses also existed. Each site is different, however, and unstable ground also might explain the use of these long posts to support dwellings.

DISTRIBUTION AND DATING

In Switzerland many sites came to light around the bigger lakes, among them, Lake Neuchâtel, Lac du Bienne, Lake Zurich, Lake Zug, and Lake Constance. Lakeshore settlements are less common around Lake Geneva. The reasons are not known, but differences in topography and environment as well as less survey work may be possible explanations. There also are lake dwellings around smaller lakes and in or near peat bogs.

The distribution of lake dwellings is determined largely by preservation, modern construction activities, and the intensity of survey work. Climatic conditions, prehistoric human impact, and the topographic situation are chiefly responsible for how eroded the sites are by lake action or the flow of rivers into the lakes. Because lake dwelling layers lie below the water table, there is no oxygen in the layers. Aerobic bacteria, which are responsible for decay, are thus scarce, and organic materials—such as fruits, seeds, leaves, wood, and even fragments of



Selected Neolithic lake dwellings in the Swiss Alpine region.

textiles—frequently are preserved. As with sites in dry sediments, animal bones, flint, or stone tools and ceramics also are present but in much better condition. Tools made from animal bones or from red deer antler, for example, are preserved with all their manufacture and use wear clearly visible (fig. 1).

Swiss Neolithic lake dwellings were built between 4300 B.C. and 2450 B.C. Because of differences in the conditions of preservation, certain time periods (e.g., 3800–3650 B.C.) are well documented with many sites, and other periods (e.g., 3600–3400 B.C. or 3370–3250 B.C.) have gaps, with no known sites, from several decades to more than 100 years. There probably were villages, but they were not preserved.

Owing to superb preservation and the fact that wood was the most widely used construction material, many wooden house construction elements, such as posts and planks, survive, allowing archaeologists to date the lake dwelling sites precisely. The dating method of dendrochronology exploits the fact that tree growth is influenced by unstable climatic conditions that change from year to year. Tree-ring thickness likewise varies every year. During the spring and summer of a year when the weather has been favorable, trees form a broad tree ring. In a year with unfavorable weather, trees form only a thin ring. The thickness of the tree rings can be measured, and thickness curves can be connected by comparison with sequences from trees of known date, starting with wood from a modern tree, continuing with a piece of wood from an old house, and ending with prehistoric wood (e.g., lake dwelling posts).

It is possible, in fact, to date oak in central Europe back as far as twelve thousand years. This method requires a piece of wood with a minimum of thirty tree rings and is most precise when the outermost tree ring is still present. With dendrochronological methods one can date the wood from lake dwellings to within a year or even a season (spring–summer or autumn–winter) of its cutting, even when settlements are 4,500–6,500 years old. Other dating methods, such as carbon 14 or typology, help researchers place these sites within a chronological context.

RESEARCH HISTORY

Written sources dating to the fifteenth century refer to the remains of old settlements in Swiss lakes.

Often the authors recognized the fields of posts when the water level of the lakes sank or the water was clear. Ferdinand Keller, president of the Antiquary Society in Zurich, examined many such finds, discovered by different Swiss lakesides during construction work. It was only in 1854, however, that he recognized that these wooden posts, animal bones, and other artifacts came from prehistoric settlements.

In the winter months of 1854 the water level in Lake Zurich was exceptionally low. People in the village of Obermeilen decided to build a wall to extend the land. Wooden posts, animal bones, and artifacts of stone, bone, and clay were unearthed. A local teacher, Johannes Aeppli, collected the finds and presented them to Keller, who realized that they must be from a prehistoric settlement. Keller first published these discoveries in a newspaper on 17 March 1854. The discoveries and their publication garnered worldwide interest. Subsequently, finds from these prehistoric settlements are in museum collections around the world.

In the following years there were many more excavations of lake dwellings. From analogy with ethnographic examples from Southeast Asia, Keller interpreted the fields of excavated posts as construction elements of house platforms. Today it is known that these fields are composed of posts from several settlement layers. Dendrochronological dating permits archaeologists to discover which posts belong together as individual houses. The findings from these wooden construction elements, along with various artifacts and plant and animal remains, have all been detailed. Ludwig Rütimeyer identified and published information concerning animal bones from several lake dwellings, and Oswald Heer did the same for plant remains. Even with what is known today, and despite the imprecise dating of the finds, both scientists published accurate identifications of these remains and interpreted them in stimulating ways. Thus began a long and venerable tradition of archaeozoological and archaeobotanical research in Switzerland.

Fig. 1. Antler axe in situ, 3384–3370 B.C. Arbon-Bleiche 3, Thurgau, Switzerland. AMT FÜR ARCHÄOLOGIE DES KANTONS THURGAU, FRAUENFELD, SWITZERLAND.

EXCAVATIONS

The stratigraphy or "cultural layers" of lake dwelling settlements have a dark brown color that comes from the plant remains they contain and stains even the animal bones. If there are several cultural layers preserved at one site, they usually are separated by naturally deposited white lake sediments, the so-called lake marl. Stratigraphic profiles typically display mixed deposition, with dark brownish cultural layers and white natural layers. The lake marl was deposited when the lake levels rose and covered the villages by more than 1–2 meters.

Wooden posts or postholes where posts were removed can be seen in the cultural layers. Dendrochronological samples are taken from each extant post. When the dates and position of each post are determined, individual houses can be reconstructed from the confusing mass of posts. During excavation the location of each artifact is recorded, making it possible to reconstruct special activity or storage areas. The animal bones and normal kitchen and food refuse are collected by square meter or even smaller units, allowing archaeozoologists to detect possible differences in diet between households. All botanical remains cannot be collected, so they are sampled. These soil samples are wet-sieved through varying mesh sizes to separate the remains into units of different size. These sub-samples contain botanical remains as well as bones from fish, amphibians, reptiles, birds, small and large mammals, and even the remains of insects. Identification of all these organic remains helps archaeologists reconstruct the diet of the inhabitants and tells something about agricultural practices and the environment.

LIFE IN THE NEOLITHIC ALPINE REGION

Environment. During the fifth and fourth millennia B.C. the Swiss alpine foreland was covered by forest, with only small, naturally open areas. The settlers needed to clear forest to create fields for cultivation. At first, these arable fields were small. The densely forested landscape could not support large herds of domestic animals. It is thought that in summer, cattle must have been led into the forest for grazing, whereas in winter people collected and stored leaf fodder for them. It is likely that in winter the animals grazed around the settlements and ate winter fodder, such as fern leaves, blackberry leaves, and catkins (as analyses of their excrement show). These limited food supplies would have kept herd sizes small, however. As the human population grew, bigger fields were needed, and the human impact on the environment became more profound. From about 3000 B.C. more remains of plants from open fields are present in soil samples taken from settlements. Bones of birds and mammals, such as hare, typical of open landscapes, become more numerous in the faunal assemblages. Because the landscape around the villages was used more intensively, wild animals, such as aurochs or moose, were driven out of their habitats and become rarer in the excavated material.

Human activities also gradually altered the lakeshore area. Continuous clearing resulted in larger areas of open landscape, so that rain eroded soil, causing more minerals to flow into the lakes. Together with all the waste from the villages, the lake waters slowly became more eutrophic. This process can be traced from around 3500 B.C. in the reed belts bordering the lakeshores. These reed belts created special habitats for water birds and a haven for big pike. With the opening up of the landscape for more arable lands and fields at the end of the Neolithic lake dwelling period, increasing numbers of domestic animals, especially cattle, could be kept. Thus, after 3400 B.C., wooden wheels and carts started to be employed at these settlements.

Villages and Houses. The lake dwelling villages of the alpine foreland were constructed on a soft, porous ground surface of lake marl near the lakeshores. Deep-sunk posts were needed to stabilize the houses. Normally, wall and roof construction was separated from the construction of the floors. Different kinds of posts and post sizes and distinct types of wood were used in various parts of the dwellings. Because the ground was soft, the floors had to be rebuilt every four to five years and the wall posts renewed. This explains the presence of postholes without posts.

Smaller posts and planks between the main upright posts were used to construct the walls. Thin hazel withes were woven between the smaller "posts," and clay was smeared over the wall to fill in gaps. Some roof shingles were made of white fir. Most of these houses were 6 to 12 meters long and 3 to 6 meters wide. Some houses were divided into two rooms, one large room with a fireplace and a smaller one. Clay ovens also were built. It is thought that the roof spaces were used as sleeping and storage areas.

About every ten years these houses needed to be renewed or rebuilt. The dendrochronological dates reveal that the life span of a village, as elsewhere in the Neolithic world, would have been ten to thirty years. Houses stood in two or more rows and typically were oriented with their shorter sides facing the water. The distances between the long sides of the houses were very small. Villages of various sizes, ranging from 500 to 10,000 square meters, are characteristic of the third and fourth millennia B.C. There could have been villages with only six to ten houses but also villages with as many as one hundred houses. If six to eight persons occupied each house, populations may have ranged from fifty to eight hundred people. Larger villages tended to become more numerous over time as the population grew until the end of the Neolithic, with ever more intense human impact on the environment.

Vessels. The house was the center for large families of several generations. Cooking was carried out at the fireplace, where pots of cereals, herbs, meat, or fish cooked with herbs for several hours. The pots were large, up to 40 centimeters high and 20–25 centimeters in diameter. The form of the pot depended on the cultural traditions of the village. For example, in Mediterranean-influenced cultures, such as the Cortaillod culture (elsewhere known as the Lagozza culture in Italy and Chassey culture), the bases of pots were rounded. In eastern-influenced cultures, like the Pfyn culture (3800–3500 B.C.), pot bases were flat. There were many variants, among them, tall ceramic forms and flat vessels, also used for food storage. Whole pots containing charred cereals have been found in some houses. Most of the harvested grains probably were stored in such vessels. The few other pot types include beakers, jugs, and miniature cups. From five to twenty ceramic vessels were used in each dwelling.

Until the period of the Corded Ware culture (2750–2400 B.C.) toward the end of the Neolithic, ceramics were more or less undecorated. There are, however, differences between vessels produced in the eastern part of the Corded Ware culture distribution area and the western part. Vessel forms varied. The impressed cord used to decorate these pots had a Z twist in the west and an S twist in the east. Many wooden vessels also were made, in particular, flat forms, beakers, and spoons, mostly of ash and elder.

Tools and Raw Materials. An assortment of implements was needed in each house. The most frequently encountered tools are those made from animal bones or red deer antler. Before bronze came into common use, bone and antler represented the "plastic" of the Neolithic period. Different types of awls were employed to work leather and to weave textiles or basketry. Other bone or antler points were used as arrowheads or to catch fish. Bone chisels could be used to manufacture objects from wood, bark, or even softened antler. One important bone tool, employed at these settlements between 3700 and 2700 B.C., was a special type of comb made of several halved and pointed ribs from cattle or red deer, used to separate linen fibers.

Axes or adzes were indispensable for all work at this time. The fact that all parts of lake dwelling houses were built with wood underscores the importance of these tools. Clearing arable land necessitated felling trees, which likewise required axes and adzes. Antler was the raw material used to make sleeves. The production of the wooden handles and stone blades was very time consuming and finding the appropriate raw materials was also not very easy. This made the handle and axe blade valuable. Easily manufactured antler sleeves acted as protection, absorbing part of the shock of the axe bows during use. Their use marks an important technical innovation in this period.

Antler, bone, and especially teeth also were important raw materials for making ornaments. Tusks from male wild boars were formed into pendants that reflected both the elegance and courage of the hunter. The canines and metapodial bones of dogs, wolves, and bears were perforated and used to make finery. So-called green stone was the raw material used in the production of groundstone blades as well as chisels. Flint was used to knap knifes, sickles, scrapers, or arrowheads. The distribution of all these artifacts, debris from their manufacture, and half-finished bits and pieces show that these tools were produced in every household. Only from 3100 B.C. is there evidence for specialized production of tools, such as like grondstone celt blades.

Special melting pots and copper objects, such as celts and jewelry, show that from 3900 B.C. copper was produced locally and used just in eastern Switzerland. Only from the later fourth millennium can copper be found anywhere in Switzerland. Ötzi, the famous Iceman, who lived in about 3200 B.C., carried an axe with a copper blade. Finds of linen, spindle whorls, and loom weights show that textiles were woven in these villages, and evidence points to specialized linen textile production from 3100 B.C.

Nutrition. When the climate was good the lake dwellers' diet was based on plants, mainly cereals, comprising 60–70 percent of all consumed calories. The remainder of the calorie intake came from mammal and fish meat as well as milk and milk products. The diet also varied depending on the season. Most vitamins were consumed between late spring and autumn. In the winter vitamins were provided by stored nuts and dried fruit. When the climate deteriorated, people became more reliant on hunted meat and fish as well as nuts and wild fruit. When the bad conditions were prolonged, the inhabitants of the lake dwellings may even have starved.

Analyses of the few available human skeletons, and especially human excrement, provide some clue to the health of these people. They certainly suffered from parasites, the eggs of which have been found in their excrement. Eggs of tapeworms show that raw fish was consumed. Between famine and illness, it is clear that the inhabitants of the lake dwelling settlements did not enjoy perfect health.

All Neolithic lake dwelling settlements contain rich assemblages of wild and domestic mammals or fish as well as remains of collected and cultivated plants. Why did these people need to hunt and gather in combination with subsistence food production? The proportions of wild and domestic animal bones and plant remains found at the settlements has varied through time, and these variations were not related to cultural changes but rather to climatic fluctuations. Long-term deterioration in the climate led to bad cereal harvests. Because cereals contain many more calories than meat, they were much more important in terms of nutrition. If a harvest was bad, fewer calories were produced. People therefore sometimes were forced to hunt and to collect more to complement their diets. The proportion of wild animal bones found at the sites increases parallel with poor climatic conditions.

Cereals and Other Plants. In the fourth millennium B.C. a naked wheat (macaroni wheat) and six-row barley were the main cereals grown in the northern alpine foreland. Beginning around 3400 B.C. hulled emmer wheat became increasingly common, replacing naked wheat in the early third millennium B.C. There also were regional specialties in cereal growing. In some parts of western Switzerland, einkorn was eaten. The cereals were threshed inside the villages, as large amounts of chaff and pollen in the cultural layers testify. Cereals were consumed either as bread or as a component of "hot-pot" meals. An entire loaf of carbonized bread from the fourth millennium B.C. was found in Twann. Cereal grains often are visible in carbonized crusts found on the inside of pottery sherds together with microscopic fragments of cereal bran.

Flax and opium poppy were cultivated widely. Whereas opium poppy appeared in quantity at the beginning of the lake dwelling period, flax became more important from around 3600 B.C. onward. Flaxseeds were consumed as food and the stem made into fibers for linen textiles. We do not know how the poppy flower itself was used. Only the seeds are found in large numbers, with the capsules absent. Perhaps the poppy was put to medicinal purposes, although the oil-rich seeds also could have been eaten. Legumes are astonishingly rare, with only peas found in small quantities.

Wild plant remains occur in very large amounts on these sites. The most important of these plants collected for the diet of the lake dwellers, especially in terms of calories, was the hazelnut. Acorns had some importance as well, and apples also were widespread. The gathered wild apples were cut in half with bone knifes and then dried. Stocks of such apple halves have been found in burnt layers. Other seasonally available fruits were collected, including blackberries, raspberries, wild strawberries, and sloes. Almost every plant brought into the settlements could be used for some purpose, whether for food, medicine, dye, or animal fodder.

Domestic and Wild Animals. As elsewhere in Neolithic Europe, cattle, sheep, goats, pigs, and dogs were kept. It is possible that the domestic horse was introduced during the period of the Corded Ware culture (around 2700 B.C.). Until about 3900 B.C., when the human population was still small and the forest cover dense, sheep, goats, and pigs were more economically significant than cattle. Afterward, until 3400 B.C., cattle became more important, although the population density of domestic animals still was not very high. Only from 3400 B.C. did pig numbers start to grow. More open landscape from about 2800 B.C. encouraged increases in the numbers of the domestic species, especially cattle. Chemical analyses of residues in pots show that from 3400 B.C. cow's milk was consumed. From this time forward, cattle also gained importance as draft animals. Sheep began to be exploited for their wool after 2700 B.C. With the appearance of wool textiles, buttons and needles made from bone or antler also became more common. Sheep grew larger and were slaughtered older if they came from wool-producing herds.

The most important game animal during all prehistoric periods in Switzerland was the red deer.

It was exploited for meat, antlers, and its skin. During times of climate deterioration, up to 80 percent of the mammal bones found at lake dwelling sites may have come from red deer. During the thirty-seventh century B.C. the poor weather lasted for several decades. Intensive red deer hunting, in fact, may have wiped out the population in the region of Zurich for several years.

Roe deer, wild boar, fox, wolf, bear, and beaver were hunted regularly. Less common are bones from aurochs, European bison, moose, chamois, ibex, and smaller fur-bearing animals. Bird bones are still more rare, even in the sieved samples, perhaps because they were eaten where they were caught. Frog bones, however, frequently appear in sieved soil samples. It is not surprising, given the lakeside location of these settlements, that fish played an important role in the diet of these Neolithic villagers. The presence of their bones in soil samples and the finding of such artifacts as nets, hooks, and harpoons confirm their importance in the diet. Pike were caught by the shore, and other species were fished from dugout canoes in open water.

Travel and Trade. The dense forests of Neolithic Switzerland were an obstacle to travel. The easiest way to move through the landscape was over water. Villages could communicate and trade easily with each other in the lake areas, with people traveling in dugout canoes (examples of which have been found). There also were contacts over longer distances. Thus, raw materials such as flint from northern Italy or eastern and central France or rock nodules for stone celts from southeastern France were traded to distant places. Another example of these far-flung contacts is the decorated clay vessels from Arbon-Bleiche 3, which are best known from sites of the Baden culture in Hungary, Slovakia, and Bohemia.

Social Class and Religion. The absence of special buildings and the equal size of houses suggest that there was no social differentiation at this time. Grave goods would give some indication of social diversity, but graves are not very numerous compared with the number of villages. During the fifth and fourth millennia B.C. people mostly buried their dead in stone cists, each containing several skeletons placed on their sides in a contracted position. There are also cists with only one person, such as one in Lenzburg, where a single, very tall man about thirty-five years old was interred. He was buried together with many special grave goods, including beads, pendants made from dog canines, bone tools, and a bow with arrows. His burial may be an example of a chieftain's grave. Unique Neolithic burial structures, such as the grave stele in Sion, come from later in the third millennium B.C., but normally all sepultures were collective. On the whole, the impression is of societies where differentiation possibly existed along age and gender lines but was not hierarchical.

The few Swiss Neolithic graves found contain grave goods showing that people believed in life after death. The fact that only a few graves have been located, compared with the overall number of settlements, shows that many people were buried in ways that left no trace. Did these individuals have other beliefs about what happens after death? Did they practice a different religion?

Symbolic life also was displayed in pendants. Were pendants that were made from dog canines or metapodials an expression of a particular belief? It is clear that agricultural societies, which were affected so strongly by the vagaries of weather, believed strongly in some kind of religion. Perhaps opium also was consumed as a drug among these peoples.

CONCLUSION

At the end of the Neolithic in Switzerland, prehistory once again loses its sharp focus for archaeologists. Almost no sites between 2400 and 1800 B.C. have been preserved. While Early and Late Bronze Age lake dwellings exist, sites from the Middle Bronze Age (1500–1250 B.C.) are missing. After 800 B.C. information comes only from dry sites, where organic materials are poorly preserved and dating is less exact. The Swiss lake dwellings are unique in the way that they open a window on the world of small farming and hunting societies in this region. Although we may never know what these people called themselves, we now have a much clearer idea of how they interacted with and exploited their environment.

See also **The Iceman** (*vol. 2, part 4*); **Arbon-Bleiche 3** (*vol. 2, part 4*); **Sion-Petit Chausseur** (*vol. 1, part 4*).

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THE ICEMAN

On 19 September 1991 a couple from Heidelberg, Germany, were hiking high in the Tirolean Alps when they spotted what turned out to be a desiccated, yellow-brown human body lying at an altitude of more than 3,200 meters (10,500 feet) by the Similaun glacier in the Ötztaler Alps. At first believed to be one of the modern corpses that occasionally come to light in these mountains, the Iceman, Similaun Man, or "Ötzi," as the body was nicknamed, proved to be the oldest fully preserved human that has so far come down from prehistory.

Contrary to popular belief, Ötzi is not a mummy but a naturally preserved body. It was not preserved in a glacier but rather seems to have undergone the same process as did the frozen mammoths of Siberia, in that the buildup of ice in the sediments enveloping the body caused its preservation: the ice layers desiccated the soil and dehydrated the corpse. Unlike freeze-drying, which leaves an object intact, this process shrivels the body. The corpse was excavated very crudely, using ski poles, ice picks, and a pneumatic hammer. Nobody had any idea of its age or importance. Damage was caused, particularly to the left hip. It then was taken to Universität Innsbruck (Innsbruck University), Austria, and the many objects and garments later found in the vicinity were taken to Mainz, Germany, to be preserved. Precise measurements at the spot where the body was found proved that it had been lying 93 meters (305 feet) inside the Italian border. For this reason, on 16 January 1998 Ötzi was transferred to a permanent home in the new Südtiroler Archäologiemuseum (South Tyrol Museum of Archaeology) in Bolzano, Italy, where he is displayed today in a chamber with constant humidity and a temperature of –6°C (21°F), along with all his restored equipment.

The first assessment was that the Iceman's axe had a bronze blade and that the Iceman himself probably was about 4,000 years old. Subsequent examination, however, showed that the metal was almost pure copper, and radiocarbon dating of the body, of grass from the garments, and of artifacts placed the Iceman at c. 5,350–5,100 years ago, the Copper Age (Late Neolithic) in this region. The immense importance of the Iceman is that, for the first time, researchers are presented with a time capsule: a figure from the remote past together with his everyday clothing and equipment. This is in stark contrast to the vast majority of prehistoric human remains, which are in the form of skeletons or ashes or which, even when buried or mummified, are accompanied by specially chosen clothing and objects. Of course, organic materials—from which most ancient artifacts were made—normally disintegrate through time and thus elude the archaeologist completely. The Iceman's well-preserved and frozen equipment and garments have revealed an enormous amount of information about the tremendous range of materials that played a major role in prehistoric life—before this discovery, absolutely nothing was known of Copper Age clothing or perishable equipment in Europe.

For example, no fewer than eighteen types of wood have been identified in the Iceman's seventy artifacts. The articles include a flint dagger with an ash haft, or handle, in a woven grass sheath; an unfinished yew longbow; a deerskin quiver with fourteen arrows of viburnum and dogwood, only two of which were finished; an axe with a yew handle and a copper blade glued in place with birch pitch and leather straps; two sewn birch-bark containers that held what may be embers for starting a fire; a fur backpack with a frame of hazel and larch; a net of grass twine that may have been used for catching birds or small game; a short rod of linden with a fire-hardened piece of antler embedded at one end, probably used for working flint tools; two round pieces of birch fungus attached to leather slips, which are thought to have had a medicinal purpose; and a marble disk with a perforation at its center attached to a leather strip and a tassel of leather thongs.

Microscopic analysis of the tool surfaces showed traces of animal hair, blood, and tissue, suggesting that the Iceman recently had killed or butchered a number of animals, such as chamois, ibex, and deer. Deposits of large, partly cooked or heated starch grains on the axe blade, where lashed to the shaft, have led to the suggestion that one of his last acts was to repair or refit the shaft while eating porridge.

The Iceman's clothing comprised much-repaired leather shoes (with bearskin soles and deerskin uppers) stuffed with grass for insulation; goathide leggings and loincloth; a calfskin belt and pouch; a cape of woven grass or reeds of a type still worn by Alpine shepherds in historical times; a coat made up of pieces of tanned domestic goat hide sewn together with animal sinews; and a bearskin cap. Archaeologists are surprised that he was wearing nothing of wool, even though textile fragments

Fig. 1. A reconstruction of what the Iceman might have looked like before frozen on the Tirolean Alps. © South Tyrol Museum of Archaeology, Italy, www.iceman.it. Reproduced by permission.

are known from this period in Europe. Everything appears beautifully adapted to the Alpine conditions. Indeed, experiments with exact replicas worn or carried by a man following sheep in their transhumance, or seasonal migration, up through the snow have shown that the coat was warm, the longbow was invaluable as a climbing pole, and the copper axe also was very useful for climbing in snow. The Iceman's shoes proved to be a disaster—fragile, with no traction in snow and no resistance to water. Why, with his beautifully designed clothing and equipment, was he wearing such useless footgear?

HOW DID HE DIE?

Ever since the discovery, much speculation has centered on the Iceman's identity and the cause of his death. It has been suggested that he was a hunter, a shepherd (but he has no shepherding equipment), a metal prospector (because of traces of arsenic in his hair, perhaps from copper smelting), and, inevitably—following one fad in archaeology—a "shaman" (for which there is no evidence whatsoever). DNA analysis of his intestinal contents has revealed that his last meal consisted of red deer meat and possibly cereals and that earlier he also had eaten ibex. Pollen from the hop hornbeam in his stomach has shown that he died in late spring or early summer—probably in June. It is known from the pollen (which he inhaled about six hours before death), as well as from the specific kinds of flint in his equipment, that he came from the Katarinaberg area, to the south in Italy, where he doubtless inhabited a farming village.

The man was in his middle to late forties (quite old for the time) and dark-skinned. He stood about 1.57 meters (5 feet, 2 inches) in height and was of average build, weighing about 50 kilograms (110 pounds). He was not in good physical condition and clearly had lived a hard life. His lungs were blackened by the smoke from fires, he had hardening of the arteries, his teeth were worn (probably from coarsely ground grain) albeit free of cavities, his toes showed traces of frostbite, and some of his ribs had been fractured and then had healed. There are small tattoos, mostly short lines and a cross, at various points on his lower back, knees, ankles, and left wrist, which were made by rubbing charcoal into small cuts. These marks may have been therapeutic, being linked to the places where he clearly had arthritis, and speculation has even been made about ancient acupuncture methods.

Finally, one of his fingernails was recovered. (Like his hair, the nails had fallen off the body in the course of his preservation.) Dark lines in the nail revealed that he was prone to regular periods of severe disease or malnutrition (which affected nail growth) during the months before his death. Despite melodramatic published accounts that portrayed him as a desperate man, fleeing from a "pogrom" or massacre in his village, he actually appeared to be an already enfeebled person who perhaps had been caught by a storm on the mountain and succumbed to the elements. Even today sudden storms are all too frequent in this region and can find the most experienced traveler unprepared. The fact that the Iceman was naked, or almost naked, when he was found points strongly to hypothermia, a condition that makes one feel incredibly hot just before freezing to death, leading one to strip off clothing; this has been confirmed by analyses that indicate that his body had an elevated temperature at death.

A CT scan later showed something that earlier X rays had missed—the presence of what appears to be a stone arrowhead lodged in the Iceman's upper-left shoulder. A hole in the shoulder blade is thought by some researchers to be an entry wound, and a minute slit in his back is thought by some to be the external entry wound that never healed, although it could well be damage caused during the Iceman's manhandling at the time of discovery. Nevertheless, reckless speculation immediately began that he had been stalked and murdered or deliberately sacrificed by an archer. It has not been established that this arrowhead caused his death; if it did so, where is its shaft? After all, the Iceman's own arrows were preserved beautifully, so why did the shaft of this one disappear? Could it be something other than the vestige of an old hunting accident?

Two deep wounds also have been detected on his right hand and wrist, and it appears that something sharp penetrated the base of his right thumb, causing a serious injury not long before he died. These marks also have led to speculations about hand-to-hand fighting. If the Iceman was indeed defending himself, fighting for his life against a knife-wielding attacker, as has been suggested, then one would expect to find many more slash marks on his forearm or puncture wounds in vital areas of the body. In short, even after years of study, the Iceman is still presenting researchers with enigmas and surprises, and we still do not know how he died, let alone what his occupation was or why he was on the mountain.

Nonetheless, Ötzi unquestionably is one of the greatest archaeological finds of all time, a unique package of data about the life and culture of Europeans in the Copper Age. A tremendous amount has been learned from him and his equipment by using a wide range of scientific techniques. The Iceman also has become one of the most famous people in the world, visited by tens of thousands every year. Despite all the poking and prodding he has undergone at the hands of scientists, his remains are treated with great respect by the public. In the museum at Bolzano, one needs to mount a podium and peer through a small window to see Ötzi, and the audio recording reminds the visitor that this is not a museum exhibit but a human corpse. Several other museums around the world have full-size reconstructions of the Iceman as he might have looked in life, complete with garments and equipment. Like many other finds with global appeal, the Iceman has made a considerable contribution to the popularity of archaeology. His greatest legacy undoubtedly is the vast amount of information he has provided from beyond the grave, information that, but for the sharp eyes of two hikers, might have been lost forever.

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ARBON-BLEICHE 3

The site Arbon-Bleiche 3 is on the Swiss side of Lake Constance, within the territory of the modern village of Arbon. The site of the Neolithic lake-dwelling settlement lies a few hundred meters back from the present-day lakeshore. In Neolithic times the village was situated in a bay, near small inlets. Three excavation campaigns between 1993 and 1995 saw nearly half of the Neolithic village recovered, including remains of twenty-five houses plus two small storehouses. The entire village must have comprised about fifty houses. If we calculate about six to ten persons for each house, the population of the village would have ranged between three hundred and five hundred.

Based on samples from the house posts, dendrochronology gives exact dates for the settlement and helps trace its construction history. The first building work in the village began in the year 3384 B.C., when a single dwelling was raised. In the following year, only two more houses were built. More houses were constructed over the next few years, until the entire village had been completed. This settlement history makes it clear that during the construction of Arbon-Bleiche 3, part of the village community must have lived elsewhere, in another village.

In the year 3370 B.C., catastrophe struck as the entire village burned. Arbon-Bleiche 3 had existed only fifteen years and was never rebuilt. Thus, archaeologists were presented with a single-layer settlement containing material deposited over a very short time, making it easy to reconstruct the village plan. All the houses had been constructed using posts of white fir and arranged in separate rows with their long sides facing the lake. There also seems to have been one broad lane running toward the lakeshore. Some evidence suggests that the house floors were raised slightly above the ground.

From this period not much evidence exists for lake-dwelling sites and cultural developments in Switzerland, probably the result of climatic conditions that led to erosion of the deposited archaeological layers. Arbon-Bleiche 3 was preserved fortuitously by the presence of a nearby small river. Flooding from the river covered the remains of the destroyed village with a protective layer of sand.

The Pfyn culture predominated in the region of Lake Constance before the thirty-fourth century B.C. Its material remains are characterized by, among other things, ceramic pots with S-profile walls. After this time Horgen culture finds dominate at Late Neolithic sites. These ceramics look like

Fig. 1. Reconstruction of the lake-dwelling site Arbon-Bleiche 3, Thurgau, Switzerland. PHOTOGRAPH BY D. STEINER. AMT FÜR ARCHÄOLOGIE DES KANTONS THURGAU, FRAUENFELD, SWITZERLAND. REPRODUCED BY PERMISSION.

buckets with typically straight, thick walls. The ceramic vessels from Arbon-Bleiche 3 display forms and characteristics of both the Pfyn and Horgen cultures. Bone or antler tool types also display typological overlaps. The find material from Arbon-Bleiche 3, therefore, seems to mark a transition between these two cultures.

Among the ceramic vessels from Arbon-Bleiche 3 were a few pots decorated in a totally different style. Comparable forms and ornaments can be found on sites of the central European Boleráz group of the Baden culture in Bohemia, Moravia, and Hungary. Archaeologists first thought that these pots and vessels represented important evidence. Mineralogical analysis of the burned clay from these vessels has shown, however, that they were made of local clay. Craftspeople from Arbon must have copied this foreign form, examples of which perhaps originally were brought by a woman marrying into the village community or imported as traded ware.

Axe blades made of ground stone or red deer antler also were found everywhere in the village. These blades were fixed directly into ash-wood handles, as opposed to what appears at both older and later sites, where axe or adze blades were fixed into antler sleeves. There is evidence that during the previous two centuries, a series of climatically influenced economic crises took place. Red deer was hunted intensively and possibly became extinct in some regions. This may be why craftspeople had to forgo using antler sleeves as a shock-absorbing material between the blades and the valuable wooden handles. Direct hafting became the tradition. It was only from the thirty-second century B.C. onward that antler sleeves were used once again around Lake Zurich and Lake Constance.

About seventy thousand animal bones were collected and analyzed, together with botanical remains and small bones from mammals, birds, amphibians, and fish, from more than seventy soil samples. In addition, pollen, macro plant remains (plant parts and seeds), and sediments from several profile columns were analyzed. Their identification has made possible the reconstruction of the environment around Arbon as well as agricultural and animal husbandry practices, in addition to plant gathering and hunting strategies and the food eaten by the village inhabitants. Agriculture was based on cereals (mainly tetraploid naked wheat, emmer, and barley), with large amounts of poppy and flax. A large portion of the caloric intake came from collected plants, of which hazelnuts were by far the most important. Human excrement (in the form of large masses of various berry seeds) and cereal threshing remains are most common in the zones between the houses, reflecting the custom of dumping garbage outside the buildings.

Botanical analyses of the sheep/goat and cattle feces showed that animals stayed inside the village only in winter. Their food was "collected" around the village in the form of plants, such as ferns or blackberry leaves. Masses of mistletoe leaves or pollen from early-flowering catkin-bearing shrubs suggest that such plants as alder or willow probably were used as fodder in late winter or very early spring. It is likely that during the summer animals were pastured away from the village. About 50 percent of the consumed meat came from hunted animals, especially red deer. Most of the meat from domestic animals came from pig and cattle. Thus, hunting was important in supplying food, especially during times of food-production crises. The small bones extracted from the soil samples show that the inhabitants also must have consumed frogs and a great deal of fish. Whitefish was most common, although there were also many bones from large pike.

The distribution of hand-collected bones and bones from soil samples indicate that the people living in houses nearer the lake consumed more pigs and caught more whitefish. Because whitefish must be caught in open water, it may have been that these people had dugouts. People from inland houses hunted more red deer and caught more pike. These differences may be evidence of very early separation and specialization in food production, which also may reflect the beginnings of social differentiation. There are no big differences between houses as far as cultivated plants are concerned.

The excavations of the well-preserved site of Arbon-Bleiche 3 took place at a time when the full range of scientific analyses could be applied to the artifacts and rich biological data. The site presents us with a more reliably detailed model for Late Neolithic village life in central Europe than we have ever possessed.

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THE MEGALITHIC WORLD

FOLLOWED BY FEATURE ESSAYS ON:

The megalithic world was created as a result of the adoption of agriculture along the Atlantic coast of western Europe by local Mesolithic hunter-gatherers, with a few immigrant Neolithic farmers from central Europe and the Mediterranean. This transition had taken place by about 5500 B.C. in Spain and Portugal, 5000 B.C. in Southwest France, 4700 B.C. in Northwest France, and 4000 B.C. in southern Scandinavia, Britain, and Ireland.

Although these groups by then were cultivating cereals and keeping sheep, cattle, and pigs, there is little evidence for major clearances of woodland to grow crops. Pollen analysis suggests mostly small-scale clearance, and the earliest convincing field systems (from Céide Fields in western Ireland) date to about 3500 B.C. Many excavated sites have produced the remains of wild plant and animal foods, and these items continued to be an important element in the diet, although scientific analyses of human bone chemistry suggest that seafood by this time had been abandoned.

The ephemeral nature of the settlements matches the lack of evidence for large-scale clearance, that is, there seem to be no large communities requiring a large cleared area for their subsistence needs. It has been argued that the overall lack of houses points to a quite mobile society, showing continuity with the Mesolithic. Many houses have been found in Ireland, however, so there, at least, existed a fairly settled lifestyle of single households (fig. 1). Large rectangular houses, such as Balbridie in Scotland, Lismore Fields in England, and Balleygalley in Ireland, may have been special-purpose buildings connected with grain production or the exchange of flint. The rectangular house at Le Haut-Mée in Brittany, in Northwest France, may indicate a community of incoming farmers from the Paris basin, using flint and flint technology brought from that area.

In Britain villages of round stone houses appeared in the Orkney Islands off the northern coast of Scotland in about 3300 B.C. The best-known site is Skara Brae on Orkney's Mainland, with several very similar houses in terms of layout, size, and internal features facing one another. The same kinds of sites are known elsewhere in Orkney, for example, Barnhouse, on Mainland, where the houses are remarkably uniform in appearance except for one larger building—a massive structure resembling a

Fig. 1. Reconstruction of an Irish Neolithic house. Courtesy of Nick Thorpe. Reproduced by permission.

tomb—right next to the village. Similar contemporary developments are seen in southern Scandinavia, where there are very large sites; their arrangement has yet to be confirmed by excavations. In Brittany the settlement of very large houses at Pléchâtel developed at about the same time.

MONUMENTS TO THE DEAD

It is not farming and housing that best demonstrates the changed relationship between people and land; the most dramatic change comes with the appearance of a variety of monuments, especially burial mounds and enclosures. Although there have been claims that some burial mounds, such as Carrowmore in Ireland (fig. 2), predate the Neolithic, the radiocarbon dates at that site are not for actual burials but come from charcoal, which could easily derive from earlier activity in the same place.

The importance of these monuments is clearly shown by their early development. In many areas along the Atlantic, including Spain, Brittany, southern Britain, and Denmark, radiocarbon dating has established that the first monuments appeared early in the Neolithic. Older theories of a long "pioneer phase," during which farming communities evolved to the stage at which they had the free time to construct monuments, have been abandoned. Instead, it is clear that these monuments were essential to the societies that created them, perhaps in part because of the dispersed nature of communities in their everyday lives.

The earliest examples of these burial monuments have been identified as stone-chambered tombs or megalithic tombs. In some cases, these are impressive monuments, built to last and to dominate the landscape. Many contain elaborate carvings, although later examples also can be rather small and unimpressive. They occur along the Atlantic coast from Portugal to Ireland and up to southern Scandinavia.

There is great debate over the origin of megaliths and burial in stone-chambered tombs, which emerged during the fifth millennium B.C. It is on the evidence from Brittany that debate has centered. The oldest theory of the origin of megaliths was that they represented the spread of a religious cult by

Fig. 2. Megalithic cemetery at Carrowmore in Ireland. © DOUGLAS PEEBLES/CORBIS. REPRODUCED BY PERMISSION.

megalithic missionaries. This possibility was ruled out, however, by the impact of radiocarbon dating, which showed that the Atlantic megaliths were much older than their supposed Mediterranean forebears.

The rejection of a Mediterranean inspiration for megaliths led to suggestions of a local origin. In Late Mesolithic Brittany, at Téviec and Hoëdic, small islands off the coast, these plausible ancestors to megalithic burial occur in shell middens. There are twenty-three burials at Téviec and fourteen at Hoëdic. Men, women, and children were interred together in stone-lined pits, covered, in the most elaborate examples, by small heaps of stone (cairns). In one case a small upright stone marked the burial. These burials date to the period 5500–4500 B.C.

Thus the idea of multiple burial existed among the hunter-gatherers of Brittany before the emergence of monuments, negating the possibility of a purely local development of megaliths. The living community's ancestors were placed visibly in the landscape, with the result that they became an important part of future social developments. Focusing such attention on their ancestors could have represented a way for the living to demonstrate their rights to the territory they controlled—perhaps fishing rights in the case of the hunter-gatherers on the coast of Brittany and presumably land and its wealth in the case of Neolithic groups. Earlier models, such as that of Renfrew, suggested that megalithic tombs acted as territorial markers for societies under pressure because of the lack of land to the west to absorb a growing population. The evidence from pollen analysis, however, shows that the impact of farming was too slight for this explanation to hold true, and it may be that other resources, such as stone suitable for making axes and ornaments, were just as desirable as farming land.

One of the most dramatic developments in the study of Breton prehistory has been the discovery that many passage graves contain reused standing stones (menhirs) with a set of carvings different from those in the tombs themselves. At Gavrinis, one of the most elaborate tombs, the uncovering of the top of the chamber capstone revealed that it was part of a substantial carved stone, which joined with the capstones from two other mounds. The carvings on this 14-meter-high stone, and on another possibly original stone, are of cattle, sheep, and goats; axe plows (which look like plows with axe-shaped blades); and axes. These items clearly are representative of food production through the stages of clearance, cultivation, and pasturing, perhaps a celebration of the introduction of agriculture. The largest of these standing stones—Le Grand Menhir Brisé (Great Broken Standing Stone), some 21 meters (70 feet) long—was not reused. Reexamination of older excavations also has shown that groups of menhirs formed the first phase of activity at numerous places that later saw the construction of stone-chambered tombs.

The discovery of a series of long burial mounds at Passy-sur-Yonne, with central European material and burial customs, in Burgundy, central France, has revived the theory of an outside origin for megalithic burials. The earliest stone-chambered tombs in France, according to radiocarbon dating, are in Brittany rather than the Paris basin, however. Crucially there are equally early megalithic tombs in Iberia, which lies well away from any central European influences. In Iberia the possibility has been raised that, just as in Brittany, megalithic constructions began with menhirs, some carved with a shepherd's crook, but this speculation needs to be supported by dating evidence. Some of the earliest tombs have small chambers that were sealed by mounds. Others could be reentered through low passages; unfortunately, this meant that material was added to and removed from the chambers over thousands of years, making it difficult to be sure of the earliest activity. This problem is common across the megalithic tombs of western Europe.

In southwest France the tomb complex at Bougon has been intensively investigated. At least ten tombs were constructed over a thousand years, beginning with simple round chambers containing a dozen skeletons and imported pottery and stone beads and ending with massive extensions to existing mounds, increasing the length of the monument by more than 60 meters (200 feet) in one case. These extensions cover only a few burials, if any, so they must be primarily for displaying the construction abilities of the builders. Little can be said about the skeletal contents of Breton stone-chambered tombs, owing to the acid soil of the area, but they certainly contain a range of elaborate finds. The items include pottery from funerary ceremonies, small axes, polished stone disk rings thought to be symbols of wealth, and long flint blades from the mines at Grand Pressigny in central France. Careful excavation has revealed that such sites as Barnenez were constructed in several stages and that both long and round mounds were built early in the Neolithic, covering simple stone boxes. Later monuments incorporated a passage, so that the chamber at the center of a mound could be reentered many times. Many also are elaborately decorated, with stones in the passage and chamber covered with carvings.

In northern France and Holland, long, rectangular mounds covered a single large chamber. Early tombs contained up to fifteen bodies of women, men, and children, with earlier skeletons moved aside to make room for later burials. At La Chaussée-Tirancourt, a late tomb dating to after 3000 B.C., remains from more than 350 persons were found in the chamber, which was divided into 3 compartments. The burials had taken place over a long period, with individual acts of selective burial taking place, so that a group of six children were buried together, for example. The items accompanying the burials were quite ordinary compared with those in the Breton tombs. Similarly at Bronneger in Holland the burials were accompanied only by local pottery.

The earliest chambered tombs in Denmark are relatively small and simple, probably owing to the lack of suitable stone. They are very common, comprising perhaps fifty thousand examples overall. The tombs mostly contain few burials, often only a single person, and grave goods of pottery and local flint work and amber. Later passage graves (dating to after 3700 B.C. in southern Scandinavia) are larger and more prominent in the landscape and contain many more bodies, in the case of southern Sweden up to two hundred. Even though Scandinavian passage graves were small compared with those elsewhere, they represent the scene of intense later activity. For example, the small Västra Hoby tomb in Sweden had been emptied out in the eighteenth century, but excavations recovered some fifty thousand fragments of decorated pottery from the area in front of the tomb, more than any other passage grave in Northwest Europe. These finds generally are interpreted as offerings to the honored ancestors occupying the tomb.

Chambered tombs in Britain and Ireland often are larger and more elaborate. Early examples contain more burials than do those in Scandinavia, but grave goods are rare. Some large tombs are located very prominently in the landscape, and only a small proportion of the earth or stone mound is needed to cover the burial chamber. The most elaborate tombs of the Cotswold-Severn group of western England and Wales, such as West Kennet, have numerous chambers, which were used to bury groups selected by age and sex. Passage graves appeared in Britain and Ireland, too, after 3700 B.C. These examples are some of the finest of all stone-chambered tombs, including Maes Howe on Mainland, the largest of the Orkney Islands, and Newgrange and Knowth in the Boyne Valley of Ireland. Their scale meant that they were targeted by tomb robbers long ago—Maes Howe by the Vikings, if the runic inscription inside the tomb is true. Surprisingly there are no signs of later worship, except that at Newgrange and Knowth smaller tombs were built around the massive one, perhaps so that their occupants could rest in the shadow of these powerful ancestors.

The second major form of burial monument from this period, found in areas where stone was lacking, is the earthen long barrow, with burials in graves or inside a wooden chamber under a long mound of earth. These monuments appeared in the Early Neolithic, around 4500 B.C., in the Kujavian lowlands of Poland and spread from there to France, Holland, Scandinavia, and Britain. Most research work has been carried out on those of Denmark and Britain. Danish examples were built from the very beginning of the Neolithic, around 4000 B.C. In Denmark grave goods are quite common—excavations produce pottery, amber, flint work, and pieces of copper imported from the Alps.

There is a wide range of variation in terms of burial structure. The simplest type is just a grave; closed graves, in which the bodies were sealed by wood or stones, are the most common. The construction of long mounds was a communal undertaking, given the size of the task and discoveries of lines of stakes dividing the mound area into sections. The general lack of survival of bones (in these mostly acidic soils) makes it difficult to say more than that few people were buried. A rare exception is Bygholm Nørremark, where the first grave contained an adolescent with an amber bead and an arrowhead (possibly the cause of death), and the second held four adults buried in pairs, with their heads pointing in opposite directions and without grave goods.

Earthen long barrows in Britain are roughly rectangular or trapezoidal in shape and are found mostly in the lowlands. In this area mounds of earth cover burials placed inside a wooden chamber, here, too, small by comparison with the total area of the mound. As with chambered tombs, grave goods are rare, even in places where there are more than fifty burials, for example, at Fussell's Lodge in England. The skeletons often seem to have been deliberately disarticulated, suggesting that a community of ancestors was important, rather than individuals. Even there, only a small percentage of the population was interred in a burial monument; others came to rest in enclosure ditches, caves, pits, bogs, shores, and rivers. Over time even fewer were granted monumental burial, ending up with single burials.

ENCLOSING THE LIVING AND THE DEAD

From about 3800 B.C., causewayed enclosures, so called because of the large number of causeways, or gaps, in the ditch circuit, appeared across northwestern Europe. In the Loire region of western France they are usually thought to have been defensive enclosures, because of the deep ditches (sometimes several circuits) cut into rock, remains of collapsed drystone walls, and *pince-de-crab* (crab's pincers) entrances. Excavations have shown that the *pince-de-crab* entrances often were later additions, sometimes after the ditch behind had filled up; in those cases, they could not have been defensive. Many enclosures produce burials on the ditch floor, sometimes with pottery. Radiocarbon dates suggest a range of 3500–2900 B.C. for the dates of these sites, more than a hundred of which have been identified from aerial photographs. They have much in common with southern Scandinavian enclosures, some thirty of which were constructed from about 3400 to 3150 B.C., contain ditch burials, and have small enclosed areas tacked on to the outsides of the sites. The vast majority of these enclosures sit on promontories surrounded by wetland or open water. The ditch layout is mostly single, although double lines of ditches are known. This relatively open barrier either cuts off a promontory or forms a boundary around the whole site. At some sites a timber palisade supplements the ditches.

The layout of the sites is simple, with the exception of Sarup on Fyn, Denmark. At this site there are two lines of ditches, with individual ditch segments fenced off, fence lines and a timber palisade behind the ditches, and small enclosures outside the palisade, with two formal entrances. It may be that attempts were made to control entry into the enclosure. Sarup is by far the most intensively explored of the enclosures, having undergone almost total excavation. Deliberately placed deposits in the ditches included pottery, flint work, and adults' and children's jaws and skulls. Stone settings near the ditch base had pottery, animal bones, and charcoal in and below the stones amid layers of charcoal and burnt soil, suggesting that the charcoal sometimes was still smoldering when it was buried. The palisade trench contained considerable amounts of pottery, far more than in the interior of the enclosure; complete vessels were placed along the palisade. Neither the ditches nor the palisade was in use for long, maybe just a single year. Given this short history, the effort involved in creating the Sarup enclosure is remarkable. Some 100,000 work hours would have been expended on its construction. Inside the Sarup enclosure were twenty offering pits, some containing complete pots and carbonized wheat without weed seeds, indicating a painstaking selection of grain.

Other sites have produced similar traces of placed deposits. The bases of ditches at many sites contained whole pots, piles of flint tools, heaps of animal bone sometimes mixed with human bone, and human skulls. Traces of fire have been noted in the ditches at several sites. The site of Toftum, Denmark, was constructed and abandoned in a short time. Some deliberate filling in of ditches included the deposition of complete vessels, but other parts of the ditches were backfilled with cultural debris, including heaps of shells, flint, and potsherds.

Few sites have seen the exploration of large areas of the interior of the enclosure, but some have produced offering pits, as at Sarup. At Årupgard, in Denmark, pits have been found to contain complete pots and a hoard of Alpine copper and local amber. The major excavations at Sarup and Toftum showed that these were very short-lived sites of conspicuous consumption and therefore unlike the fixed burial mounds. These important places were not forgotten, however, as many large Middle Neolithic settlements occupy the sites of enclosures.

In Britain and Ireland some seventy causewayed enclosures are known, predominantly from southern England but with examples from Scotland and Northern Ireland as well. The distribution is not continuous, however, even in southern England. Enclosures were being constructed by 4000 B.C.—unlike the examples in southern Scandinavia, they were a significant monumental element from the beginning of the Neolithic. Enclosures in this region were located in peripheral locations, away from main areas of contemporary settlement and often in small woodland clearings. Perhaps the activities carried out inside enclosures were seen as socially dangerous and therefore had to be separated from everyday life. Many enclosures had a concentric spatial arrangement, with up to four circuits of ditches. These ditches were the primary focus of depositional activity of various kinds but also saw episodes of recutting. Different ditch segments may have been maintained by particular family or clan groups; this arrangement would have explained the wide variations in ditch segments and their later contents, which will have reflected the history of the group responsible for them.

At the main enclosure at Hambledon Hill, England, forty-five burials were recovered from the 20 percent of the ditch that was excavated, pointing to some two hundred bodies altogether. The excavated burials were predominantly of children; indeed there were twice as many as adult burials. This is a common pattern, with children being buried much more often at causewayed enclosures than in earthen long barrows. Elsewhere enclosures consistently have produced human skeletal remains.

In the ditch at Etton were specially placed deposits; they comprised small heaps of butchered animal bones on the ditch base, including a neatly tied bundle of cattle bones next to a partly dispersed group of hazelnuts, a complete upturned vessel on a birch-bark mat, and a sheet of folded and trimmed birch bark. At Hambledon Hill long, narrow deposits of organic material containing animal bone, pottery, flint work, and human bone were placed along the bottom of the ditch, possibly in leather bags. The animal bones were identified as feasting debris. Enclosure ditches often produce exotic materials; they may have played a major role in exchange. Stone axes are quite common finds at enclosures, frequently appearing long distances from their source. Thus at Hambledon Hill there were axes from hundreds of miles away in Britain and even from continental Europe as far away as the Alps. Pottery also came from a hundred miles away. Enclosures were not markets, however, from which objects would be redistributed, for the exotic items brought to enclosures remained there.

Some sites later were given defenses, possibly becoming settlements. The clearest candidates are Hambledon Hill and Crickley Hill in southern England. At Hambledon Hill several enclosures later were enclosed by a defensive ditch and a timber palisade. This defense eventually was attacked and destroyed, as evidenced, for example, by the remains of two young men killed by arrowheads buried in the ditch at the same time that the timber palisade was burned down. At Crickley Hill, where large numbers of arrowheads have been found, the palisade was burned, and then the site was abandoned for settlement. No single explanation can cope with the variety of British enclosures, but there are some clear themes: consumption, control over access, and destruction.

Evidence of violent death occurs throughout the megalithic world, as at the three tombs at Châtelliers-du-Vieil-Auzay in western France. Each tomb contained pairs of males, one killed by arrows and the others by axe blows to the head. That some of these deaths may have been attributable to executions rather than warfare is suggested by the discovery in Sigersdal Mose (bog), Denmark, of two women, one with the cord used to strangle her still around her neck.

UNECONOMIC EXCHANGES

Although conflict is often thought of as the opposite of peaceful exchange, such does not seem to have been the case in the megalithic world, in that the same communities that were fighting also were involved in wide-ranging exchange networks. Polished axes of both flint and hard stone were produced and traded on a massive scale. They were used mainly for tree felling, but they clearly had much more than purely economic importance. This can be seen in the production, exchange, and deposition of axes. Flint axes were produced at mines and stone axes at open quarries. Some mines were massive; for example, there were five thousand shafts at Rijckholt in Holland. At the Plussulien quarry in Brittany about five thousand axes a year were produced for some twelve hundred years. Although this seems like industrial production, at some sites the workers deliberately chose to quarry at difficult locations. For example, at Langdale in northern England quarrying took place on a steep mountainside, even though equally good stone can be seen on the surface along a 19-kilometer (12-mile) stretch. In Ireland people rowed out to Rathlin Island to quarry stone, despite the availability of geologically identical rock on the mainland. In addition most axes were polished all over, although only the cutting edge needs to be polished to improve performance—modern experiments confirm that this was the most time-consuming part of the whole process.

These noneconomic concerns also appear in the distribution of axes. The long-distance exchange of axes is well known, with scientific analysis showing that jadeite axes from the Alps moved across a distance of 2,400 kilometers (1,500 miles) to Scotland. The key to the importance of jadeite axes is not that they were of better quality but that they were visually distinctive and so were obviously imports. This is a very common pattern: across western Europe imported axes were of no better quality than local products but apparently were desirable because they were exotic. In southern Scandinavia massive, unwieldy flint axes were produced from distinctively colored flint and then exchanged over the longest distances. Axes from Rathlin were traded to England and Langdale axes to Ireland. On the Channel Islands off the coast of Normandy, only 16 percent of axes on Jersey are made from the local source, with imports coming from Brittany, Normandy, and the neighboring island of Guernsey. The Jersey axes, however, were clearly desirable on Guernsey, where more are found than on the island where they were produced.

Finally, axes also are marked out in their deposition. Many are found deliberately buried. In southern Scandinavia hoards contained longer axes than those found in settlements. They also are typical finds in bogs, rivers, and lakes, leading to the idea that the axes were offerings to gods or spirits, as also seems a likely explanation for the amber necklaces found in bogs in southern Scandinavia. After about 3300 B.C. many of these exchange networks shrink, and southern Scandinavia and Holland became part of the Corded Ware or Single Grave culture of individual burials in graves with pots and battle-axes under small, round mounds, looking more toward Germany and eastern Europe. In Atlantic France, Spain, and Portugal megalithic tombs continue until the introduction of copper and the transformation of society.

Developments were quite different in Britain and Ireland, however. There a range of new monuments emerged, while settlements once again became small and hard to spot. The largest were cursus monuments (rectangular bank-and-ditch enclosures, some of which are several miles long), constructed perhaps as processional ways across landscapes and incorporating older earthen long barrows into their course. The best-known monuments are the henges—the earliest and most famous being Stonehenge in southern England. A henge is defined as a bank-and-ditch enclosure with the bank outside the ditch; thus it was clearly not defensive. The external bank outside the ditch could have been a visual barrier or a platform from which to observe ceremonies in the interior. The sites range in size from very small, about 15 meters (50 feet) in diameter, to massive, more than 370 meters (1,200 feet) in diameter. Avebury in southern England is an example of the latter. They have substantial ditches, and there often are restrictions on the entrance, perhaps showing control over access. A variety of activities have been recorded inside henges, evidenced by pits, post circles (unconvincingly claimed to be buildings at some sites, such as Durrington Walls in southern England), stone circles, and even burials, but these are rare. The objects deposited at henges frequently are elaborate, exotic, and strange, such as functionally useless chalk axes.

Stonehenge is unusual in many respects. It is the earliest example of a henge monument, construction having started around 3000 B.C. It is perhaps transitional between causewayed enclosures and henges, because the bank is outside the ditch, with a ring of posts inside. A large number of cremation burials were deposited in the ditch, the bank, and the posthole circle, and timber structures (largely destroyed by later activity) and lines of posts were erected inside. The site was transformed around 2600 B.C., when the bluestone circle was constructed from stones transported more than 650 kilometers (400 miles) from Wales and the avenue was created, perhaps to commemorate the route taken in moving the stones from the River Avon.

Timber circles also were constructed on their own, for example, Greyhound Yard in southern England, which is perhaps 370 meters (1,200 feet) across, and the West Kennet group near Stonehenge. Sometimes these timber circles were converted to stone circles, for instance, the Sanctuary, located at the end of an avenue of stones leading from the Avebury henge. Stone circles were monuments in their own right; these circles are found mainly in the north and west of Britain in rocky areas, most impressively at Callanish in the Hebrides of Scotland, with a circle at the heart of a series of stone avenues.

The supreme achievement of the megalithic world was the enormous mound of Silbury Hill near Avebury. Just over 150 meters (500 feet) in diameter and 40 meters (130 feet) high, the chalk and soil piled up to a volume of 3.8 million cubic meters (12.5 million cubic feet). Despite three excavations, no burial has been found below the mound; it appears to be a ceremonial site, with survey work following the collapse of an old excavation tunnel pointing to an original spiral course around the mound. As with so many other features of the megalithic world, Silbury Hill shows how beliefs, religious or magical, lay behind the creation of the archaeological remains uncovered in modern times.

See also **Neolithic Sites of the Orkney Islands** (*vol. 1, part 3*); **Hambledon Hill** (*vol. 1, part 3*); **Sarup** (*vol. 1, part 3*); **Avebury** (*vol. 1, part 4*); **Barnenez** (*vol. 1, part 4*); **Boyne Valley Passage Graves** (*vol. 1, part 4*); **Corded Ware from East to West** (*vol. 1, part 4*); **Stonehenge** (*vol. 2, part 5*).

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I. J. N. THORPE

AVEBURY

The great henge monument of Avebury represents one of the largest and best-preserved Neolithic sites surviving in England. Henges, which are unique to the British Isles, are ditched enclosures, often of roughly circular form, with a surrounding bank and ditch entered through causeways, within which were structural arrangements and alignments of standing stones, timbers, and pits. Avebury is part of a dense Neolithic complex of surrounding monuments and domestic activity that date from early in the Neolithic (c. 3800–4000 B.C.) to the Bronze Age (c. 2000 B.C.). The henge represents a final phase of building activity and appears to replace the nearby earlier causewayed enclosure site of Windmill Hill.

The complex (which is repeated in similar form and sequence at a number of other ceremonial sites in southern Britain) includes first a dense concentration of Neolithic long barrows for collective burial (at least 25 are known from within 10 kilometers of Avebury), together with evidence for occupation and ritual activity, such as mortuary enclosures. The complex is followed by later Neolithic monument building, including avenues of posts and stones, burials, circular ceremonial buildings, enclosures, and henges. At Avebury an immense artificial mound called Silbury Hill dates from this phase together with enclosures and buildings or circles at the Sanctuary, Beckhampton, West Kennet, and other sites. Such landscapes and monuments are considered to have been intentionally designed as part of the "sacred geography" of the Neolithic world.

Avebury is located in central southern England, in the county of Wiltshire, some 130 kilometers (80 miles) southwest of London. It lies within a basin in rolling chalk downland, which offered an easily cleared, well-drained, and fertile environment to the early farming communities of prehistory. Located at a height of between 150 and 200 meters (about 500 to 600 feet) above sea level, the hilly landscape is dissected by small streams and river, draining to the River Thames, with Avebury broadly visible from the landscape around it. Local resources also included sarsen stone (a hard silicaceous sandstone used for constructing the stone circles), which is scattered over the area along with flint.

The Neolithic in Britain began about 4000 B.C. with the arrival of agricultural practices and associated domestic artifacts from continental Europe, including pottery and groundstone axes. For several centuries the clearance of natural vegetation and woodland formed a major activity, one that is well

Fig. 1. Village of Avebury and Stone Circle. © ADAM WOOLFITT/CORBIS. REPRODUCED BY PERMISSION.

documented in the Avebury area, revealing a progressively open and managed landscape. The Windmill Hill enclosure was constructed in the middle of the fourth millennium B.C. and was in use well into the third millennium B.C. Avebury and other henges were built in the first two-thirds of the third millennium B.C., often over many centuries. Stone circles were constructed from late in the third to the early second millennium B.C. (c. 2200–1600 B.C.). At Avebury dating evidence has been obtained from the surrounding ditch, showing it was constructed between 2900 and 2600 B.C. Dating the stone circles is more difficult. Carbon-14-dated charcoal from the outer circle suggests erection between 2500 and 1700 B.C. (broadly contemporary with the much damaged stone Beckhampton Avenue, c. 2400–2200 B.C., which lies to the west of Avebury and is under archaeological investigation). The inner circles, however, remain undated by modern methods, and the presence of lower chalk packing (a harder and geologically earlier chalk excavated from the deepest parts of the great ditch and not exposed elsewhere) around the standing stones suggest an early date.

The henge of Avebury had an immense ditch and bank; excavation shows that the ditch was 10 to 14 meters deep, with the spoil (dirt) made into a huge outer bank reaching originally to a height of as much as 6 meters. There were four causewayed entrances, each about 20 meters wide, and aligned north-northwest, south-southeast, east-southeast, and west-southwest. The southern entrance was connected to a stone avenue (the West Kennet Avenue) and there may have been additional standing stones linking Avebury with sites at Beckhampton. The "circle" reached a diameter of about 350 meters (1,140 feet), and covered 11.5 hectares (28.5 acres). The now-reduced standing stones within the circle were arranged as an outer circle of some 95 to 100 stones surrounding a number of other arrangements, including two inner circles each with a diameter of about 100 meters and at one time comprising some 25 to 30 stones each. At the center of the northern circle was a "cove" of three huge stones, and at the center of the southern circle was an arrangement of small standing stones known as the "Z" feature surrounding the "obelisk," an upright monolith. Resistivity and other remote sensing techniques have identified several other potential settings of timbers, stones, and earth within the henge, which may include timber buildings such as found at Woodhenge and the Sanctuary. These settings may have been aligned on solar, lunar, and other celestial observations, forming a simple astronomical observatory, although this has never been proven. Excavations undertaken in 1908–1922 by Harold St. George Gray and in 1934–1939 by Alexander Keiller explored the ditch and the standing stones and showed how the site was constructed. However, artifactual finds mostly in ditch and stone-hole deposits have been few, and they include later Neolithic and Beaker pottery, flint tools, rare animal and human bones, and antlers. Some scholars interpret the placement of such artifacts, for example, at the terminal ends of ditches, as symbolic and intimately connected to the ceremonies and activities of Avebury.

Avebury is one a small group of so-called superhenges, which are of great size and are spread across Britain and parts of Ireland. Other sites include Marden (530 meters diameter) and Durrington Walls (525 meters diameter), both in Wiltshire; Mount Pleasant (370 meters diameter) in Dorset; Knowlton (227 meters diameter) in North Dorset; the Giant's Ring (180 meters diameter) near Belfast in Northern Ireland; Dowth Q (175–165 meters diameter) in Ireland; and the Ring of Brodgar (123 meters diameter) in Orkney. Stonehenge, in comparison, has a diameter of only 110 meters. The "superhenges" enclosed settings of wood posts, stones, pits, and circular buildings and were located within landscapes of dense prehistoric activity with large and prominent monuments. Typically they seem to be part of a long succession of monumental ceremonial landscapes and monuments, often originating around clusters of Early Neolithic long barrows and causewayed enclosures. By the later Neolithic in the mid–third millennium B.C., the long barrows and related sites had been replaced by henges, avenues, rare large round burial mounds—such as Duggleby Howe in Yorkshire, Knowth in Ireland, and Maes Howe in Orkney, Scotland—and other individual graves, structures, and enclosures.

Research since the late twentieth century has concentrated on interpretations of the meaning of henges and how they were perceived by their builders and users. In particular phenomenology has become a popular means to investigate prehistoric sites. Phenomenology is a personal and interpretative approach to the human experience of landscapes and places and involves a philosophy of space, society, and perception. It is thought that the enclosures were used for the enactment of ceremonial and religious activities involving large numbers of people. The banks and ditches may have served the function of providing a viewing area while at the same time excluding active participation from the onlookers. Landscape research and reconstruction has provided important evidence about tree clearance and land use and shows a reversion to scrub and grassland during the third millennium B.C. Such changes may have been the result of economic and social upheaval, and monument building in the form of henges and avenues might express new social identities and belief systems.

See also **Neolithic Sites of the Orkney Islands** (*vol. 1, part 3*); **Boyne Valley Passage Graves** (*vol. 1, part 4*); **Stonehenge** (*vol. 2, part 5*).

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CAROLINE MALONE

BARNENEZ

An immense dry-stone cairn at Barnenez in the Finestère region of Brittany, France, contains eleven passage graves and ranks among the most important prehistoric monuments of western Europe (fig. 1). It overlooks the Morlaix inlet in the commune of

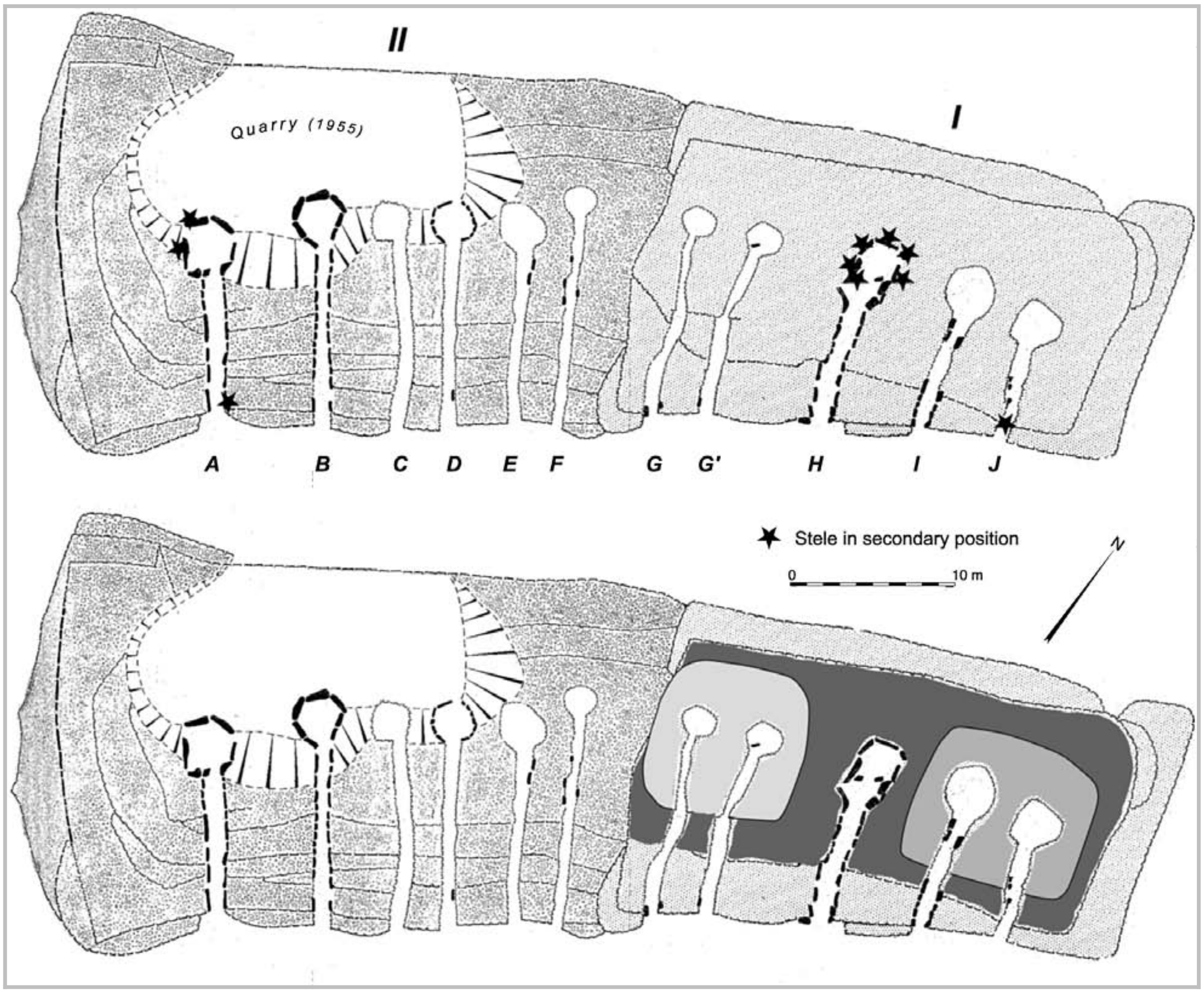

Fig. 1. Plan of the Barnenez mound (adapted from Giot 1989) with position of the decorated steles, and interpretation of the architectural sequence. COURTESY OF SERGE CASSEN. REPRODUCED BY PERMISSION.

Plouézoch. Analysis of the construction of the cairn and the form of its passage graves indicates that the monument was built in several phases. Although some initial radiocarbon dates among a long series, when recalibrated, suggested that the Barnenez tombs were built very early in the fifth millennium B.C., analyses of the forms of the tombs and the contexts of the charcoal samples used for dating now point toward a date of approximately 4300–4100 B.C.

The footprint of the Barnenez cairn takes the form of a trapezoid. The entire monument is 74 meters long on its east-west axis, 29 meters wide at the western end, and 17.5 meters wide at the eastern end. Its eleven passage graves (A, B, C, D, E, F, G, G', H, I, and J) lie roughly parallel to each other. The passages enter at the south and run north to the chambers. Some of the Barnenez passage graves are constructed using dry-stone walling (flat stones stacked up) and corbeled vaulting (in which each course of stones is shifted toward the center of the chamber until the roof is eventually closed in). Others have orthostats (large upright stones) roofed over with capstones (large boulders laid flat across the orthostats, fig. 2). In several instances, orthostats are combined with dry-stone construction.

The Barnenez site was discovered in the mid-1950s. A quarry had been established at the site, and a pit opened in the mass of stones revealed buri-

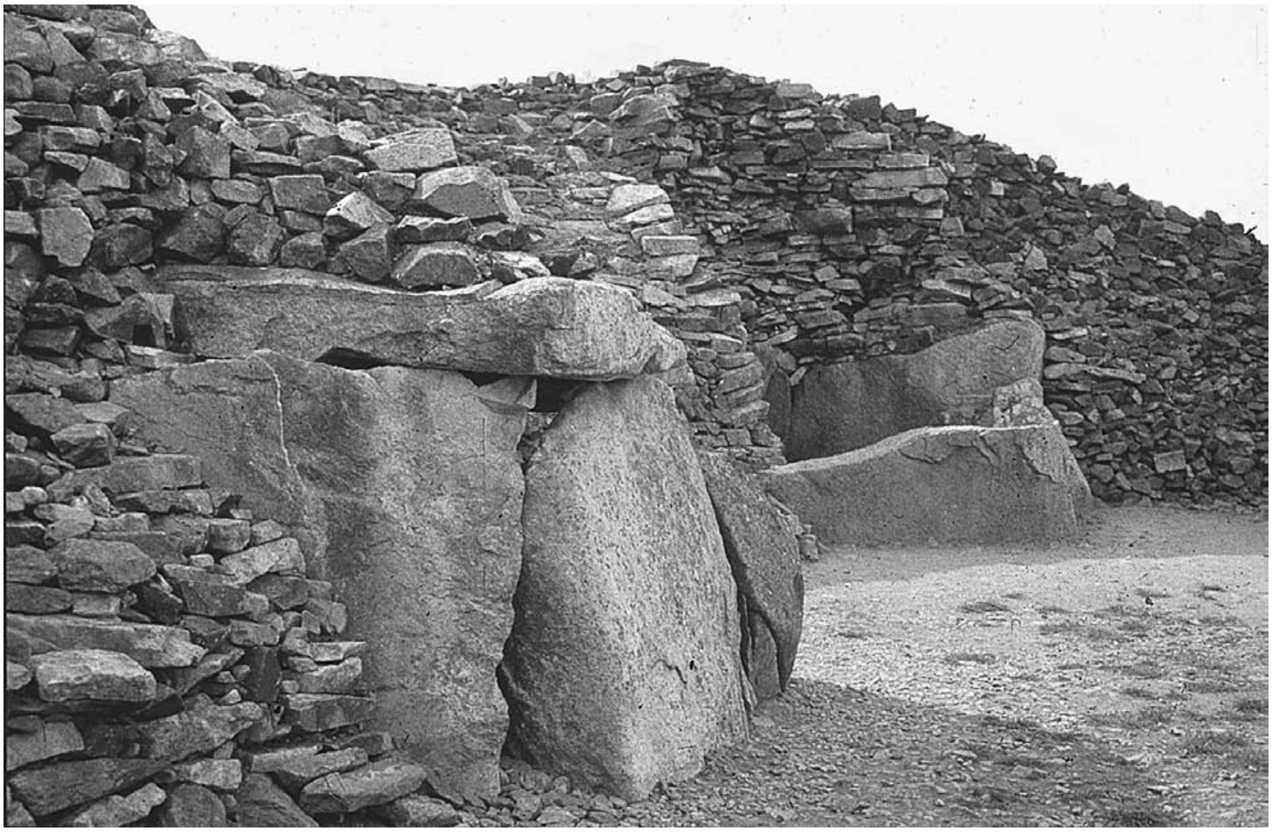

Fig. 2. View of the northern part of Barnenez mound: the cairn, destroyed by a modern quarry, gives a glimpse of the internal megalithic chambers A (background) and B still covered by a stone slab. COURTESY OF SERGE CASSEN. REPRODUCED BY PERMISSION.

al chambers A, B, C, and D. They were brought to the attention of archaeologist Pierre-Roland (P.-R.) Giot, who headed the Anthropology Laboratory of the National Center for Scientific Research at the University of Rennes. At that time France lacked the archaeological resources it has today, but Giot spearheaded efforts to carry out a rescue excavation. At his insistence, work in the quarry was stopped. Consequently, France applied a national rule that the accidental discoverer of an archaeological site would be responsible for its preservation. Giot began his research in 1955 and closed most parts of the monument to the public while conducting his studies.

Barnenez and the neighboring monument of Carn were the first European passage graves to be radiocarbon dated. The first reported dates—in the first half of the fifth millennium B.C.—surprised scientists, who had expected a late-fourth millennium B.C. date, based on typological classification of the architecture. The unexpectedly early dating made it possible to affirm the presence of a Breton identity on the French archaeological landscape, this at a time when the preservation of Neolithic monuments was gaining importance. Giot's research accelerated the rate of learning about megalithic architecture and its origins. Nonetheless, it was not until 1987, more than thirty years after the site's discovery, that Giot's scientific monograph on Barnenez and Carn was published, giving archaeologists the hard data and scientific analysis to assess his conclusions.

THE ARCHITECTURE

Eleven passage graves stretch through the body of the Barnenez cairn, all of which open to the south through a rectilinear facade. Rather than being the product of one or two construction stages, this massive monument was in reality constructed in several stages, offering successive states that were very different from the final appearance of the enormous stone mound as it appears in its restored form. The Barnenez construction phases have been the subject of debate among archaeologists, but a plausible sequence based on the form of the burial chambers is presented here.

The cairn is divided into two distinct parts that can be identified by the composition of their respective building materials, which are of distinct geological origin and have different colorations, at least on their outer surfaces. One part of the cairn contains five graves in a high topographical location; the other includes the six remaining chambers built on the slight downslope. The second group of graves seems to be the more recently constructed, but the design of the graves are similar from one part of the massive structure to the other. In fact, it is necessary to consider these two constructions in detail to realize that the sequencing is more complex than it appears and involves the chronology of individual graves.

To understand these differences fully, it is necessary to sidetrack to a classification principle of the chambered tombs of western France. The typologies of megalithic funerary architecture in Brittany are well established and have been steadily improved by a long line of researchers. Despite the limitations of classifying funerary architecture, a main goal of such classifications is to define the structure and organization of the internal space. Examples include passage graves with a well-differentiated single chamber, passage graves and chambers divided into compartments, and passage graves and chambers with widened openings.

This classification of the Breton chambered tombs is based on a spatial differentiation of the tomb interiors into two principal parts: a burial chamber and an access passage to the burial chamber. These parts are naturally linked, and their relationship changed over time. As the chambers developed and grew longer, the access passage and surrounding burial mound grew shorter. This typological sequence of megalithic burial places is not rigidly established but rather is driven by a dynamic evolution leading from the first passage graves (moving from the fifth to the fourth millennium B.C.) up to the gallery graves (end of the fourth millennium B.C.). In the earlier tombs, there is a strong differentiation between the chamber and the entrance passage, while in later tombs the differences in width and height between chamber and passage grow smaller and eventually disappear.

It is exactly this progressive loss of differentiation of the internal space of the graves that makes it possible to distinguish the various phases in the Barnenez cairn. Thus, in the eastern cairn, the central tomb (H) differs typologically from the adjacent tombs (G and G'; I and J). Until recently, the carvings and megalithic construction of tomb H led to its interpretation as a sort of temple or monument of prestige, while the neighboring tombs that used only dry stone were interpreted as ritual spaces that were in simultaneous service with tomb H.

Such simultaneous use is thrown into doubt, however, upon examining the tomb interiors. The extreme differentiation between chamber and passage in tombs G, G', I, and J, not only discernible in plan but also in elevation (with vault heights reaching five meters), contrasts with the absence of such features in tomb H. Analysis of the variation in chamber and passage shape now allows new speculations on the layout and construction sequence of the original monument: Two small adjacent cairns initially coexisted, each containing two first-generation passage graves, G and G', I and J. Subsequently, tomb H was built between these two earlier cairns, according to a distinct plan and with distinct materials. The whole tomb complex was covered by a more enveloping cairn, making it necessary to lengthen the passageways of the older monuments.

The construction sequence of the second part of the massive cairn can also be reexamined according to this model. Application of the classification principle again differentiates tombs A and B, placed at the western extremity, from the other four adjacent chambers to the east. The lack of internal differentiation is seen in the volumes of the chambers of tombs A and B, where the ceiling heights are barely higher than the passage heights. They are indeed constructed differently than the neighboring tombs, using massive capstones rather than corbeled vaults. This method is the result of a choice to reduce the chamber volumes, and it is identical to the construction of the Table des Marchands, another famous monument of Brittany that cannot date further back than 3800 B.C. Tombs C and D exhibit a little more differentiation between passage and chamber than A and B, and the next ones, E and F, even more so. It is possible to imagine an initial small cairn containing these older passage graves as suggested by similar narrow sections in their passageways.

During the final process of covering over the graves with a pile of stones, it was necessary to lengthen the pre-existing passageways to adapt to the elongated trapezoidal plan of the final monument. It can be clearly seen that the orientation of the passageways in the two parts of the Barnenez cairn differ by several degrees. It was necessary to extend the passageways so that their opening could be reestablished on a relatively straight, rather than concave, facade.

QUESTIONS ABOUT RADIOCARBON DATING

Radiocarbon dating carried out on charcoal samples from Barnenez initially identified the monument as the oldest stone architecture in western Europe. The dating was seen as a successful application of the radiocarbon technique and was used to support arguments for a "long" chronology of Breton megalithic monuments beginning close to 5000 B.C. But a careful reinterpretation of the samples that were originally analyzed prior to the early 1990s has questioned these findings.

The oldest Barnenez radiocarbon date (between 5010 and 4400 B.C.) comes from the excavation conducted in chamber G in 1968. The charcoal samples were collected from the clay soil of the chamber, and this soil, as Giot wrote in *Barnenez, Carn, Guennoc,* was apparently intentionally brought in to level out the floor of the chamber. In tomb F, the charcoal samples came from a forty-centimeter-thick layer of sterile clay topped by the layer of gravel that contained the archaeological material (between 4705 and 3955 B.C.). In chamber A (between 4550 and 3895 B.C.), the charcoal samples were taken from a supply of broken stones deposited there to level out the natural slope of the terrain. As can be seen in all the cases, the materials from which the charcoal samples were collected—the sterile clay layer and soils brought from outside—do not in any way date the construction of the tombs. Instead, it is probable that the charcoal resulted from fires that occurred long before the monument was constructed.

When viewing Barnenez within the overall regional typological sequence of mortuary monuments, it appears that a more realistic date for the construction of its earliest passage graves would lie in the last centuries of the fifth millennium B.C. It was perhaps not until several centuries later that the monument reached its final form. Although a revision in dating of several centuries closer to the present may seem relatively insubstantial on the scale of the millennia of later prehistory, it is important to provide an accurate chronological position for the type of mortuary architecture seen at Barnenez. At the same time, it is important to keep in mind that this architecture was the product of a long period of development of monumental mortuary construction in the west of France. In this regard, the carved upright stones, or orthostats, found in several of the Barnenez tombs assume new significance.

MEGALITHIC SYMBOLISM AND STELAE AT BARNENEZ

Several orthostats from the chambers and passageways have carvings made by pecking on the rough surfaces of the granite. Motifs include axe blades, bows, horned signs, and goddesses, but the images are open to a variety of interpretations (in one recent view, the horned signs are judged to be birds and the goddesses to be phalluses). An important observation is that the stones on which they appear seem first to have been used elsewhere as upright standing stones or stelae and then were subsequently incorporated into the tomb architecture at Barnenez.

It is now known that passage graves appeared in Brittany only after the development of two phenomena of prime importance that took place between 4700 and 4300 B.C.: the use of upright stones as burial markers and public stelae and the creation of burial mounds. The marking of human burials by devices on the surface is one of the developments that indicates the transition from the Mesolithic to the Neolithic period. At first these markings were unobtrusive, characterized by deposits of earth over the individual grave pit. Later these mounds, or barrows, grew increasingly more ostentatious, in some cases extending more than one hundred meters in length and rising to more than ten meters in height. The concept of the stone stela quickly came to accompany these round and long barrows. In addition to the funerary stelae associated with the stone cist graves, gigantic public stelae were set up in lines, of which the most spectacular culmination is seen at the colossal site of the Erdeven-Carnac-La Trinité complex. There, thousands of upright stones were erected over a distance of several kilometers.

All the stelae at Barnenez, decorated or not, visible or hidden, give evidence of only one chronological stage before 4300 B.C. They can be viewed as proof of a formative period of monumentalism that preceded the construction of the first passage graves. It took place after Neolithic populations from the Parisian basin had settled on the fertile loess lands of Armorica (the ancient name of Brittany) around 4900 B.C. In the coastal areas they encountered the settlements of hunter-fisher-gatherer societies that already knew of the Neolithic presence far to the east. Given these earlier developments, the passage graves at Barnenez can be seen as a central point in the tradition of Neolithic mortuary monumentalism. The passage graves were preceded by long or short or round barrows and stelae and were followed by the construction of gallery graves. This sequence began early in the fifth millennium B.C. and concluded about 3000 B.C.

See also **Boyne Valley Passage Graves** (*vol. 1, part 4*).

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SERGE CASSEN
(TRANSLATED BY JEANNE S. ZANG)

BOYNE VALLEY PASSAGE GRAVES

The name "Brugh na Bóinne" (the Bend of the Boyne) refers to a small area of the valley of the

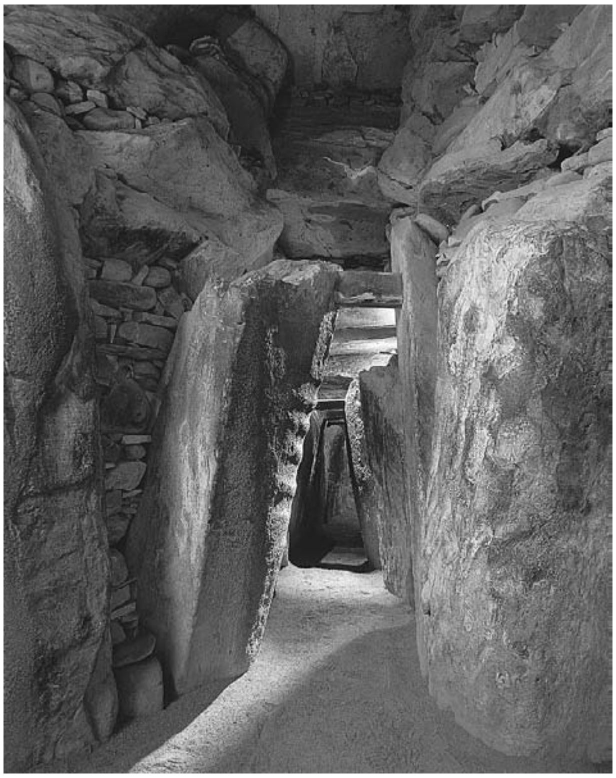

Fig. 1. Interior corridor of the passage grave at Newgrange, Ireland. © GIANNI DAGLI ORTIS/CORBIS. REPRODUCED BY PERMISSION.

River Boyne north of Dublin in County Meath in the eastern part of Ireland. It is one of Europe's most significant archaeological areas, containing evidence for human activity that has extended (with gaps) since about 4000 B.C. In all, twelve separate archaeological phases are represented at this location, with significant monuments and artifacts surviving for each.

One Boyne Valley phase, however, has produced more spectacular monuments than others: the phase characterized by megalithic passage tombs, which were built and used over a period during the Neolithic that extended from sometime before 3000 B.C. to 2500 B.C. or even later. As the name implies, passage tombs consist of a passage that led into a chamber. The principal structural elements of these tombs are large upright stones, called orthostats, that are roofed over with capstones. In some tombs the chamber is somewhat bottle-shaped, while others have a much more elaborate cruciform-shaped chamber. Burial was mainly confined to the chambers. The burial rite was cremation, and it was usual for a burial deposit to contain the remains of more than one individual. Successive burial also occurred. Sometimes grave goods accompanied the deposit. Grave goods were usually of a personal nature and consisted of beads of stone and bone, which were parts of necklaces, and bone pins that could have fastened cloaks. Tools or weapons were not included. The passage and chamber were covered by a circular cairn of smaller stones or by an earthen mound, often outlined by a curb of smaller upright stones.

Evidence for about forty passage tombs has been found at Brugh na Bóinne, with half of them occurring at Knowth. These tombs average 16 meters in diameter. But Brugh na Bóinne is especially known for the presence of three massive monuments that are among the largest known passage tombs, each covering about an acre of ground. These are found at Dowth, Knowth, and Newgrange. All have features of their location and structure in common. Each is located on an elevation, the mound is circular in shape, and the tombs and curbs were constructed from huge stones, hence the use of the term "megalithic" to describe them. The mound at Dowth is 85 meters in diameter and 15 meters high. It is the least well-preserved of the three great sites. In 1847 excavations at Dowth involved the digging of a large pit in the center that has never been filled in. The mound is delimited by a series of curbstones; there is evidence for about sixty. Further examples exist, but these are now covered by slip from the mound. Underneath the mound are two passage tombs, the entrance to both opening toward the west. The larger tomb is 12.5 meters long and has a cruciform chamber, but two small annexes open off the right-hand recess. The other chamber is 8.25 meters long and has a circular chamber from which a recess opens on the south side.

Knowth consists of a cemetery of twenty tombs, one being the massive mound that measures 95 by 80 meters and 11 meters high. The mound contains two tombs placed back to back, discovered in 1967 and 1968. The example that opens to the east is the larger and more complex. Its passage is nearly 40 meters long. The cruciform-plan chamber is 6 meters high and has a corbelled roof, in which flat stones were laid with each course progressively closer to the center, forming a beehive-shaped dome over the chamber. The west tomb is more than 34 meters long. Toward the inner end of Knowth West the passage bends to the right before expanding into a somewhat bottle-shaped chamber. Around the mound are 127 curbstones averaging 2 meters long. The grave goods were standard, beads of stone or pottery and bone pins, but one object, a flint macehead, stood apart from the others due to its elaborate geometric art and technique of manufacture. The site has also produced evidence for settlement predating the passage tomb.

Newgrange is a truly impressive monument consisting of a mound formed from loose stones, 85 meters in diameter and 11 meters high. Its chamber was discovered in 1699, so little has survived of its original contents. The passage at Newgrange, as at Knowth East, leads into a cruciform-plan chamber with a corbelled roof, 6 meters high. The tomb is 24 meters long, with its entrance on the southeastern side. A stone-lined slot above the entrance allows the rising sun on the shortest day of the year (21 December) to shine down the passage into the chamber. On the outside there is a surrounding circle of free-standing stones, the largest of which is about 2.5 meters high.

A remarkable feature of the Brugh na Bóinne passage tombs is the presence of designs engraved on many of the structural stones that form the passages and chambers. These are nonrepresentational and geometric forms with circles, spirals, and lozenges the most common motifs. Due to damage over centuries a number of the structural stones are missing, but on the evidence of what survives it may be that in total a thousand stones with art were used at Brugh na Bóinne. This is by far the largest number of decorated stones from any one place in Europe. This art can be looked on as part of ritual activities.

The Boyne Valley passage tombs constitute the largest and most spectacular of several major megalithic cemeteries in Ireland. Other concentrations of passage tombs are known from Lough Crew, also in County Meath, and from Carrowkeel and Carrowmore in County Sligo. While these cemeteries have similar general characteristics, each has specific features. Although the sites are called "cemeteries" due to their obvious mortuary role, it is also clear that Neolithic people visited and used these localities for a variety of ceremonial activities.

The magnitude of the major tombs suggests clearly that passage tomb society was wealthy, innovative, and economically stable. The economy was based on mixed farming. Indeed there must have been a substantial population in that area. This population would have included experts in different fields. Some had a knowledge of geology, as a particular type of rock with specific characteristics was chosen as the foremost structural element. These stones did not come from the immediate area; building the tombs required transporting large stones weighing several tons over some distance, an enormous undertaking. Achieving the actual construction of the tombs, futhermore, must have involved specialists, especially architects and engineers. For that time, around five thousand years ago, passage tomb society was probably the most advanced of any in Europe. Brugh na Bóinne was an integral part of this society; for several centuries it was a place where vibrant Late Stone Age society flourished and developed and even influenced areas abroad.

See also **The Megalithic World** (*vol. 1, part 4*); **Avebury** (*vol. 1, part 4*); **Stonehenge** (*vol. 2, part 5*).

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GEORGE EOGAN

TRACKWAYS AND BOATS

Throughout prehistory humans negotiated access through their environment via structures such as trackways and roads and through the use of a range of boats in riverine, estuarine, and coastal contexts. Evidence supports the hypothesis that prehistoric populations had the ability to cross significant water bodies, such as the North Sea.

TRACKWAYS

From northern Europe alone—in Britain and Ireland, the Netherlands, Denmark, and northern Germany—roughly one thousand trackways and roads have been discovered, primarily through exposure during commercial and private peat-cutting activities. Perhaps one of the more famous, and certainly most intensively studied, trackways recovered to date is the Sweet Track found in the Somerset Levels, a large expanse of peat land in Somerset County, southwest England. The Somerset Levels is a low-lying area on the southern side of the Severn Estuary. Fieldwork has been carried out in the Somerset Levels since the nineteenth century, but the formation of the Somerset Levels project in 1973 under the direction of John Coles and Bryony Coles enabled systematic surveying and recording of the wetland archaeology of the Levels. The Sweet Track ran for a distance of about 2 kilometers from the base of the Poldern Hills on the south side of the Levels in a northeasterly direction to a sand island called Westhay.

One of the most important aspects of waterlogged archaeology is that waterlogging excludes oxygen from the burial environment, making it anaerobic and thereby inhibiting the activities of bacteria and fungi—key agents in the decay process. Waterlogging preserves a wide range of materials, resulting in the recovery of significant organic evidence for past human activities. The Sweet Track is an excellent example of the preservation afforded by waterlogging. It was discovered during peat cutting in 1970 by Ray Sweet, after whom it was named. This trackway is a single-plank walkway constructed across the reed and sedge beds of the Levels. Environmental evidence collected during excavation and sampling—in particular, the specific environmental preferences of the beetle species whose remains were recovered from the peats in which the trackway was preserved—indicates that in certain areas the trackway crossed pools and areas of open water.

The trackway was constructed using split oak trees to produce planks of about 3.4 meters long and 0.6 meters wide. Pegs of hazel and alder were used to secure poles of ash, alder, hazel, or elm that formed the substructure of the track, with the pegs hammered in obliquely to produce a secure base for the plank walkway. Over the basal structure thus produced, peat and vegetation were deposited to provide further support for the upper planks. These planks were made of oak, set down parallel to the basal poles and wedged in place between the tops of the pegs. Finally, the planks themselves were occasionally secured in place by vertical pegs driven through holes that were cut toward the ends of the planks. The excavations carried out along the trackway showed that it followed the line of an earlier trackway, called the Post Track, which was constructed of long planks of ash and lime laid on the marsh surface and marked by posts of hazel spaced at 3-meter intervals along its route.

The excellent preservation of the Sweet and Post Tracks has provided significant insights into the woodworking capabilities of prehistoric populations. Numerous finds have been recovered in close proximity to the trackway since its initial discovery by Ray Sweet, who himself found a Neolithic "leaf-shaped" arrowhead when he found the first ash plank of the trackway. Other finds include numerous flint artifacts including an unused flint axe. A particularly important discovery was of a jadeite axe, a polished light green stone, which was in perfect condition. The significance of this axe is that its source is the foothills of the European Alps, indicating long-distance exchange networks that would presumably have required transport across the North Sea or English Channel. The precise dating of the trackway, afforded by dendrochronological (tree-ring) analysis of the oak planks, indicates that this axe found its way to southwest England in 3806 or 3807 B.C., the year the trees were felled. This precise calendar age provides a context for other finds along the trackway, including a broken pot with its contents of hazelnuts, a wooden dish, and several leaf-shaped arrowheads. One of these arrowheads retained the resin used to secure it to its shaft, whereas another retained a part of the shaft and evidence for its binding.

The Sweet Track is just one of many trackways found in the Somerset Levels, but in 2003 it was the earliest yet known. Other forms of trackway continued to be constructed across the Levels into the later prehistoric periods up to c. 500 B.C.

In Ireland, systematic survey and excavation undertaken by the Irish Archaeological Wetland Unit has recovered more than one thousand prehistoric sites in the wetlands of County Longford, County Mayo, and County Offaly. Many of these sites are trackways, called *toghers* in Ireland, and given that there are about 1.2 million hectares of wetland in Ireland, the need for routes across the bogs is readily apparent. Trackways of all periods from c. 3650 B.C. to A.D. 1450, except for a hiatus at c. A.D. 1–500, had been recovered from the Irish bogs as of the early 2000s.

One such site is Curraghmore-16 in County Offaly, a single-planked oak walkway 580 meters long, which is estimated to have been built c. 1625–1435 B.C. on the basis of radiocarbon dating. In a fashion resembling the construction of the Sweet Track, the Curraghmore planks were secured by pegs driven through mortise holes cut in their ends. The distinguishing feature of Curraghmore-16's construction is the extreme narrowness of the planks; at about 0.2 meters wide, they are among the narrowest in a single-plank walkway ever discovered in Ireland.

In the Mountdillon Bogs of County Longford, Ireland, the opposite end of the chronological range of planked trackways is found. The planked corduroy road of Corlea-1, first studied scientifically in 1984, is the first known Iron Age trackway from the Irish wetlands. Dendrochronological analysis dates this trackway at 148 B.C. Corlea-1 is made from oak sleepers about 3 or 4 meters long (on average), placed side by side over longitudinal roundwood rails, or runners, of oak. Numerous wooden artifacts were recovered from under the track's timbers: these finds included parts of a wagon, pieces of buckets, handles, and a piece of timber with markings comprising lines thought to represent the earliest evidence for writing in Ireland.

Trackway finds and associated artifacts constructed in wood provide significant insight into the woodworking capabilities of prehistoric and historic communities. Past communities split oaks to produce planks and managed woodland to ensure sustainable timber supplies. Woodland management also assured the provision of roundwood poles for use in the making of "hurdles," woven wooden panels used in another form of trackways and similar to fencing panels still in use today in some areas. The presence of mortise holes and reused structural timbers of buildings found in some trackways also provide insight into possible woodworking practices used in prehistoric house construction.

BOATS

Throughout prehistory humans used water-borne transport to facilitate movement in their landscape. Such craft included hide boats, sewn-plank boats, and dugout or logboats. In the Stone Age fjords of Halsskov and Lindholm, Denmark, at least 21 Mesolithic boats have been excavated. In total, some 250 logboats have been recovered from Denmark, 57 of which date to the Stone Age. The Mesolithic boats are found in coastal contexts and are dated to 5400–3900 B.C. The excavated evidence, supported by experimental studies, indicates that the Danish logboats were made by hollowing out tree trunks with an axe, a technique considered quicker and more controlled than the use of fire. The boats were constructed from linden trees and were about 6 or 7 meters long; their hulls were between 1 and 4 centimeters thick. A finished boat had a pointed bow and a stern with a separate bulkhead. Such logboats would probably have been capable of crossing large expanses of sea, allowing their navigators to travel between 20 and 40 kilometers from the mainland.

One of the most significant forms of prehistoric boats are the Bronze Age sewn-plank boats recovered from the Humber Estuary on the east coast of England, from the Welsh side of the Severn Estuary, and from Dover in southeastern England. These craft attest an advanced level of technological skill in boatbuilding beginning c. 2000 B.C. Experimental studies have shown that these craft would have the potential for crossing the North Sea and could possibly have been propelled by sail as well as by paddling. The finds from Ferriby on the Humber Estuary in Yorkshire have been interpreted by their original finder, Edward V. Wright, as being from a boatyard or similar facility. The original find of a Ferriby boat was made in 1937. A half-scale reconstruction of Ferriby 1, a sewn-plank boat dated to 1880–1680 B.C., was undertaken in 2003 (fig. 1). The maximum length of boat discovered in the Humber is about 16 meters. The keel plank was curved upward at the bow and stern, and the side planks were tied in to the keel. An unusual aspect of these craft was the use of stitches to hold the planks together. Finds of planking and aspects of the construction identified from the study of these timbers have shown that between 2000 and 1600 B.C. these craft would have been substantial; the boats themselves would have weighed about 4 tons empty, and they were able to carry a cargo of 7 tons or about thirty passengers.

Fig. 1. Ferriby boat reconstruction, 2003. COURTESY OF MALCOM LILLIE. REPRODUCED BY PERMISSION.

The sewn-plank boats from England all reflect an advanced level of construction technique, suggesting that the original construction and development of these craft may date back to the very earliest part of the Bronze Age, at c. 2500–2000 B.C. Their social and economic context would thus coincide with the rise in importance of the individual, a shift from the Neolithic emphasis on communal societies. The fact that variations occur in Britain during the Neolithic is significant in that the Yorkshire region of England has individual burials from c. 3000 B.C. Individuals were buried with "prestige" items thought to reflect the status or importance of the individual who was buried. Many of the prestige items were traded from the Continent, arriving in Britain in a manner probably similar to the circumstances that brought the jadeite axe found at the Sweet Track. The development of prestige exchange networks in the Bronze Age and possibly the later Neolithic may reasonably be associated with the sort of boats found at Ferriby and elsewhere in Britain. Furthermore, the Yorkshire region is a known source of jet, a black stone that was polished and used to make necklaces, buttons, and other items. Objects made from jet are found throughout the British Isles in burial contexts associated with "important" individuals, from the Neolithic into the Bronze Age between c. 3000–1600 B.C., signifying that long distance trade in Whitby jet is synchronous with the rising importance of the individual in British prehistory.

The Humber Estuary was also the site of a significant logboat discovery: a craft 12.78 meters long and 1.4 meters wide, constructed from a single oak tree that was felled between 320 and 277 B.C., was recovered from the wetlands adjacent to the Humber. Excavation has shown that this Iron Age vessel, known as the Hasholme boat, may have been carrying a cargo of meat, and in the absence of evidence to the contrary, it is usually assumed that this craft was used for the transport of cargo in riverine contexts. The size of the single oak tree from which the Hasholme logboat was constructed suggests that oak forests still existed in the British landscape into the Iron Age period. Environmental evidence from the Humber region has suggested that the area to the north of the Humber may have been heavily forested throughout the Bronze Age, when the Ferriby boats were constructed, and remained wooded into the Iron Age.

Prehistoric populations around the world exhibit advanced woodworking capabilities from early times. Trackways and watercraft attest a considerable level of technical expertise, using techniques that are still in use in the twenty-first century. The need to cross watery areas such as bogs and rivers or seas is stimulated by the everyday requirements of access to resources such as the plants, birds, and animals in the wetlands of the Somerset Levels. The movement of cargo, as in the case of Hasholme, where meat may have been transported, or the Ferriby craft, which may have been integral to the Early Bronze Age exchange networks that were a fundamental part of society at that time, was equally important throughout both the prehistoric and the historic periods around the world.

See also **Boats and Boatbuilding** (*vol. 2, part 7*).

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MALCOLM LILLIE

CONSEQUENCES OF FARMING IN SOUTHERN SCANDINAVIA

Before the advent of agriculture, hunter-gatherers settled southern Scandinavia, during the later sixth millennia and the fifth millennia B.C. They are known in the archaeological literature as the Ertebølle culture—Ertebølle being one of the large shell middens (*køkkenmødding* in Danish) on the Limfjord in northern Jutland. In cultural terms, such hunter-gatherer communities occupied a substantial area of northern Europe: in Schleswig-Holstein, Mecklenburg, and as far east as the Polish Baltic coast, although the shell middens seem to be confined to Danish fjords. Research in southern Scandinavia during the last quarter of the twentieth century onward has vastly altered the picture of these communities. They are now seen as economically and technologically resourceful, engaged in elaborate social processes leading to the enhancement of the individual's social standing, and possessing a clear vision of their place within the natural and cultural world and within a social and economic sphere that included people with a vastly different lifestyle—the Neolithic farmers.

BEFORE FARMING: THE LATE MESOLITHIC HUNTER-GATHERERS

The Ertebølle communities lived inland as well as along the extensive coastlines, exploiting very rich natural environments; a mixture of hunting of game, fishing, seal hunting, and gathering of plants and sea mollusks often enabled year-round settlement. The Ertebølle hunter-gatherers were skilled craftspeople with a rich tool kit manufactured in flint, stone, and antler, and individuals adorned themselves with jewelry made of animal teeth, shell beads, and amber. Some of these materials, through form and decoration, indicate geographically discrete styles, suggesting regional groups in need of expressions of social, spiritual, and economic identities. At least some groups buried their dead in cemeteries: those from Skateholm in Scania and Vedbæk on Zealand provide evidence of complex burial rituals expressed in the position of the dead, the choice of grave goods, and the accompanying burial ceremonies. This evidence has vastly expanded modern understanding of the Late Mesolithic hunter-gatherers' view of the world and their relationship with nature and with other contemporary groups.

More significantly, these hunter-gatherers did not live in isolation and were more than aware of developments farther south, where the early so-called Danubian farmers were establishing themselves from the mid-sixth millennium B.C. on the fertile loess soils of central Europe. Discoveries of items of an exotic as well as a quotidian nature that derive from the Danubian sphere speak vividly of trading links and exchanges between the Ertebølle hunter-gatherers and the southerly farmers. There is little doubt that ceramic technology, so enthusiastically adopted by the Ertebølle communities around 4700 B.C., derived from the south. Perforated Danubian axes (*Schuhleistenkeile*), made of hard crystalline rocks unavailable in the north, were very attractive to hunter-gatherers, and discoveries of such axes in Ertebølle graves and from votive deposits indicate that possession of such exotic tools was prestigious and enhanced the status of those who could procure them. Gifts of domesticated animals and caches of

Selected sites in southern Scandinavia.

cereals featured in these transactions, and there is no doubt that the southern Scandinavian hunter-gatherers were familiar with agricultural foodstuffs and practices.

All these items demonstrate trade and exchange links between communities with different lifestyles; return gifts offered by the hunter-gatherers could have been equally attractive, comprising flint, bone, and antler tools; perishable commodities, such as foodstuffs (plant, protein, and honey); salt; skins and furs; and even laborers and marriage partners. Thus the issue of why the southern Scandinavian hunter-gatherers did not engage in agricultural pursuits until the very end of the fifth millennium B.C., and even then continued with the traditional economies side by side, remains one of the great debates of southern Scandinavian archaeology.

THE TRANSITION TO AGRICULTURE

The adoption of agriculture was part of a much wider process of transition from hunting and gathering to farming across the whole of the North European Plain. From a purely geographical point of view, southern Scandinavia—that is, the area from the Danish border with Schleswig-Holstein in the south to central Sweden in the north—was one of the last regions in which agriculture was established. Different groups took up the Neolithic elements at varied rates and in differing combinations. It is reasonable to assume that at least five hundred years separated the first indigenous attempts at farming on the southern fringes of the North European Plain and the final appearance of farming in southern Scandinavia.

The idea of large-scale colonization by farmers migrating from the south is no longer supported, and it generally is accepted that hunter-gatherers themselves adopted agriculture. There is, however, little consensus on the precise nature of this process. Scholars working within an economic paradigm argue that it was only a dramatic change in the climate—to drier and warmer conditions—that forced the hunter-gatherers to engage in agriculture. Some researchers have viewed the adoption of farming as the result of a dramatic depletion of natural resources, for example, of seasonal staples such as oysters, whereas others suggest that the effects of climatic change on soil conditions permitted cereal growing to be taken up more fully. In either scenario the change is seen as swift, taking place at some time between 4100 and 3900 B.C.

In contrast to this economically oriented view, social processes also have featured prominently in discussion of the transition. The Swedish scholar Kristina Jennbert has long espoused the idea of a "fertile gift"—the slow and gradual introduction of cereals and domesticated animals into the hunter-gatherer milieu. This idea finds support in Denmark, suggesting that the process may have been more gradual than originally envisaged. Excavations at Visborg on the Mariager Fjord in northern Jutland have brought to light a coastal kitchen midden that dates to the final Ertebølle and the earliest Funnel Beaker culture (also known as *Trichterbecher* or TRB culture and *Tragtbægerkultur* in Danish). Here, during the early TRB period, game hunting, fishing, seal hunting, and fowling continued, but alongside these traditional pursuits, a few domesticates—cattle and pigs—were kept, and small quantities of crops were grown. The signs of a similar process of transition have been noted in the Store Åmose bog on western Zealand. Here technological changes in the manufacture of flint tools are seen as a slow and gradual process spanning the Late Mesolithic and the Early Neolithic, even though the appearance of polished flint axes is rather sudden.

While the debate on the mechanics of the transition remains firmly embedded within the specific paradigms espoused by individual scholars, the change ultimately must be seen as a complex process. The uniqueness of it, in southern Scandinavia and elsewhere on the North European Plain, lies in the active participation of the indigenous hunter-gatherers, who modified and transformed the central European "Neolithic package" in response to their own needs and thus created an entirely singular Neolithic culture—the so-called *Tragtbægerkultur*.

NEOLITHIC FUNNEL BEAKER CULTURE COMMUNITIES IN SOUTHERN SCANDINAVIA

The adoption of farming had a profound impact on southern Scandinavian communities. In terms of chronology, the Funnel Beaker culture—so named after its characteristic funnel-necked pot known in German as *Trichterrandbecher* (fig. 1)—traditionally is divided in Scandinavian chronology into two major horizons: the Early Neolithic (EN I and II: 4100/4000–3400 B.C.) and the Middle Neolithic (MN I–V: 3300–2800/2700 B.C.). Each of these horizons has been refined on the basis of distinctive ceramic styles, which, in general, find support in other dating evidence.

Not surprisingly, there was a considerable degree of continuity with the preceding Mesolithic, but many aspects of everyday life were given a new content and symbolism, not just through novel economy but also, even more significantly, in the transformations in all cultural, social, and ideological spheres. By way of illustrating some of these phenomena, one may consider aspects of settlement, industrial development, and ceremonial activities, all of which demonstrate the originality and profundity of this historically momentous process.

Funnel Beaker Settlement and Land Use. The early farmers in southern Scandinavia had a strong preference for lighter soils, locating their settlements in hilly landscapes interspersed with bogs, marshes, and stretches of open water. Such topography emphasized the importance of both the dry higher ground and the low-lying wetter landscape; it also ensured ecological diversity with a combination of forest, meadow, and arable land offering ideal conditions for early agriculture. The only reliable evidence of agricultural activities comes from the presence of cereal crops and bones of domesticated animals on settlement sites. It was the Danish palaeobotanist J. Iversen who, in the 1940s, first recognized the possibility of interpreting the influence of humans on the natural environment through the study of pollen records. Subsequent research in this field, using pollen from bog deposits and from old land surfaces preserved beneath the burial mounds, has led to an understanding of the type and extent of anthropogenic activities of the early farmers. While there are regional variations, pollen analyses from various localities in Scania, eastern Denmark, and northern Jutland show that, during the EN, open lime or birch forests were maintained for small-scale cereal cultivation and intensive grazing of cattle and pig. In the MN, coppiced hazel woodlands were used for permanent cereal growing, with repeated burnings for the improvement of grazing.

While cereals of various types (wheat and, later, barley) and domesticated animals (cattle, pigs, sheep, and goats) began to contribute more to the overall economy, many of the hunting and fishing stations established during the Ertebølle continued to be used by the Funnel Beaker farmers. In the Store Åmose, farmers still made use of the earlier hunting and fishing locations. The small island of Hesselø north of Zealand was popular during the winter months with seal hunters. Sølager, by the Roskilde Fjord, may have been the hunting outpost for those living at Havnelev, 3 kilometers farther inland, and was used to catch birds that migrated in the winter. The old kitchen middens continued to be occupied: at Norsminde, eastern Jutland, and at Bjørnsholm and Visborg, northern Jutland, there is evidence of farming settlements just outside the midden zone, suggesting that permanent occupation was possible along the coast.

Initially settlements appear to have been small. This finding may reflect the preservation conditions rather than the original size, because many are found preserved under the earthen long barrows. Numerous sites, including the famous Barkær site on Djursland Peninsula that once was thought to be a classic Danubian-style longhouse, have been reinterpreted convincingly as long barrows placed upon early TRB settlements. The actual settlement structures are difficult to decipher: light buildings of unclear construction noted at Mosegården and Lindebjerg and D-shaped houses postulated elsewhere (Hanstedgård and possibly Troldebjerg). Only

Fig. 1. Funnel-necked beaker from Sarup, Fyn—a vessel form which gave name to this vast cultural complex. COURTESY OF NIELS ANDERSEN. REPRODUCED BY PERMISSION.

when the Funnel Beaker culture became fully established, from the MN onward, do larger sites appear. (The late settlement at Spodsbjerg on Langeland, for example, apparently extended over 300,000 square meters.) As if in exact opposition to the early Funnel Beaker settlement pattern, many of these later settlements had been located upon abandoned ceremonial causewayed enclosures. This phenomenon is well recognized, but initially it led to some difficulties in interpretation, evoking concepts of fortified settlements for which there is no evidence. House structures become clear only toward the end of the TRB, with some of the best-preserved examples being on the island of Bornholm.

The settlement of this island is a remarkable testimony to the navigational skills of the Neolithic farmers. The 37-kilometer-wide strait separating the island from the Swedish mainland is known for very strong currents and changing winds, and the crossing must have been one of the most hazardous enterprises of that time. Excavations on the southern part of the island, at Limensgård and Grødbygård, have brought to light remarkable remains of several long rectangular Funnel Beaker houses, up to 22 meters in length, revealing sophisticated architecture based on complex arrangements of central and side posts supporting the roofs of the structures.

Flint and Ceramic Industries. One of the consequences of the introduction of farming to southern Scandinavia was the development of a new kind of industry catering to the needs of farmers, that is, mining for flint and mass production of tools—most important, axes. Whereas small implements, such as knife blades, scrapers, sickles, and even arrowheads, usually could be made from abundantly available surface flint, the manufacture of axes for forest clearance and woodworking required good-quality flint in large nodules. The chalky cliffs of the eastern Danish islands, as well as chalky deposits in southern Scania and northern Jutland, provided deeply placed primary flint deposits that were exploited by means of surface extraction as well as deep-shaft mining.

The northern flint mines at Ålborg, Bjerre, Hov, and Kvarnby as well as the numerous quarries and workshops from eastern Denmark provide details of the extraction and production processes. These activities clearly were carried out by specialists with expert knowledge of mining techniques, flint properties, and tool manufacture. The flint nodules were subject to on-the-spot quality control: one of the Kvarnby shafts had on its floor about three hundred roughly worked nodules that had been tested and rejected. Similarly abandoned axe preforms also have been found near workshops along the eastern shores. Hoards of axe blanks indicate that axes normally left the mines as blanks, to be worked and traded elsewhere, although workshops outside the shafts at Kvarnby show that at least some tools were finished and even hafted on the spot.

Experiments in axe manufacture conducted by Danish archaeologists show that an individual craftsperson must have had a precise notion of what the finished product should look like and that the production of a rough-out (the initial rough form, with a few hammerings only to give it a shape, from which an axe would be made) could have been accomplished in about ten minutes. Further knapping for about two hours was needed to produce a well-proportioned axe, but the polishing, which ultimately is responsible for the aesthetics and the excellent working quality of the Scandinavian Funnel Beaker axes, was the truly time-consuming process, taking from six to thirty hours of work.

The enormous scale of these industrial activities is difficult to imagine. Not only were the axe manufacturing centers able to satisfy the seemingly continuous demand for axes as tools, used both locally and for long-distance exchange with communities in the western part of the North European Plain, but they also produced a surplus that became an important social resource employed in a variety of votive and ceremonial contexts. Just like the pottery, an essential everyday tool, such as the flint axe, also was considered an important social resource with symbolic prestige, used in complex intercommunal exchanges and freely disposed of in waterlogged locations, at megalithic tombs, and in causewayed enclosures.

Pottery is the most common find in all Funnel Beaker contexts. The manufacture and use of ceramic vessels were very important. Nonetheless, the strongly decorative character of Funnel Beaker pottery means that it features in the archaeological literature more as a tool for the construction of elaborate typochronologies than as a significant element of the material culture, enlightening archaeologists as to its role in the quotidian and ceremonial spheres of activity. In everyday life clay vessels were used for storing and cooking food. While the late Ertebølle hunter-gatherers were keen ceramic makers, the Funnel Beaker vessels are technologically greatly improved. The tempering was increased to withstand high temperatures and to prolong the life span of the pot as a cooking vessel, and there was a wider range of forms and decoration. In the early Funnel Beaker, bowls generally were used in the mixing and serving of food, whereas beakers were used as cooking pots—staining on their exterior walls clearly reveals foodstuffs that boiled over. Later the beakers were replaced by a variety of bowls, hanging vessels, and simple, virtually undecorated bucket shapes. Throughout the Funnel Beaker, flat clay disks also were used in culinary activities; the name "baking plates" may well reflect their function.

Apart from household activities, from the very beginning pottery was employed in a wide range of contexts extending well beyond the domestic arena. It seems that some of the most expertly made and beautifully decorated vessels, such as the so-called pedestal bowls, were produced deliberately for display and use in ceremonies and rituals. Thus pots, together with other objects, were deposited in bogs and at the edges of lakes. They were manufactured and disposed of at ceremonial enclosures and also played a significant role in the funerary ritual, as grave goods and in ceremonies that involved wasteful and extravagant destruction of pottery (doubtless containing food offerings) outside ancestral tombs.

The Ritual and Ceremonial Landscape. Through their agricultural practices, the farmers did alter the natural environment around them: forests were cut to create land suitable for crop fields, meadow pastures, and settlements. Their most powerful and lasting legacy, however, was achieved not so much through agricultural practices but rather through the creation of a rich ceremonial landscape—a theatrical setting for social interaction and for the expression of rituals on a scale never before encountered in Scandinavia. The most dramatic aspect of this ceremonial landscape manifests in the presence of burial monuments and enclosures. Less tangibly, but no less significantly, votive offerings of pottery and hoards of flint axes and other goods are witness to the heavily ritualized consumption of commodities, suggestive of an ever growing competitive nature among the Scandinavian farmers.

Votive offerings placed at lake edges, deep in the marshy and boggy areas, and in other watery locations, seem to have been made by the late Ertebølle hunter-gatherers, perhaps symbolically linking the natural and the cultural worlds in which they lived. The Scandinavian farmers continued these traditions, on a greatly intensified level, with peak activity between 3500 and 2950 B.C. The hundreds of flint axe hoards, disposed of in wet environments in close proximity to settlements and tombs, underscore the scale of the flint industry, which was capable of sustaining not just the economic but also the ritual demand for axes. They also emphasize the social significance of agriculturally marginal land. This importance of watery places is particularly well documented on the Danish islands, where the bog deposits make ritual use of ceramics, foodstuffs, and, occasionally, even human sacrifices.

The excellent records for peat extraction in the Store Åmose bog on Zealand, going as far back as the 1870s, provide a fascinating source of information on the bog pots and associated deposits. Unlike the goods seen in funerary contexts, the vast majority of vessels represent the most common domestic category, the beaker. At least some were used for cooking before their deposition; traces of fish have been identified, and wooden spoons sometimes are found inside the pots. In their classic form, these votive offerings—in addition to flint axes—comprise various combinations of pots with amber jewelry and domesticated and wild animals. Complete skeletons of domesticated cattle, with remains of sheep, goat, deer, birds, and fish, are some of the exceptional finds that have come to light from Store Åmose. Human sacrifices also were part of these lakeside rituals, and at least some of the Neolithic bodies found in bogs represent individuals who met with violent death by arrow, strangulation, or drowning through being weighted down with stones. What guided people to dispose of material goods, animals, and humans in lakes and rivers is not known, but such practices demonstrate that material culture was an important symbolic resource used in mediation between humans and their natural environment.

The megalithic tombs of southern Scandinavia are dramatic, monumental structures, and their prominence in the archaeological record is such that, until the late 1930s, it was not uncommon to refer to the Funnel Beaker culture, both here and in Germany, as the "megalithic culture." New discoveries and theoretical approaches to Neolithic burial, however, have altered the perception of the "megaliths" in relation to other forms of contemporary burials. Megaliths now are regarded as only one of the many expressions of monumental burial that have become an accepted feature of the Neolithic of northwestern Europe. Scandinavian research at the end of the twentieth century has contributed significantly to the recognition of this phenomenon.

Thus the earliest burial chambers of the Scandinavian Neolithic, dated from c. 4100/3900 B.C., were constructed in timber. Some of these so-called flat graves remained without any elaborate superstructure, as, for example, at Dragsholm on west Zealand; others at one stage or another were enveloped in massive earthen mounds. While these barrows, their graves, and associated structures display a range of different forms that reflect the local customs and preferences of individual communities, the tradition offers a background against which the megalithic chamber may be seen as a stone version of an already popular grave form.

From the middle of the nineteenth century, the stone-built tombs—the so-called megaliths—inspired Scandinavian scholars. Sven Nilsson was among the first to concern himself seriously with the Scandinavian megaliths, and he was followed by another Swede, Oscar Montelius. While the latter is remembered primarily for his typologies of the Scandinavian Bronze Age, he also was the first to present a typology of the southern Scandinavian megaliths. Since then many typochronological schemes have been presented to account for the development of this phenomenon. While many types have been proposed, in principle, there are two basic categories: the dolmen (*stendysse*) and the passage grave (*jættestue*), each with a variety of forms. The construction of dolmens began toward the end of the EN (Fuchsberg phase), soon after 3700 B.C., while passage graves do not contain materials that are older than the MN Ib (Klintebakke phase), dating to 3300 B.C.

Hand in hand with the elaborateness and complexity of megalithic architecture goes the refinement of the funerary ritual. The earliest dolmens appear to have contained single inhumations accompanied by few grave goods, but the majority of tombs display a different ritual. In contrast to timber chambers, the accessibility of the stone-built chambers permitted repeated use of the interior, and in some cases, remains from as many as two hundred individuals have been found. In the interior, piles of bones with skulls carefully placed on top were described by nineteenth-century archaeologists as chaotic. The selection, manipulation, and arrangement of human remains—thus active engagement with ancestral bones—were socially significant to the users of the tombs. Associated rituals are expressed most dramatically in the deliberate placement and subsequent destruction of pottery by the entrances to the tombs.

The tombs, which most likely operated on a local, village level, were complemented in the wider landscape by ceremonial enclosures devoted to communal activities for scattered populations. These sites are endowed with their own architectural identity, which seems to have arisen as a cumulative effect of numerous ceremonial acts: cutting and recutting ditches, piling up banks, and erecting palisades. The activities involve deposition of materials that cannot be considered normal domestic refuse. Burned cereal grain and animal remains in the form of skulls of cattle, sheep, pigs, and dogs are suggestive of feasting. Depositions of selected items, such as flint axes, weapons, ceramics, and ornaments as well as partial human remains in the ditches are reminiscent of votive activities performed at waterlogged locations.

The distribution of votive river and lake places, the megalithic tombs, and the causewayed enclosures within the range of .5 to 2 kilometers from settlements—as well as the distribution of artifacts at and between these locations—implies transport, communication, and physical movement. Thus another consequence of the Neolithic in southern Scandinavia was the creation of transport and communication routes, some of which were used over many millennia. The old medieval Haervay-Heerweg route, from Viborg in northern Jutland to Hamburg (Germany) and beyond, has been shown to have originated in the TRB period, with the megaliths its oldest markers and with the Neolithic flint axes manufactured at Bjerre and Hov the earliest goods to have traveled along it.

THE DEMISE OF THE FUNNEL BEAKER CULTURE

The end of the Funnel Beaker culture in southern Scandinavia some time between 2900 and 2700 B.C. was, like its origins, a complex process; it is poorly documented in the archaeological record, and its interpretation remains largely intuitive. In global terms the TRB culture was followed by another massive, pan-European phenomenon, the largely pastoral Corded Ware culture. In Denmark, the Corded Ware is referred to as the Single Grave culture (*Enkeltgravskultur*) because single graves are the most diagnostic type of site. In Sweden it is known as the Battle-Axe culture (*Stridsyxekultur*) after the profusion of this type of stone weapon. This situation in southern Scandinavia is complicated further by the presence of another cultural complex, the Pitted Ware culture—named after the characteristic decoration of ceramics with deep, pit-like impressions.

The relationship between the Pitted Ware culture, found mainly in southeastern Sweden and northeastern Denmark, and the Funnel Beaker culture is unclear. The chronological position of Pitted Ware culture—emerging in the archaeological record toward the later part of the Funnel Beaker culture and contemporary with the early stages of the Corded Ware culture—as well as the fact that it was based largely on hunting and gathering pose serious problems of interpretation. The Pitted Ware culture generally has been thought of as one of the numerous groups in the circum-Baltic region that continued the traditional foraging way of life. With the exception of ceramics, its material culture seems to have been geared toward hunting and fishing activities. Nonetheless, investigation of sites in Scania and northeastern Jutland shows that such groups, in some regions at least, were familiar with cereal crops and domesticated animals, even if they themselves were not actively engaged in agricultural production.

Against the background of the available evidence, it is difficult to imagine that in the shadow of the dynamic agricultural communities of the Funnel Beaker populations continued to exist that by and large followed the traditional hunting and gathering way of life. Scholarly opinions tend toward the view that at the end of the Funnel Beaker culture some communities, living in proximity to coasts and estuaries, simply may have returned to a greater reliance on hunting, fishing, and gathering. This could have been caused by a combination of factors, including environmental, economic, and ideological changes within the TRB itself. In most areas of southern Scandinavia this process of change resulted in the emergence of the pastorally oriented Corded Ware culture, whereas around the southern Kattegat zone, for a time at least, some communities seem to have faced this transitional time by returning to the rich natural resources available there.

Although in the past fanciful notions of horse-mounted eastern warriors were evoked to explain the appearance of the Corded Ware culture in Europe, it now seems that a local, if regionally diversified, emergence is a more appropriate working concept. Indeed there is sufficient evidence to show a degree of continuity from the late Funnel Beaker culture to the subsequent Corded Ware culture and to demonstrate that the process of social and economic change, which ultimately led to the emergence of the Corded Ware culture over much of southern Scandinavia, can be perceived within the later Funnel Beaker culture. The settlement and economy of the Corded Ware were rooted in the preceding period, although there are some regional differences. Thus in eastern Denmark and Scania, there is little evidence for change in land use, and on Bornholm and the southern Danish islands, settlement continued more or less uninterrupted on sites previously occupied by the Funnel Beaker culture. Initially at least the extant megalithic tombs in this region offered convenient burial places, since many Corded Ware burials can be identified as late additions.

The exploitation, in the later Funnel Beaker culture, of secondary animal products, such as milk and wool, began to change the overall role of cattle and sheep, leading to an increase in the sizes of herds, which, in turn, led to a demand for larger expanses of grazing land. There was a gradual opening of the landscape in eastern Denmark, but the clearest evidence for this process comes from western Jutland. There, analyses of old land surfaces preserved under Single Grave barrows have shown not only a progressive uptake of new landscapes at the time of the transition but also a conversion of vast areas into permanent pastures.

With reference to the basic material culture of the Corded Ware, elements such as beakers, amphorae, the use of cord in decoration, thick-butted flint axes, and indeed weapons in the form of the battle-axe were already familiar types, although they clearly acquired different social significance. Indeed, within the social sphere of the later Funnel Beaker culture, one may point to the progressive shift toward recognition of the individual through the increased presence of small, single graves. This is most dramatically illustrated by the so-called stone-packing grave cemeteries from western Jutland, where Corded Ware barrows with individual graves are found in large numbers (fig. 2). Moreover the emphasis on tools and weapons, rather than ceramics, in the ceremonial and funerary activities of the Corded Ware also may be said to have begun within the Funnel Beaker culture. Toward the end of the TRB, deposits in waterlogged environments and offerings in front of megalithic tombs and in association with other forms of burial—particularly the stone-packing graves—consist predominantly of stone and flint tools and weapons, with ceramics no longer fulfilling an important communicative role.

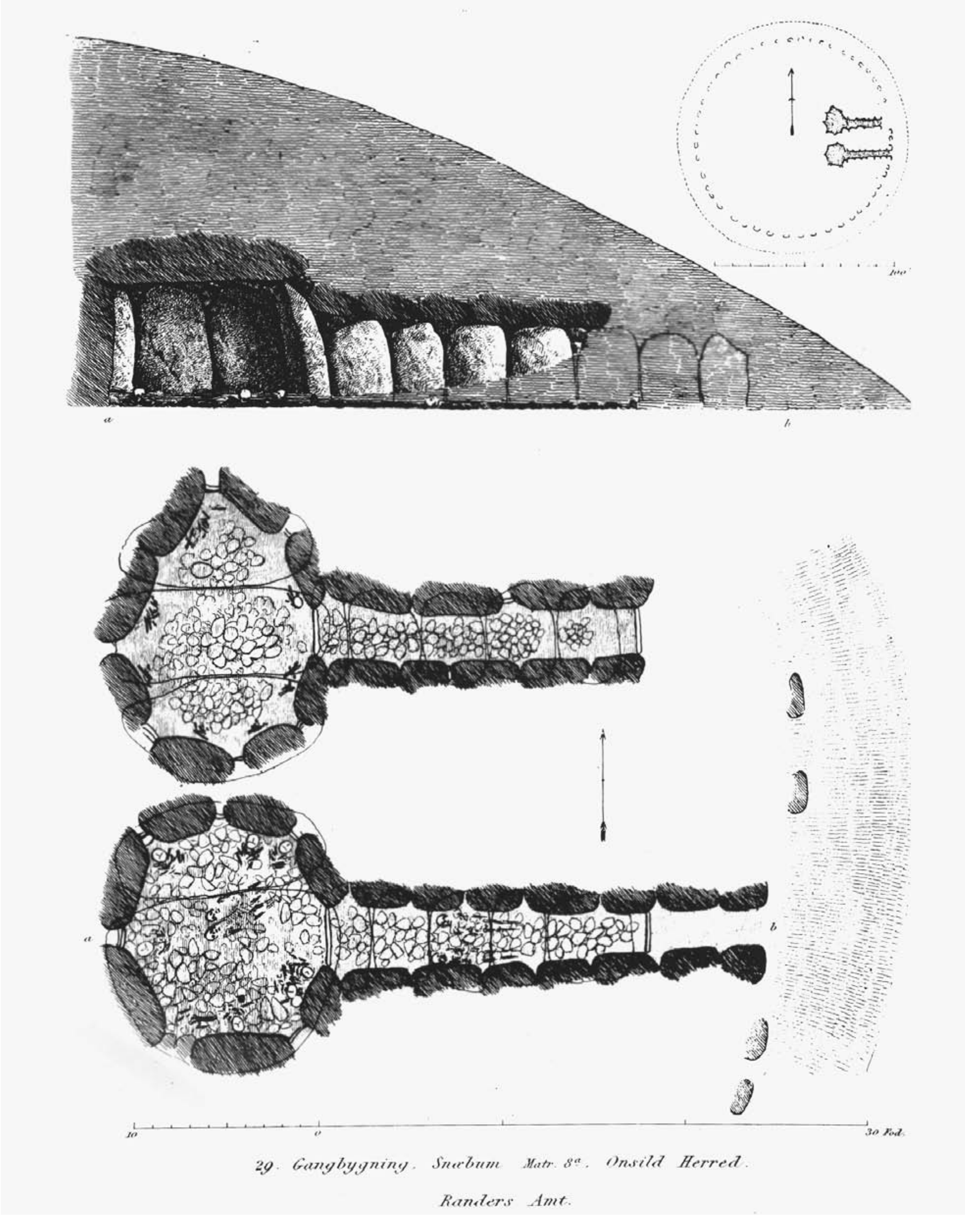

Fig. 2. Snaeburn Passage Graves, Jutland, with complex burial deposits. FROM MADSEN 1900. COURTESY OF MAGDELENA S. MIDGLEY.

Thus irrespective of the wider, pan-European processes of cultural change toward the end of the third millennium B.C., the developments in southern Scandinavia demonstrate that it was local traditions, rather than extraneous ideas, that shaped the cultural patterns for the next millennium.

CONCLUSION

The Early Neolithic of northern Europe, in its Funnel Beaker cultural manifestation, is a consequence of extensive and prolonged contacts between the indigenous hunter-gatherers and the more southerly farmers. The southern Scandinavian hunter-gatherers played an important role in this historically significant process. While intellectual orthodoxies see the Neolithic economy as leading to social and ideological changes, the evidence from southern Scandinavia and from other regions of the North European Plain indicates that there the change in subsistence and diet may not have been the prime mover.

The archaeological record indicates that, whereas the proportion of domesticated foodstuffs was increasing steadily if slowly, the principal changes originated in the sphere of ideology and social relations. It was here that the dynamic and competitive nature of the late hunter-gatherer communities found a path for expressing new social, religious, and undoubtedly, political needs. This ultimately led to the emergence of an entirely singular vision of themselves and the world around them—the world of the northern European Neolithic farmers. This new world, however, was never static. It possessed its own energy, which was able to sustain new initiatives for more than a millennium and which, in its turn, contributed to subsequent cultural patterns across the whole of southern Scandinavia.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*); **Sarup** (*vol. 1, part 3*); **Corded Ware from East to West** (*vol. 1, part 4*).

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MAGDALENA S. MIDGLEY

PITTED WARE AND RELATED CULTURES OF NEOLITHIC NORTHERN EUROPE

FOLLOWED BY FEATURE ESSAY ON:

The arrival of farming in northern Europe around 4000 B.C. changed substantially the life of prehistoric communities in the Baltic Sea basin and southern Scandinavia. Archaeologically, this event was marked by the development of the Funnel Beaker (also known as *Trichterbecher,* or TRB) cultural tradition—indeed, in the view of most scholars, Funnel Beaker culture arose as a result of the adoption of new farming practices and cultural traditions (such as new ways of making pottery, production of long-bladed flint and of polished stone tools, and new burial practices and house construction) by the local hunter-gatherer communities after a prolonged period of contact with the first farmers to the south, in central Europe. In terms of lifestyle changes, these hunter-gatherers-turned-farmers adapted farming to the local conditions by placing emphasis on stock keeping, by building more permanent villages away from coastal locations and shifting from a largely marine diet to one that was more terrestrial, and by developing complex ceremonies and rituals having to do with the celebration of ancestors and the burial of the dead. In the landscape, such rites were symbolized by earthen long barrows, megalithic chambered tombs, ritual earthworks, such as ditch and bank enclosures (causewayed camps), and other impressive structures. But northern Europe's first farmers also continued with hunting and gathering, and in terms of land use, their strategies to some extent followed earlier land use patterns, prompting some researchers to agree with Per Johansson's suggestion that farming "was only one ingredient in locally varying subsistence practices." The health and life span of the Funnel Beaker people remained broadly the same as that of their hunting-gathering ancestors.

However, this process of "Neolithization," marked by the dispersal of the Funnel Beaker tradition, covered only the southern part of northern Europe: Denmark, Scania, central Sweden, and coastal southern Norway. To the north and east, vast areas of northern Europe continued to be inhabited and utilized by hunting and gathering communities that now engaged in contact and exchange with the Funnel Beaker and similar farming settlements as they became a part of a new agricultural frontier zone. Such communities developed their own ways of coping with the challenges and opportunies offered by the relative proximity of the farming world; they made changes and adjustments, while at the same time retaining a hunting-gathering lifestyle—in some cases, into the historical period. This is a fact little appreciated by most scholars of European prehistory, who tend to see the introduction of farming into northern Europe as the end of the hunting and gathering communities there. But the history of hunter-gatherers in Europe did not end five thousand or six thousand years ago. In eastern and northern Europe it continued for another two or three thousand years, and in some regions, hunter-gatherer communities—transformed into reindeer herders and commercial hunter-gatherers—have continued into the twenty-first century. Pitted Ware and related cultural traditions in northern Europe form an early stage in this exceptional cultural development.

IDENTIFICATION AND LOCATION

Pitted Ware culture is defined by a characteristically shaped ceramic, which is round-based or pointed-based as well as flat-bottomed and which is decorated by rows of pits and incisions pressed into the body of the pot before firing. In shape and decoration, this ceramic reflects influences from northeastern Europe, where a major ceramic tradition became established in the sixth and fifth millennia B.C. Known as Combed, or Pit-Comb, Ware, this tradition originated probably in eastern Siberia and China in the Late Palaeolithic and so constitutes the oldest ceramic tradition anywhere. Although Funnel Beaker technological and stylistic elements are evident in Pitted Ware—demonstrating close relations between the two communities—Pitted Ware as a whole represents the westernmost extension of this ancient ceramic tradition.

The repertoire of Pitted Ware cultures varied from region to region, reflecting perhaps the heterogeneous nature of this tradition: that is, in each region, different ancestral communities participated in the constitution of the local culture. For example, the manufacture of stone tools reflected regional sources of raw materials, as did the production and stylistic variation of stone axes. One fairly widespread element of Pitted Ware culture was the use of fishhooks, harpoons, and nets and sinkers, as well as the use of lanceloate flint points (arrowheads or spearheads), which were sometimes serrated or fixed with a tang (or both) and which were probably used in the hunting of marine mammals.

Pitted Ware settlements are located in coastal regions of northern Europe: along the southern coasts of peninsular Scandinavia from southern Norway to central ("middle") Sweden, along the northern coast of Jutland, and on major islands in the Baltic: Öland, Gotland, and Åland between Sweden and southern Finland. There are some Pitted Ware sites in the interior, such as Alvastra, but such locations tend to be multicultural aggreggation sites and may not have belonged to any one community. Such coastal orientation suggests a focus toward the exploitation of marine resources, and this was indeed the case.

DAILY LIFE: ECONOMY, DIET, RITUAL

Bone remains from Pitted Ware sites show that sealing, fishing, and capture of waterfowl were the mainstays of the Pitted Ware economy. The only terrestrial animal of any importance was the pig, which appears to have supplemented the diet of Pitted Ware communities on special occasions.

The economy of the Pitted Ware people, like their material cultures, varied from one region to another. Studies of seasonality of occupation on Pitted Ware sites in central Sweden (around Stockholm) suggested to Stig Welinder that, at first, Pitted Ware communities spent most of the year at their main village on the coast, making seasonal forays inland to hunt for pigs and fur-bearing animals and to engage in exchange with farming communities in the interior. Later on, islands off the coast became more important, and people switched to a seasonal exploitation of seals and other resources in the archipelago in the spring and the autumn when these resources were the most abundant.

On Gotland in the central Baltic, seals made an overwhelming contribution to the diet of Pitted Ware communities. Cultural layers of Pitted Ware settlements such as Västerbjers, Ire, and Ajvide revealed bone remains of seals, pigs, dogs, fish, and waterbirds. At Ajvide, an extensive dark cultural layer was saturated with seal train oil and numerous seal bones and was interpreted as a "seal-altar," a ritual seal-butchering area. On the nearby island of Åland, people of Jettbole seem to have treated seal skulls in a special ritual manner, and clay figurines found there combined seal and human features.

The clearest indication of Pitted Ware diet, however, comes from the stable isotope carbon and nitrogen analyses of human bones and teeth. Skeletons buried on Gotland offer evidence that seal was by far the predominant element of the Pitted Ware diet, so much so that Gunilla Eriksson has described the Pitted Ware people on Gotland as "the Inuit of the Baltic."

At the same time, however, pigs feature as an important part of bone assemblages found on many Pitted Ware sites. It is clear that pigs had to be brought to Gotland, Åland, and other islands by human agency—pigs do swim, but not that far. The size and shape of some of the pig bones suggest some sort of selective breeding, perhaps domestication. This is a classic problem for archaeology: Were these pigs domesticated? And if so, why did people eat mostly seal? Scholars have argued about this for some time. Some favor a domestic pig hypothesis; others argue for them being wild; and still others suggest that people kept semiwild "freeland pigs" that were under partial control of human beings who fed them surplus seal and fish and so tamed them without exercising much control over their reproduction. It is clear from the stable isotope analyses that none of the pigs examined had any marine input in their diets; they consumed completely terrestrial foods. This argues in favor of the wild pig hypothesis, although it does not explain how wild pigs got to be on Gotland in the first place. The evidence also suggests that pigs were consumed on ritual occasions only—the intermittent pig feasts did not occur often enough to make a mark in the stable isotope record, but they did generate enough pig bones to feature prominently in the bone remains. It is clear that the pig was a ritually significant animal: carved boar tusks and pig jaws were deposited in the graves of the Pitted Ware people.

It seems that Pitted Ware communities buried their dead in cemeteries, although most of the evidence for this comes from a single region: the island of Gotland, where around 180 graves, distributed over several burial sites, usually with associated cultural layers, were found. At Västerbjers, flat-grave inhumations contained grave goods such as ceramics; worked boar tusks; pendants of seal, dog, and fox teeth; awls, spears, harpoons, and fishhooks of bone; stone and flint axes, hollow-edge axes; flint, slate, or bone arrowheads; stabbing weapons of deer antler; bone plaques and awls; perforated bone disks; tubular beads of dentalium and cylindrical bone beads; and bones of seals and pigs. Slate artifacts, battle-axes, and several other artifacts testify to far-ranging contacts with other regions of the Baltic and northern Europe. All age groups, from children to mature adults, were buried in the cemetery. Although there is some variation in the grave goods, there is no clear pattern indicating a special social standing by gender, age group, or any other grouping. It seems that grave goods reflected life history and social status on an individual basis. The time span of the cemetery has been radiocarbon dated to 2850–2500 B.C.

ORIGIN, DURATION, AND SIGNIFICANCE OF PITTED WARE CULTURE

The origin and duration of the Pitted Ware culture have been a matter of some debate among prehistorians. On the one hand, the Pitted Ware tradition has been represented as a wholesale return of the Neolithic society to hunting after the initial experiment with farming: Fredrik Hallgren, for example, maintains that "farmsteads in the interior were deserted in favour of coastal settlements, where the main livelihood was fishing and sealing." On the other hand, Pitted Ware culture is regarded by some researchers as an offshoot of an essentially farming society: they see Pitted Ware societies as pig-herding farmers who occasionally cultivated cereals, or else they view Pitted Ware artifacts as a signature of Funnel Beaker or Corded Ware farmers who might have traveled to the seaside to get some fish and seal. Another view, however, rejects both of these interpretations. As Gunilla Eriksson correctly notes, Pitted Ware was a hunter-gatherer society with its own sense of identity. The clue to its existence lies in the history of contacts between foragers and farmers in the first five hundred years of Stone Age farming in southern Scandinavia (4000–3400 B.C.).

Pitted Ware culture seems to have arisen in the fourth millennium B.C., and its tradition falls into a time between 3500 and 2500 B.C. The culture emerged in the context of two events. First, it coincided with the disappearance in some regions of the first farming settlements of the Funnel Beaker tradition, which for the previous four hundred years had occupied the interior regions of the southern part of Scandinavia. And second, it was associated with the strengthening of contacts and exchange with hunting-gathering communities in Finland and the eastern Baltic, evident in artifact imports and stylistic traits. Pitted Ware tradition was replaced in most regions by the Corded Ware culture before or by 2500 B.C., which in turn gave rise to a range of cultural traditions combining Pitted and Corded Ware elements in the Early Bronze Age.

Pitted Ware culture, represents a broader historical development: a case of innovating hunter-gatherers active in a contact zone between foragers and farmers. As people adopted farming practices within the context of the Funnel Beaker culture, hunting and gathering traditions were not forgotten. After a few generations, coastal regions—where fishing and sealing presented a more viable alternative to farming for subsistence—returned to a hunting and fishing lifestyle, with seal and pig forming the focus of activities. This shift in emphasis was supported by the presence of agricultural communities inland and farther afield (as in Denmark and Poland), where the demand for seal fat and oil, furs, and perhaps various forest products supported the development of specialized hunter-gatherer strategies for trade. The presence of large amounts of ceramics, the size of the pots, jars with remnants of seal oil, and mineralogical indicators of the movement of pottery between Pitted Ware sites and the southern shores of the Baltic all suggest such trade. Within a few generations, these activities created a separate set of communities with a separate set of symbolic expressions: the Pitted Ware culture. The model for these symbols was provided by contact with the cognate hunter-gatherer communities farther east: perhaps Pit-Comb Ware in Finland, Combed Ware cultures in the eastern Baltic, and other similar groups.

Pitted Ware culture was eventually absorbed into a foraging-farming society of the Early Bronze Age about four thousand years ago. But the set of strategies its people generated provided a viable alternative to becoming farmers. These strategies focused on contact and exchange with the farming world, while remaining a hunting and gathering community. Such use of the agricultural frontier zone was also developed successfully by many other foraging communities in northern and eastern Europe, as the evidence from large, weathy villages such as Kierikki in northern Finland or Sarnate in Latvia indicate. Augmented by fur trade and reindeer husbandry, commercial hunter-gatherers—a lifestyle pioneered by the bearers of the Pitted Ware culture—has been continuing successfully to the present day.

See also **Ajvide** (*vol. 1, part 4*).

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MAREK ZVELEBIL

AJVIDE

Ajvide is a large settlement and cemetery on the west coast of the Swedish island of Gotland in the central Baltic Sea. It belongs to the Pitted Ware culture, chronologically placed in the Middle Neolithic, but this is a case where the term "Neolithic" does not carry with it the usual connotations of agriculture.

Gotland is a large island, measuring some 130 by 70 kilometers, located about 85 kilometers off the coast of Sweden and twice that distance from Latvia; it was never joined to either mainland but has been an island since the retreat of the Ice Age. It has a spectacular archaeological record and often has been considered culturally distinct from mainland Sweden. The longest archaeological sequence comes from the cave site of Stora Förvar, on a small island just off Gotland's west coast. This site reveals occupation from early in the Mesolithic, based mostly on marine resources: fish, seals, and birds. Early excavations also yielded pig bones, but direct dating of these bones has indicated that they are later intrusions into the Mesolithic layers. The largest terrestrial mammal on Gotland in Mesolithic times was the hare, an animal that could have colonized the island by crossing the sea ice that forms in the cold winters. Pigs, weighing far more than hares, apparently could not have colonized the island in this way.

Gotland was the northeasternmost limit of the Early Neolithic expansion of farming. During the time of the Funnel Beaker culture, farmers introduced cereals, cattle, sheep, and pigs, and for some centuries they exploited the interior of the island—a settlement pattern markedly different from that of the predominantly coastal Mesolithic. Carbon isotopes from the food people eat can be recovered from their bones and give a clue to their diet, because there is less carbon 13 in seafood than in terrestrial food; at Ajvide the change toward a terrestrial diet is reflected in the carbon-13 measurements from human bones. Because the Baltic Sea was always brackish rather than very saline, the Mesolithic human remains from Gotland produced a carbon-13 result that in the North Sea area indicates only a partially marine diet; in the Baltic, however, it probably represents a diet based almost completely on marine foods. In the Early Neolithic the diet was as fully terrestrial as in other agricultural areas.

Ajvide is the most important of the sites that show what happened during the early part of the Middle Neolithic: a recession of agriculture and a resurgence of coastal hunting and fishing. The carbon-13 measurements indicate a diet as thoroughly marine as in the Mesolithic, reflected in the coastal settlement pattern: the interior of the island (once again) was largely unoccupied. It is not clear why hunting and fishing regained preeminence at this time, but one factor may have been a small rise in sea level. This rise increased the salinity in the Baltic, enriching and expanding its natural resources. It is even possible that the harp seal established a short-lived breeding population at this time.

In any event, the coasts of Ajvide were occupied from c. 3300 to 2900 B.C. by coastal hunters and fishers of the Pitted Ware culture. Conditions of preservation are excellent: the site has yielded 2 tons of pottery and 3.5 tons of animal bones. Some seventy graves have been excavated, containing skeletons of varying ages, including an unusually high proportion of children. Adult graves contain diverse grave goods; one individual was buried with a large number of pig jaws and others with ceramics, harpoons, and fishhooks. Remarkably, some of the children have harpoons just as impressive as those of the adults, even though they were too young to have been proficient hunters.

Status, at least as reflected by grave goods, may have been inherited rather than attained. One of the most remarkable graves held the skeleton of a twenty-year-old woman. Across her knees was a row of perforated teeth of seal, fox, and dog, which may have been attached to the hem of a garment. On her breast were the jaws of five hedgehogs, and around her head were many hedgehog spines, apparently the remains of headgear made of hedgehog skins.

Hunter-gatherers did not usually establish cemeteries unless they lived in fixed settlements and claimed ownership of the land they occupied. Such permanent settlements were occupied for extended periods of the year or were occupied year-round. Ajvide may well have been inhabited all year: pigs were killed during the autumn and winter, seals were hunted in winter and spring, and the numerous fish would have been most easily caught during the summer. The major economic difference between Ajvide and sites of the Mesolithic is that pigs were present at Ajvide. Some researchers have argued that pigs were domestic and others that they were wild; this question remains unresolved.

Ajvide has produced many postholes, although it is difficult to isolate the ground plans of individual structures. In the center of the settlement was a large black area several meters in diameter caused by the spillage of large quantities of oil rendered from

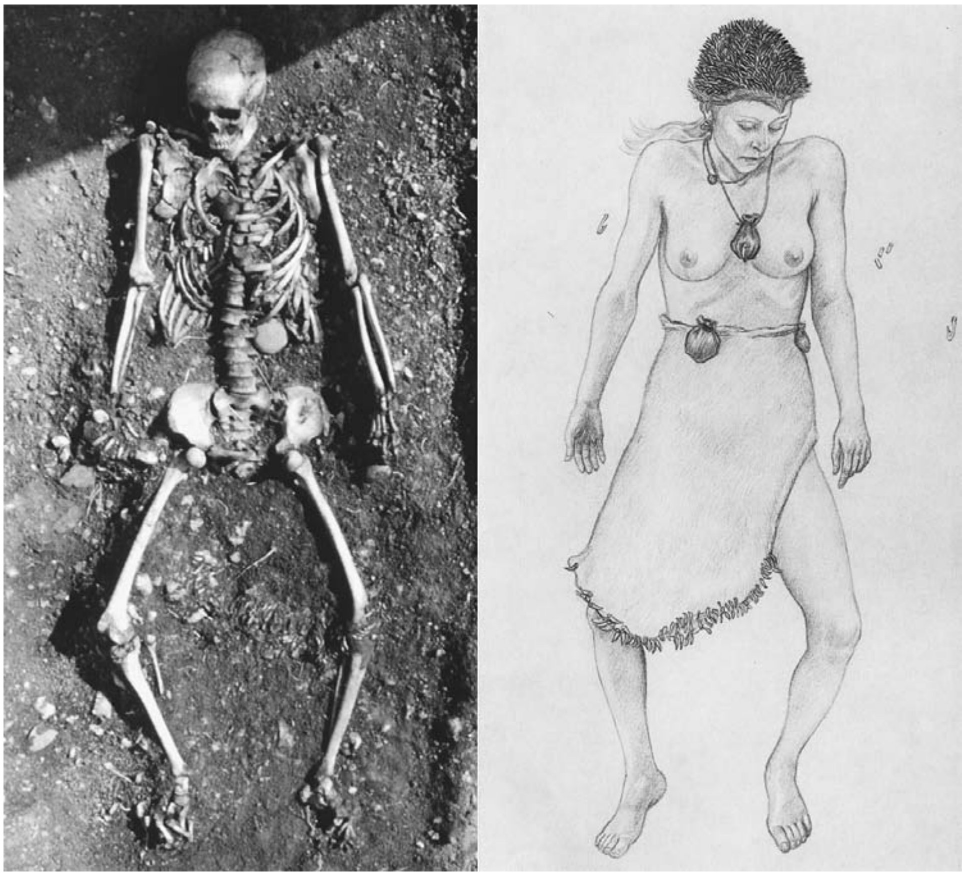

Fig. 1. Ajvide grave 2 as excavated (left). Reconstruction of interment (right) showing animal teeth on garment hem, bag containing five hedgehog mandibles on breast, and hedgehog-skin cap. Göran Burenhult. Reproduced by permission.

seal blubber, the smell of which was unmistakable during excavation. This could have resulted from purely economic activity, but at Ajvide the area may have had ritual connotations. The oil patch was demarcated by a series of large postholes, and the graves were placed in an arc around it. Some of the graves themselves were impregnated with seal oil. An economic product as valuable as seal oil may well have been imbued with ritual meaning.

After some centuries, agriculture returned to Gotland, and Ajvide was abandoned. Modern excavation and the application of scientific techniques have revealed the primary importance of Ajvide among the Pitted Ware sites on Gotland. The site shows that the appearance of agriculture need not have been an irreversible process and that under certain conditions hunting and fishing were a viable alternative, at least in the medium term.

See also **The Mesolithic of Northern Europe** (*vol. 1, part 2*).

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PETER ROWLEY-CONWY

LATE NEOLITHIC ITALY AND SOUTHERN FRANCE

FOLLOWED BY FEATURE ESSAYS ON:

Mediterranean southern France and Italy were closely linked in the Late Neolithic era, sharing similar climates, landscapes, and natural resources as well as modern boundaries. The Alps along the northern limits of Italy and eastern France linked communities together within a common cultural milieu, the Lagozza-Chassey cultures, which were also linked to the Cortaillod culture of Switzerland. The Tyrrhenian coasts of western Italy and southern France were likewise linked, sharing Neolithic origins in the western Mediterranean Cardial culture. Cardial culture represented the primary introduction of domesticated plant and animal species in the western Mediterranean and is characterized by its pottery decorated with shell impressions, known as the Cardial Impressed style. From central Europe, different "Danubian" and Balkan-Neolithic processes had an impact on central France and northern Italy, through distinctive pottery forms, shell ornaments, styles of lithic technology, and settlement from the late seventh millennium through the late sixth millennium across central and southwestern Europe.

The region's topography is remarkably mountainous (it includes the ranges of the Alps, Pyrenees, Apennines, Sila, and the Massif Central as well as the Languedoc and Provence Garrigues); it is a landscape made up of dry limestones and other rocks, with lowlands restricted to the major river valleys and the limited plains of the Tavoliere and Catania. Such topography restricted opportunities for rapid economic or social developments over many areas, until the new technology and social systems of the Bronze Age hastened change.

In general, the Italian Peninsula and Sicily and Sardinia retained distinctive cultural characteristics during much of the Neolithic, often rather isolated from neighboring lands, whereas the north of Italy, with its shared Alpine margins, was more connected with cultural developments in central and western Europe. In the Late Neolithic, the French Chassey, the northern Italian Lagozza, and the Swiss Cortaillod cultures all developed in parallel, using similar pottery and artifact assemblages, even though local conditions dictated different settlement and economic styles. Some raw materials, especially hard Alpine rock for axe manufacture, flint, and the rare island sources of obsidian (especially from Sardinia and Lipari), promoted active economic contacts across considerable distances by land and sea.

The Neolithic traditions of megalithic architecture were adopted during the Neolithic–Copper Age in the western Mediterranean, particularly in

France, Corsica, and Sardinia, whereas megalithic constructions in Italy were rare, limited to Bronze Age Apulia in the southeast.

KEY ARTIFACT TYPES AND STYLES

The cultures of the Italian Late Neolithic are most easily defined through their pottery. They fall into distinctive regional styles and separate the peninsula from the Po Valley and Alpine zone through finely made and distinctive forms and decoration. The general trajectory of pottery style development in both Italy and southern France follow similar paths, with local ceramic styles of the later Middle Neolithic period subsumed within very large "cultures" in the Late or Final Neolithic, only to fragment again into regional groups in the Copper Age.

Pottery. In southern Italy, distinctive painted ceramic fine wares represented highly valued commodities. Across Italy, pots were widely traded—along with obsidian, fine lithics, and polished axes—in networks that connected the Po Valley with the south. Such high-prestige goods were often deposited in graves and cult sites far from their places of origin. The production of such pottery had its origins in the earliest Neolithic painted pottery. By the Late Middle Neolithic, distinctive Trichrome pottery styles (c. 5000–4300 B.C.), first the Lipari, Scaloria, and Capri styles and then the Ripoli of central Italy and the Serra d'Alto of the south and Sicily, dominated the fine wares in circulation. Comprising jars, cups with elaborately modeled handles, and miniature flasks, the forms typically had rounded, flared rims and were decorated with curvilinear, "flame," and geometric painted patterns.

The later phase of the southern Italian Late Neolithic was characterized by a uniform pottery culture—the so-called Diana-Bellavista type. This was a red-slipped and burnished pottery that evolved between c. 4300–3700 B.C., comprising forms that ranged from globular jars to highly carinated bowl shapes but always with distinctive rolled, trumpet-shaped lug handles. As in the Middle Neolithic, much of this material was deposited in graves and cult sites and was extensively traded alongside obsidian, especially obsidian from Lipari. Pottery of this type is especially known from the cemeteries of Bellavista near Taranto and Contrada di Diana on Lipari. Local ceramic styles (such as brown-slipped wares) were maintained at sites such as La Romita di Asciano near Pisa and Norcia in the Umbria areas of Tuscany, Umbria, and Marche alongside imported Diana-Bellavista and Lagozza elements (trumpet lugs and scratched geometric patterns). The end of the Neolithic in the peninsula is marked by the darker ceramic styles of the Copper Age. Several phases and cultures create a complex picture for this era, but essentially, smooth, burnished, rounded forms, one- and two-handled cups, jars, flasks, bowls, and large storage vessels typify the central Italian Rinadone and Conelle-Ortucchio and the southern Italian Gaudo pottery styles.

In northern Italy, the cultural sequence of the mid–Late Neolithic saw a variety of earlier ceramic styles spread across the Po Valley and take hold in the surrounding mountain region. The Middle Neolithic in the north had been dominated by variations of the Square-Mouthed pottery culture. For example, in the eastern plain, the Quinzano (represented at La Vela in Trento) was a late Square-Mouthed pottery with incised curvilinear (*meandro-spiralico*) decoration. The pottery typically had a flared four-sided shape rising from rounded bases and foot rings, and it took the form of jars and cups, often decorated with bands of incised patterns. Assemblages included *pintaderas,* or clay stamps, with spiral patterns, possibly used for body painting or fabric decoration. The central part of the western Po Valley and the Alps maintained local forms, such as the Isolino of Lombardy with its coarser incised and cordoned pottery, normally modeled as open bowls with footed bases and handled jars. By the Late Neolithic, as in southern Italy, local styles were subsumed within a broad cultural identity—Lagozza. The dark, burnished pottery of this group ranged from wide open (and often sharply carinated) and wide, flat bowls to narrow-necked, wide-bellied jars, characterized by vertical "panpipe" lugs and small button lugs around the rims and vessel bodies. Incised geometric decorations, carefully and precisely scratched, were applied around the inner rims of bowls and in bands around the bodies of some pots. The Lagozza style was replaced by the Copper Age Remedello pottery, which contained Beaker elements together with rounded and carinated forms and angled strap handles reminiscent of those in peninsular Italy.

The sequence of pottery styles in Liguria links Italy and France. Sites such as the Arene Candide cave in Liguria include classic Lagozza and Chassey material. The Cardial Impressed pottery of the Early Neolithic of southern France was replaced in the Middle and Late Neolithic by pottery from the almost ubiquitous Chassey culture. The Chasséen du Midi pottery types of the south are finely made bowls, jars, and plates, often with carinated or baggy round-based profiles. The repertoire of incised geometric motifs around the body of the vessel together with lugs, buttons, and suspension handles and the characteristic vertical panpipes parallel the Lagozza style. Extravagant patterns were applied to vase supports in central France and beyond, and sometimes pots were encrusted with white or red paste to enhance the patterns. Elements of the French Chassey continued in local styles in the succeeding Final Neolithic–Copper Age. The Véraza and Ferriéres styles occur in the western areas of southern France (in the Pyrenees and on the Aude), employing hachured triangle patterns on the pottery. Farther east, in Provence and Languedoc, the Treilles group on the (Grande) Causses and the Gourgasien–Saint Ponien groups in Languedoc have plain and decorated pottery, often with cordons and geometric incised bands together with asymmetrical and crenellated arrowheads and distinctive winged beads. The Fontbouisse culture of the Late Neolithic extends into the Copper Age and is characterized by jars and carinated vessels that have channeled, incised, and impressed patterns arranged in distinctive checkerboard and garland designs. Broadly speaking, the mainland pottery styles link loosely with those of the Tyrrhenian Islands, where the Corsican Terrinien and Sardinian Bonu Ighinu–Ozieri cultures developed in parallel.

Stone. The lithic assemblages of Late Neolithic peninsular Italy are characterized by the production of large, long blades that replaced lingering microlithic traditions. Tools were retouched, forming triangular, leaf-shaped, barbed, and transverse arrowheads. Lithic technology in northern Italy remained more deeply embedded in its Mesolithic origins, with geometric tranchet-blade technologies still present in the Lagozza culture. Retouching became highly developed in the Final Neolithic and Early Copper Age; large and finely flaked daggers and knives are especially characteristic of the Remedello and Rinadone cultures.

Obsidian use reached its maximum level of use in the Late Neolithic, with the massive exploitation of the Lipari source. Work by A. J. Ammerman at Piano di Curinga in Calabria, close to Lipari, showed how coastal communities there specialized in the reduction and working of raw obsidian, presumably for onward trade. Sardinian obsidian from the Monte Arci sources was also traded—north to Corsica and southern France from the sixth millennium B.C.—and has been found throughout the Midi and southern Languedoc. Areas such as the Adriatic coast, distant from obsidian sources, generally had little material in their assemblages and instead made use of local flint and chert. Fine flint was mined from early in the Neolithic on the Gargano Promontory in northern Apulia at sites such as Defensola, and it was traded over considerable distances. Fine honey flint in the Lessini Mountains of Veneto was similarly prized and is found across northern Italy. The Copper Age Ice Man had Lessini flint in his kit. In France, local flint supplied regional needs, although mined sources like Le Grande Pressigny in west-central France clearly dominated trade across the region for some artifacts.

Polished volcanic and metamorphic stone (such as nephrite, amphibolite, and jadeite) was highly prized for the production of axes, adzes, and polished stone rings, amulets, and beads. The sources of these rare and widely spaced rocks were in the Maritime Alps of France and Italy and the Sila of Calabria. Finished objects were traded across the western Mediterranean, even as far as Malta, Britain, and northern France; for example stone rings of chlorite were prized in northern Italy (and Sardinia). Other functional stone sources (suitable for grindstones, querns, hammers, and ornaments) were located in many rocky areas, such as the Alps and the Massif Central, and supplied axes across France and Italy.

Other Materials. The emergence of metal use in the Copper Age was manifested in the appearance of copper flat axes, halberds, daggers, pins, rings, and knives in the Lagozza, Remedello, and Fontbouisse cultures together with rare ornaments of gold, silver, or both (especially in the Remedello and Gaudo cultures). The wetlands of northern Italy have preserved organic materials and artifacts from the Late Neolithic and Copper Age, including bone fishhooks and wooden bowls, combs, tools, hafts for axes, arrows, and bow fragments. These offer a parallel to the extraordinary preservation of the Swiss and French Alpine lake dwellings and indicate the technologically rich world of the Late Neolithic–Copper Age communities in the region.

Dating. The Late Neolithic in Italy and southern France spans the mid-fifth millennium to the mid-third millennium B.C., with local sequences of differing lengths and antiquity. The presence of local metal ores provided technological triggers in areas such as Tuscany and the Alps, with the emergence of early metalwork erupting by the end of the fourth millennium B.C. Organic remains from wetland sites—Lagozza and Remedello, for example—offer potential for detailed dendrochronology and thus for increased understanding of local sequences. However, the period is still one where cultures changed slowly and, in many cases, persisted for more than half a millennia.

HOUSE FORMS AND SETTLEMENT PATTERNS

Early Neolithic settlement sites included rock shelters and caves, as at Arene Candide in Liguria, Grotta del Santuario Della Madonna at Praia a Mare in Calabria, and Grotta dell'Uzzo in Sicily, as well as open settlements along coasts, plains, and river valleys. Detailed settlement evidence in southern Italy for the Late Neolithic is surprisingly sparse in comparison to the great ditched earlier sites, with few extensively excavated examples. Site locations were invariably closely linked to good agricultural soils in lowland plains, basins, and valleys, and surveys have indicated expansion during the Late Neolithic into more marginal areas, including low hillsides and terraces, generally below 400 meters. A survey of the Acconia area in Calabria showed how the density and size of settlements increased in the Late Neolithic, often extending more than 2 kilometers. Surveys suggest that sites covered several hectares but that enclosure ditches or walls were not used to define the limits. Huts were substantial, made of wattle, daub, and timber; hearths, pits, cobbled floors, and paving are known. In rocky upland places, stone walling was used in construction. Similar evidence for Late Neolithic expansion emerged from surveys of the Ofanto Valley and the Biferno Valley in Southeast Italy, confirming the general pattern of population and settlement increase from the fifth to the fourth millennia B.C.

In central Italy the semiditched site of Ripoli in the Abruzzo extended some 300 by 120 meters across and contained about fifty structures arranged in small groups of 3 to 6 houses and middens closely associated with burials. Other Ripoli culture sites indicate similar evidence, and the ditch-enclosed Pianaccio di Tortoreto contained some eighty structures. Houses at Santa Maria in Selva ranged from 5 to 10 meters long and were divided internally with hearths. Settlements consisting of sunken floors or large pits of 1.5 to 5 meters in diameter from Catignano and Pianaccio are the substructures of houses that otherwise consisted of stone spreads, cobbles, wattle and daub, and timber. Some sites had specialized areas for industrial activity, such as the trampled floors remaining from obsidian working at Torre Spaccata in Lazio. Toward the end of the Neolithic, survey suggests that settlement numbers declined, as semifortified, larger, and more centralized locations were selected.

The evidence from northern Italy is very different, since organic survival in the Po Plain has enabled more complete preservation. From early in the Neolithic, timber structures, pits, and gullies built close to rivers and lakes demonstrate effective wetland settlement and exploitation. Some sites were strategically placed, such as the prominent hill of Rocca di Rivoli in Veneto. This site had scant traces of ditches, pits, hearths, and dumps of burned daub. La Vela in Trento was arranged at the head of a valley, with terraces, ditches, alignment of postholes, and rectangular cobbled surfaces suggesting dwelling areas. Defensive sites were selected to control hillsides and access points across the plain and mountain areas. The Late Neolithic Lagozza culture exploited caves in some areas, but most settlement preferred lowland or terrace locations. Wood platforms as at Remedello and Fiavè were constructed at the edges of lakes; settlements formed at these sites are similar to those known from the Swiss, French, and German Alpine lakes and anticipate the later *terremare* Bronze Age lake settlements.

In southern France as in Italy, there was an increase in the number of settlements in the Late

Neolithic. Several hundred sites—both caves and open settlements—in Provence alone have produced Chassey material. Although few have been fully excavated, Saint Michel-du-Touch near Toulouse provides remarkably complete evidence, with its multiple ditches, palisade trenches for tree trunks, and some three hundred cobbled zones indicating houses, hearths, and pits. The site is located on a 30-meter-high promontory at the confluence of the Garonne and Touch Rivers. Nearby Villeneuve-Tolosane forms a 30-hectare concentration of settlement, comprising more than 200 structures arranged as hamlets, each 50 to 100 meters apart. Chassey sites varied considerably in size across the region, though most are smaller. Caves and rock shelters were maintained in use through the Neolithic, probably as seasonal shelters for pastoralists.

In the final Neolithic to transitional Copper Age period, an increased number of settlements with stone-built longhouses were constructed, and some of these are well preserved in Languedoc and Provence, on the limestone plateaus or in the Garrigues. The finest sites belong to the Fontbouisse culture of Languedoc (in Hèrault, Gard, Ardèche) and consist of clusters of up to 50 closely packed drystone-walled longhouses, each up to 15 meters long and varying considerably in size. Some sites included an extra-large communal house. Typical Languedoc house plans at La Conquette and Gravas showed each house was a separate unit, containing several different activity areas. Hearths against the rear wall faced the main entrance and artifacts were scattered in discrete groups, including storage vessels lined along the end walls. Some Fontbuisse sites in Languedoc (Boussarges and Lebois) had enclosure walls incorporating several circular "tower" constructions, suggesting the sites were highly fortified, although some scholars believe the enclosures were stock enclosures. Open settlements on the coastal plains and in the Rhône Valley comprise similar elements, although without the drystone constructions. In Provence, the Couronne culture comprised settlements on the limestone landscape of stone and timber houses associated with small plots of arable land.

SUBSISTENCE DATA

The Late Neolithic saw the establishment of more intensive and productive cereal and pulse production across large areas of the lowlands of Italy and southern France. New introductions included several varieties of wheat (including bread wheat) and barley together with peas, broad beans, lentils, flax, and a wide variety of collected fruits and nuts. Stock animals were generally dominated by caprines in the south, with smaller numbers of cattle and pigs, and pigs seem to have declined in Italy as forest browse was removed. In central Italy the balance of stock gradually changed from a mainly caprine-based economy to one dominated by cattle and pigs, and some sites were clearly highly specialized for one type of animal. In the mountains of Liguria, analysis of the fauna from Arene Candide suggests that caprines and probably cattle were milked early in the Neolithic, confounding the popular belief that secondary products were a later development. The study also showed that pigs were only domesticated in the Late Neolithic, since wild boars had supplied pork throughout most of the Neolithic. Hunted animals, especially red deer, were significant in some cult deposits, such as the Apulian caves of Pacelli, Cala Colombo, and Ipogei Manfredi and the Apennine caves of Abruzzo and Tuscany, although probably hunted food never amounted to more than a small part of the food supply at these sites. Significantly, many areas became less intensive in the Late Neolithic, as settlement expanded into less-productive landscapes. In particular, the Lagozza economy in the Po Valley seems to have become extensive, showing a greater reliance on fishing and hunting alongside herding, cereal farming, and the development of secondary products and pig production in the wooded areas. As more marginal land was exploited for grazing, seasonal movement between the mountains and the coastal plains prompted the development of long-lived transhumance. In southern France, similar patterns of mixed farming were practiced, with caprines the dominant stock over most of the Garrigues and uplands and cattle and pigs only significant in lowland, valley, and coastal areas. The importance of hunted and gathered food also declined in the Late Neolithic in France, although river valleys, coastal zones (such as the Rhône Delta), and the dry uplands may have had more specialized economies focused on wild foods, fish, and hunted animals. Transhumance was likely to have been practiced in the Late Neolithic–Copper Age, with the seasonal movement of stock from upland to lowland, and this is attested by the large numbers of cave sites used as temporary shelters containing artifacts and animals remains.

TRADE, EXCHANGE, AND INTERREGIONAL CONTACT

The emergence of the western Mediterranean obsidian exchange network demonstrates the scale and complexity of Late Neolithic interaction. The scientific recognition of the different island sources (Lipari, Pantelleria, Palmarola, and Sardinia), through neutron activation and chemical analysis, has provided new insights into the changing components of Neolithic assemblages.

The main obsidian sources during the Neolithic were Sardinia and Lipari; obsidian from these two islands circulated widely in central and northern Italy and southern France alongside the inferior Palmarola material in the Middle Neolithic. By the Late Neolithic, the pattern of distribution was dominated by Lipari obsidian, so at Arene Candide, the balance changed from Middle Neolithic levels, in which equal quantities of obsidian originated in Lipari, Sardinia, and Palmarola, to Late Neolithic levels, where only some 13 percent of the assemblage came from Sardinia and 87 percent came from Lipari. The same pattern seems to be borne out across northern Italy, and caches of cores have been located at what may be redistribution centers in the Apennines at sites such as Pescale. In France, the situation is less well understood, but Sardinian obsidian certainly competed effectively with local flint sources across much of the Rhône Delta, the coast of Languedoc, and southern Provence.

The axe and hard-stone trade also developed into an extensive network, linking the dispersed sources of raw material to consumers across the region. Greenstone and other attractive fine-grained igneous and metamorphic rock was exploited in the Maritime Alps, Jura (France), and Calabria and eastern Sicily; some quarry areas have been broadly identified from microscopic analysis. Local sites seem to have acted as collecting centers for onward exchange. Utilitarian axes, hammers, and grindstones were sourced from the basalt areas of the Massif Central, Basilicata, Lazio, Campania, and eastern Sicily and supplied relatively local exchange networks. Flint, although more generally available across the predominantly limestone landscapes of southern France and Italy, still circulated widely. Major flint sources were located in the Gargano of Apulia, the Ibeli Hills of southeastern Sicily, the Lessini Mountains of northeastern Italy, and across France, most famously the Grande Pressigny from the Loire, which was especially exploited in the first half of the third millennium B.C. Flints and cherts are usually identified through color and texture, and certain prized materials, such as banded, speckled, or highly colored flint and chert, had extensive distributions.

Other traded materials included fine pottery, such as the southern Italian painted pottery that occurs in the Po Valley and at Arene Candide, and the Ripoli, Serra d'Alto, and monochrome Diana styles, all circulated alongside obsidian and fine stone. Marine shells were also exchanged, including *Spondylus* and large conch shells, to regions as distant as the Abruzzi uplands. Doubtless, many organic materials moved alongside the durable objects, but of these, of course, there is no trace.

BURIAL PRACTICES

The Middle and Late Neolithic in Italy mark the transition from collective and informal burial to individual burials in formal cemeteries. In peninsular Italy, burial had been in settlement ditches and caves, often without grave goods or formal arrangement of the corpse. Bones were sometimes venerated and displayed, as at the Grotta Funeraria at Matera. In the Middle Neolithic, at the cave complex of Grotta Scaloria, multiple burials (perhaps as many as thirty to forty), loosely associated with pottery and grave goods, were part of a cult site. Nearby, however, more formal arrangements found at the site of Azzolini at Molfetta contained some fifty-six graves of individuals and their grave goods. Many of the ditched settlements included later formal burial areas, as at Serra d'Alto, where discrete cist, pit, or rock-cut trench structures contained a burial with simple pottery, lithics, and ornaments. Scoglio del Tonno at Taranto included a cemetery within a ditched enclosure of two cists and two ditch graves containing a total of eight individuals with a large number of pots and lithics. At Ripoli in Abruzzo the cemetery arrangements may reflect the social organization of the community; the trench graves, each containing between two and fourteen crouched corpses, were furnished with pottery, bone, and lithic tools. One female burial included a dog. The Late Neolithic cemetery of Bellavista near Taranto was constructed of twenty closely packed burial pits. Similar small cemeteries of pits and cists have been identified across southern Italy and Sicily.

Other burials were placed in caves used for cult activity, and frequently these had child burials, animal offerings, and an array of symbolic artifacts and ocher. Some caves—such as Grotta Latronico in Basilicata and Grotta Lattaia in Tuscany—had hot springs, volcanic steam fumaroles, stalagmites, and other curiosities that enhanced the liminal character of the burial places. In the Copper Age, more formal cemeteries and a greater emphasis on the dead developed, including large and often richly furnished cemeteries, such as Laterza in Apulia, Gaudo in Campania, and the many Rinadone cemeteries of Tuscany-Lazio. These often prominently located sites involved rock-cut tombs or trench, fossa, and ditch graves that employed both collective and individual burial rites. The grave goods of these cemeteries comprised specialized funerary pottery (including flasks and cups for drinking), fine flint, ornaments, and rare metal objects. Similar formal cemetery areas close to settlements also typified funerary practices in northern Italy. At La Vela in Trento, cists formed the burial structures for carefully northwest-southeast-oriented corpses. Late Neolithic Lagozza graves were also cists and arranged in groups of up to twenty-five inhumations, as at Villeneuve and Sarre in the Aosta Valley, usually with grave goods consisting of a few pots, shells, flints, and (rarely) polished stone. These graves had much in common with the Chassey across the Alps in France. The Early Copper Age cemeteries of the Remedello involved large cemeteries of collective graves, often with more than one hundred corpses and with rich grave goods. These included copper ornaments, halberds, flint axes, daggers, and arrowheads but rarely pottery. In the Ligurian Mountains, cave burials, such as at Tana Bertrand, continued the old traditions of collective burial.

The burial structures of southern France are markedly different from those of Italy, particularly because the construction of megalithic burial monuments—dolmens—reached its peak in the Late Neolithic and Copper Age. Several hundred megalithic structures survive in varying styles, locations, forms, and sizes across the region. Cave burials also persisted, often with a hundred corpses or more placed on the floors of caves, occasionally with cremations among them. The cave of Pas de Julié in Languedoc contained more than three hundred individuals. Such burial caves were often restricted in size and ease of access—which added to their mystery and exclusiveness—and in many cases they appear to have been used for a short time only.

The dolmen burials, conversely, contain grave goods representing long and successive use, even though the numbers of burials were usually only between ten and sixty individuals. Some dolmens represent dramatic events and contain numerous bodies, stacked one upon the other, containing embedded arrowheads, presumably the result of skirmishes, as at Roaix in Provence. Typical grave goods included flint tools, arrowheads, daggers, and sickles, with rare copper objects in the later contexts. Pottery was rarely deposited in graves in Provence. The Chassey cemetery at Les Moulins à Saint-Paul-Trois-Chateaux in the Rhône Valley contained some forty trench and pit graves dating from 4400–3800 B.C. with deposits of collective burials, stones, bones, wood, and isolated human body parts. At Le Gournier near Montélimar, some twenty-eight circular pit graves contained single and multiple burials, where the skulls sometime were placed on large stones, and burials were accompanied by pottery, flint, and (rarely) animal remains. Farther west in the Aude and Pyrenees areas, similar traditions of cave burial continued, although cemeteries of cists and cairns and pit burials developed. These include the Chasséen burials at Saint-Michel du Touch and Villeneuve-Tolosane, where corpses were buried with pots, ornaments, tools, and (often) animal body parts, such as a teenage burial with hedgehog jaws and an old woman with boar's tusk pendants. Some burials suggest emergent hierarchy, with numerous grave goods and impressive, large overlying constructions.

The dolmen varied in form and shape from round cists enclosed in stones to long passages covered by slabs. Rock-cut tombs, such as those near Arles, were also in use in what was a period of widely varied funerary traditions.

ART AND RITUAL

The Late Neolithic represents a period of developing art styles: of pottery that was elaborately made and decorated, of painted and incised motifs that occurred on pottery and *pintaderas,* and of rare cave and rock art. The Grotta di Porto Badisco in southern Apulia is a decorated Neolithic cult cave that contains two long corridors and one short corridor of restricted galleries that were painted in ocher and guano. The designs compare closely with those on Serra d'Alto- and Ripoli-style painted pottery, having zigzags, cross-hatching, and mazelike patterns. Some figurative images also suggest hunting scenes, and the complex is dated across the mid–Late Neolithic. Idols and figurines were made throughout the Neolithic in Italy, with examples from sites such as Passo di Corvo in the Middle Neolithic and Arnesano (Taranto) and Grotta Pacelli (Bari) in the Late Neolithic. Rock art in the Alpine areas seems to have commenced in the Neolithic, although it was principally a Bronze Age and Iron Age phenomenon. Images from Val Camonica, Mont Bego, and other areas of the Maritime Alps represent animal and human scenes, constructions, patterns, suns, and so on, suggesting aspects of prehistoric cosmology.

See also **Sion-Petit Chasseur** (*vol. 1, part 4*).

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CAROLINE MALONE

SION-PETIT CHASSEUR

The Petit Chasseur site in Sion, in the southern canton of Valais, Switzerland, was the subject of systematic excavations from 1961 to 1992. This archaeological field has yielded one of the most complete cultural sequences of the Valais area and even of the whole Alpine region for the Neolithic period and the beginning of the Bronze Age. The occupations date to the beginning of the Neolithic period, the fourth millennium B.C., up to the Iron Age, around 500 B.C. But the international renown of the site owes itself to the megalithic necropolis (four dolmens and nine cists), chronologically tied to the end of the Neolithic period, where an impressive set of twenty-eight anthropomorphic stelae have been excavated (fig. 1).

CHRONOLOGY OF THE NECROPOLIS

The megalithic necropolis is made up of thirteen monuments, designated MI through MXIII, which have various shapes and variable dimensions. The cultural horizons involved are the Valaisian final Neolithic period, which is not well known, the civilization of Bell Beaker ceramics, and the Early Bronze Age. Nine phases of occupation can be distinguished.

Phase 1. Construction of dolmen MXII. This triangular-based tomb did not yield any anthropomorphic stelae. The furniture belongs to the Valaisian final Neolithic period.

Phase 2. Construction of dolmen MVI. The material of this triangular-based tomb belongs to the final Neolithic age. The anthropomorphic stelae of this era belong to type A.

Phase 3. Dolmens MI, MV, and MXI. These three tombs do not have bases but still have side entrances. The funeral furniture belongs to the civilization of Bell Beaker ceramics. The stelae reused in the constructions are of types A and B.

Phase 4. Desecration of dolmen MVI. The old burial remains of the dolmen are removed to make way for new Bell Beaker burials.

Phase 5. Small cists. The Bell Beaker societies construct a number of small cists (MII, MIII, MVII, MVIII, MIX, and MX), including only type B stelae.

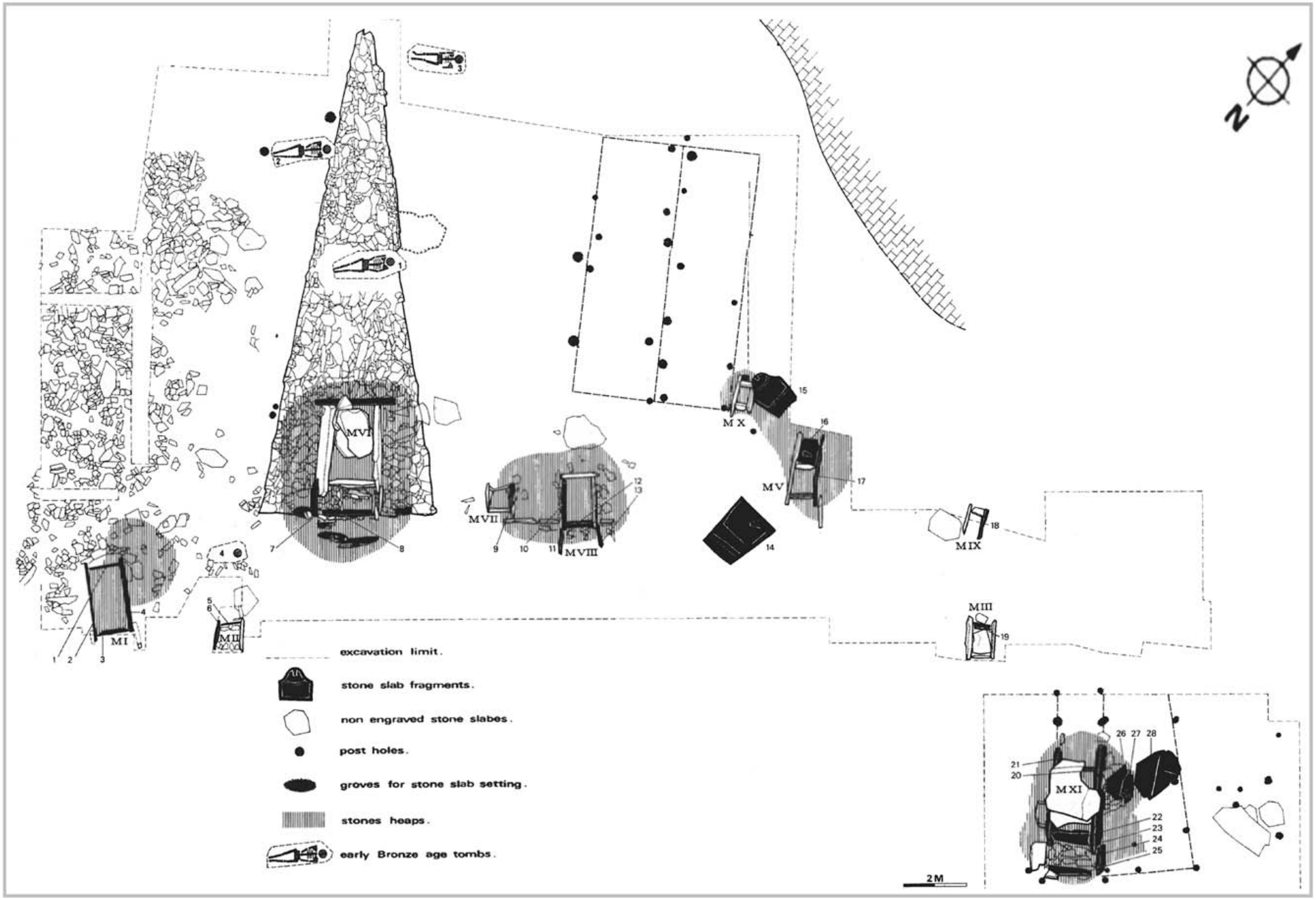

Fig. 1. Site plan of Sion-Petit Chasseur. DRAWING BY SERGE AESCHLIMANN. COURTESY OF MARIE BESSE. REPRODUCED BY PERMISSION.

Phase 6. Desecration of graves and burials of children. The last type-B stelae are erected at the beginning of the Early Bronze Age (fig. 2). Slabbed altars are arranged in front of monuments MVI and MXI. The old graves are systematically pillaged and desecrated, the funeral furniture scattered, the human bones gathered together and burned. A woman still lies in dolmen MXI. A few children are buried in a flexed position, either inside the old chambers (MV) or outside in small adventitious chests (MVI and MXI). The numerous traces of fire that can be found at the site appear to be related to a ritual to "condemn" the funeral area.

Phase 7. Cairns and jar burials. The necropolis continues to be sporadically visited during the Early Bronze Age, but the dead cease to be buried there. The monuments disappear gradually under piles of stones, around the edges of which are placed large jars as offerings.

Phase 8. Hut. Still in the Early Bronze Age, a hut is constructed at the location of the necropolis.

Phase 9. Graves in open ground. Funerary activity resumes at the end of the Early Bronze Age with a series of burials in extended position in open ground at a time when most of the monuments have disappeared, covered over by deposits.

STELAE: TYPE A AND TYPE B

Practically all the fragments of stelae discovered at Petit Chasseur have been representations of anthropomorphic personages possibly of rank, probably all males, given the abundance of representations of weapons. Two sets of stelae are distinguished. The first set, called type A, has a relatively plain geometric decoration, but it does have numerous representations of copper daggers with triangular blades and half-moon shaped handles, frequent in the Remedello civilization. Remedello is a Late Neolithic group, located in northern Italy, characterized by large necropoli with individual tombs. The artifacts include copper or flint daggers, polished or copper axes, and cups, tronconical jars with incised decorations. One stela also includes a pendant made up of two disks with nested circles. This set is related to a period of the Valaisian final Neolithic period, between 2700 and 2450 B.C., about which there is still not a great deal of information. It is not known whether or not this type of stela dates back to an older period, since dolmen MXII has not yielded any incised slabs.

The second set, called type-B stelae, has been attributed to the Bell Beaker period—that is, the period between 2450 and 2150 B.C.—and is very richly decorated, especially with regard to clothing ornaments. The triangular daggers have disappeared and are replaced by representations of bows and arrows. The head, of which there are at least two complete specimens, is now well marked, whereas the anatomical details are reduced to a simple rectangular nose.

STELAE AND SYMBOLIC THOUGHT

The functional significance of these stelae remains unclear, and the question of whether these human portrayals represent high-ranking persons, divinities who protect those persons, or gods remains unanswered. But the vision of the world partially expressed in the stelae at Sion has comparable representation in the stelae and monumental compositions of Trento, the Camonica Valley, and the Valteline in Italy: patterns, series of personages holding hands, numerous weapons (axes, halberds, and daggers), various ornaments (such as gorgets or double spiral pendants), checker works that could represent textiles, rare swing plows, and figures of animals (including wild species, such as deer, ibex, chamois, and boars) are associated in similar anthropomorphic compositions throughout the Alpine Neolithic.

Researchers agree that these associations are the expression of a complex ideology in which the sun plays a dominant role, but archaeology does not offer the means to go much further into the analysis of this type of symbolic structure. The stelae of the Petit Chasseur site nevertheless show that this ideology can be expressed in the framework of a necropolis, therefore certainly associating it with a cult of the dead.

STELAE AND SOCIAL CONTEXT

The social context in which the stelae are situated may be inferred from the analysis of the "ritual" associated with visits to the necropolis. The necropolis has numerous traces related to the often lively functioning of the graves. The archaeological structures that date strictly from the Neolithic phases show evidence of varied activities, including the construction of grave markers, the erection of stelae, the placing of bodies in the monuments, the smashing of stelae and their reuse, the overturning of graves, the despoiling of graves, the secondary placing and regrouping of skulls, the filling in of graves, and the lighting of fires in front of the monuments.

The erection of the stelae in front of the funerary monuments seems to be related to the social consecration of an eminent person during his or her lifetime on the occasion, for example, of a takeover of power or alliance ceremonies between families. The stelae could also be associated, however, with a funerary ritual taking place at the time of death of that same person.

The destruction of the stelae is more difficult to interpret, but the destruction of the incised effigies can perhaps be seen as a voluntary act that fits into a specific social context. The persons who smashed the stelae to use them as mere construction elements were aware of their meaning since, in the same era, they were carving other stelae that were absolutely identical and erecting them around the graves. Two explanations of these practices seem plausible. The first involves the destruction of the effigy, which, from a ritual perspective, constitutes a radical breaking point that may be related to the natural death of an actual person occupying a high-ranking position in the society. The second involves the destructions associated with the erections of new effigies, which are the expression of tensions existing within the society and the signs of struggles carried out by the various leaders for the control of political power. Thus, in this second case, one can speak of a situation of social death.

This type of explanation lends a certain weight to the idea of a link between the living individual and the stela. The social evolution at the end of the Neolithic period shows the change from egalitarian societies characteristic of the first farmers to societies set up in a more hierarchical manner and organized into chieftaincies. Within these chieftaincies, the individual may acquire a privileged position in the community owing to various strategies aimed at increasing his political power.

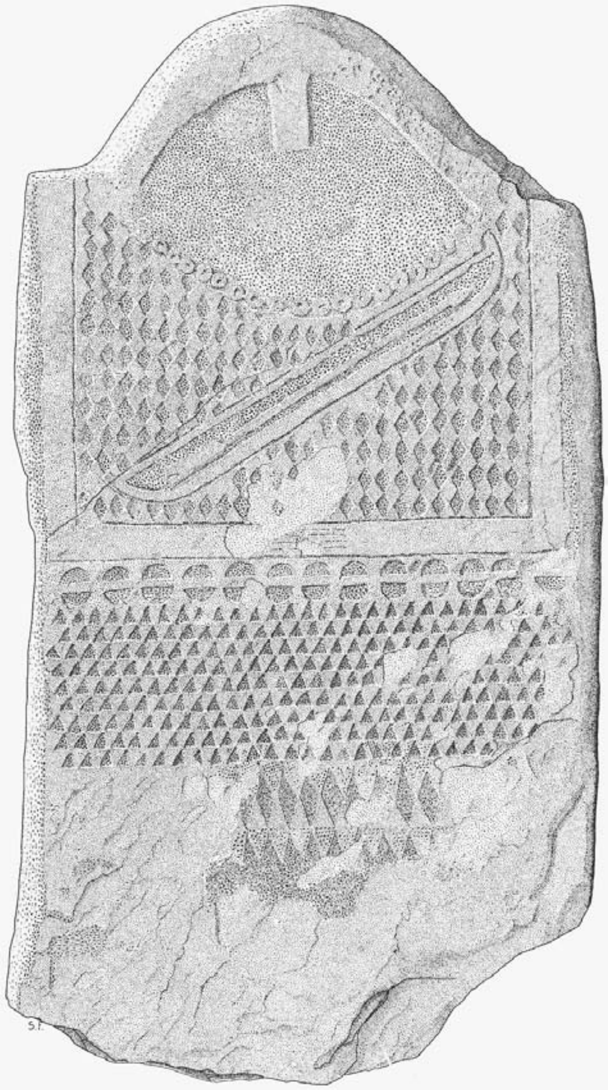

Fig. 2. Slab from dolmen MXI, type B stela. Height: 157.5 cm. DRAWING BY SÉBASTIEN FAVRE. COURTESY OF MARIE BESSE. REPRODUCED BY PERMISSION.

In the stelae of Petit Chasseur, one can perhaps see the expression of this change and the sign of the emergence of a warrior elite. These changes, which accompany the appearance of metallurgy in the Alps, foreshadow later developments in the civilizations of the Bronze Age. In western Europe the third millennium B.C. was characterized especially by the very broad diffusion of the civilization of Bell Beaker ceramics from the Iberian Peninsula to Poland. While, on the one hand, the ideology of this cultural group can be discerned through the expression of iconographic representations, the stelae, on the other hand, seem to be present only in the Alpine environment.

In this context, it is interesting to recall that the memory of the Petit Chasseur necropolis in Sion, and probably the memory of the chiefs that were buried there, was perpetuated throughout the Early Bronze Age. Throughout that period, people continued to visit the sites and place large ceramic jars as offerings around the graves while the monuments were gradually covered over by the soil carried along by the runoff from the dominating slopes. The sites, moreover, were reused as cemeteries around 1500 B.C., in an era when the burial ritual had been completely modified.

See also **Bell Beakers from West to East** (*vol. 1, part 4*).

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MARIE BESSE
(TRANSLATED BY JEANNE S. ZANG)

THE NEOLITHIC TEMPLES OF MALTA

The megalithic structures of the islands of the Maltese archipelago are the earliest freestanding buildings in world, dating from the fourth millennium B.C. They form a class of megalithic monument unparalleled in the prehistoric central-western Mediterranean area, since they are ceremonial and habitable structures rather than the more familiar megalithic mortuary constructions of western Europe. Some thirty such structures, mostly grouped together in local clusters, also include mortuary temples constructed belowground, which seem to have functioned as temples for the dead, with the insertion of hundreds or even thousands of burials over several centuries. In one case, Brochtorff's Circle at Xaghra on the island of Gozo, the mortuary complex of natural caves was surrounded by a megalithic circle and connected via a ceremonial path, marked by other megalithic monuments, to the Ggantija temple complex about half a kilometer distant. This complex appears to be one of the earliest in Malta, with the main temple dating from the Ggantija phase at the beginning of major temple building. Massive landscape change and dense settlement in modern times have obscured or destroyed the settings of many sites, and their original extent remains unclear.

RELATIONSHIP TO EUROPEAN AND MEDITERRANEAN PREHISTORY

The appearance of megalithic monuments in the western Mediterranean represents an earlier episode in Neolithic activity than the blossoming of prehistoric Maltese architecture. These early phases were invariably linked to the varied tomb-building traditions, especially those in France, Spain, and Portugal. These dolmens date from the late sixth millennium to the late fourth millennium B.C. and link the western Mediterranean with the Atlantic coast within a shared tradition of passage graves, dolmens, gallery graves, and other rough standing-stone structures and menhirs (individual standing stones). The Maltese temples (fourth to third millennia B.C.) appear to have developed locally, without apparent links to other cultures in the Mediterranean; indeed the crude dolmens of the Bronze Age (second millennium B.C.) of Malta seem to postdate the completion of the temples by centuries.

Early cultural links, however, are documented in the origins of Neolithic settlement on Malta, which has strong affiliations with the Stentinello culture of Sicily and Calabria. Similar stamped and impressed pottery with geometrically arranged decorations (Ghar Dalam style); Neolithic artifacts, such as polished stone axes and obsidian and flint tools; agricultural practices; and raw materials derived from Sicily, Italy, and the surrounding islands, suggest colonization of the Maltese islands from Italy rather than from other zones of the Mediterranean. The first settlement was in the mid-sixth millennium B.C., and a relationship between Malta and southern Italy and Sicily was maintained for at least another millennium in the sharing of similar cultural identities and raw materials, such as "Diana" style pottery (a red-slipped pottery with distinctive trumpet-shaped lugs and rounded forms) and obsidian. Thereafter close cultural similarity with Italy and Sicily ceased, and the distinctive Maltese Temple cultures became dominant, without apparent inspiration from elsewhere. Curiously, though, the material culture of Sardinia bears similarities in complex pottery forms (such as tripods and decoration), burial monuments (such as multiple-chambered rock-cut tombs), and iconography in the form of menhirs with heads, fat figurines, and sculptures of the human form.

LOCATION

The Maltese islands lie at the crossroads of the Mediterranean, between Sicily and southern Italy and Tunisia in North Africa, and roughly midway between the eastern and western Mediterranean. The location is remote in terms of Mediterranean islands, however, and Malta appears to have remained uninhabited by early human groups until agriculture became well established in the Neolithic. The distances—80 kilometers from Sicily and 290 kilometers from Tunisia—meant that navigation by small seagoing craft in prehistory was always a rather precarious activity, and thus Malta was more isolated culturally and economically than most other islands in the Mediterranean. The agricultural conditions on the islands were fertile, and the limestone-clay landscape provided an environment rich enough to support dense prehistoric populations and a variety of raw materials. Environmental reconstruction of the prehistoric landscape suggests that the originally wooded islands were cleared rapidly of their tree cover and that one basic resource thereafter was scarce—sizable quantities of wood for buildings or boats.

CHRONOLOGY

Archaeological research over the last three or four decades of the twentieth century established a secure radiocarbon sequence of absolute dates for Malta's prehistory and demonstrated the great antiquity of the temples. The dates of course provide an estimated carbon-14 range rather than a precise calendar, and the dating of stone buildings is always beset with problems. At present there is no sign of a Palaeolithic-Mesolithic occupation, and the first settlement is dated to about 5000–4300 B.C., with the Ghar Dalam phase of impressed pottery and early farming. The later Neolithic Grey and Red Skorba phases date from about 4500–4000 B.C., the latter associated with increasingly complex ritual sites and material culture. The Early Temple period is defined by the Zebbug and Mgarr phases, around 4100–3600 B.C., when small family rock-cut tombs and curious rounded structures were built. The first large and impressive temples date from the Ggantija phase, c. 3600–3200 B.C., when culturally the Maltese islands displayed structures and material wholly different from neighboring regions in Sicily and Italy. The main flowering of the temples occurred over the next millennium, with the Saflieni (3300–3000 B.C.) and the Tarxien periods (3000–2500 B.C.), when many temples were built and earlier ones enlarged and embellished.

The Temple culture appears to have ceased abruptly in the middle of the third millennium and was replaced by an apparently intrusive culture bearing close similarity to the Early Bronze Age cultures in southern Italy and Sicily. The newly introduced rite of cremation burials, metalwork in a nonmetalworking technology, and very different pottery and artifacts, such as curious flat Helladic-style figurines and a locally distinctive ceramic tradition with stylistic links across the central Mediterranean, confirm a total break with the previous indigenous cultural sequence. These Bronze Age cultures, the Tarxien cemetery and its successor the Borg-in-Nadur, developed locally but in parallel with Mediterranean neighbors in Pantelleria, Sicily, and southern Italy.

KEY FEATURES

The so-called temples were built of local limestones, from a combination of unworked and rough coralline and smoothly cut, shaped, and carved softer globigerina limestone. The stone is important, since very large rough slabs allowed for the realization of the huge megalithic structures, which then were embellished with the finely finished softer stone. The temples normally were arranged in a series of semicircular apses around central corridors in a trefoil form, which in turn opened to an entrance shaped by impressive trilithons and threshold steps facing a large, open court. Some courts, as at Ggantija, were on raised manmade terraces and form an impressive approach to the high, curved facade of the temple. The size of the individual apses and temples seems to have been limited by building materials, where the length of stone or timber to span roofs may have been restricted.

Typical apses are between 5 and 8 meters in diameter and, when paired across the corridor, allow a maximum width of 15 to 20 meters. The depth of many temples is some 20 to 30 meters, and the whole then is encapsulated within massive outer walls and a facade. The most elaborate and late temples, such as Tarxien and Hagar Qim (fig. 1), have complex ground plans around several separate corridors and entrances, whereas the earlier and simpler structures focus on an end apse with pairs of apses on either side, usually two or four, as seen at Ggantija and Mnaijdra north.

The artistic embellishments to the temples in the form of carvings, reliefs, pecked and drilled stone surfaces, altars, painted plaster walls, and finely finished plaster floors are a particular characteristic of Maltese temples. Decorative forms include floral and geometric patterns, spirals, animals, and human forms and are remarkably sophisticated, rivaling art in contemporary Egypt or the Near East. The shape of stones and their finish was significant, and altars made up of stones in pillar and triangle forms, as at Hagar Qim and Brochtorff Circle, appear to be shrines to male and female genitalia and thus perhaps fertility symbols. In other examples, plants, stacked ram's horns, rows of male animals, or carvings of suckling pigs may have comparable symbolic associations.

FINDS

The material culture of the Temple period is remarkable for its craftsmanship and unique style. Pottery developed distinctive forms and handles, with jars, cups, and bowls designed for domestic use and for ritual feasting. There also were miniatures for ritual offerings. Dumps around some temples have revealed great quantities of drinking cups and jars, indicating the scale of use. Stone tools made from imported rock, obsidian, and flint or local chert were formed into knives, scrapers, and axes. Greenstone was imported from Italy and ground into tiny axe amulets, which often accompanied the dead as grave goods. Animal bones were carved into utilitarian tools (spatulas, points, and needles) and also beads and amulets, along with seashells, which were used as personal ornaments and even musical instruments. The most distinctive objects are the figurines and phalluses made from clay and stone. These items include the famous "fat ladies"—small and large seated or kneeling figurines, standing skirted priest figures, and a range of both realistic and highly symbolized human forms (fig. 2). A rare group includes human and fish figures seated or lying on couches, known principally from the hypogea (underground burial chambers), although a huge pair of seated stone figures is included in the outer wall of Hagar Qim. A cache of six stick figures was found together with three other carvings at the Brochtorff Circle; they represent a new category of cult figure. The location of such finds appears, from surviving archaeological records, to be highly significant, since figurines and cult material seem to be placed in close proximity to shrines, altars, and thresholds into special areas and under floors.

ANALYSIS AND INTERPRETATION

The temples have been subject to much study since they were discovered in the late eighteenth century, and interpretations have changed alongside the developing discipline and fashions in archaeology. Themistocles Zammit undertook the first significant research early in the twentieth century, first with his work at the Hal Saflieni Hypogeum and then with the excavation of Tarxien Temple. Earlier only clearance and crude excavation had taken place, removing without record the bulk of pre-

Fig. 1. Monolithic altars stand at the ruins of Hagar Qim, a Neolithic temple on Malta. The pits and pockmarks in the limestones are caused by long-term erosion. © ROGER WOOD/CORBIS. REPRODUCED BY PERMISSION.

served sediment at the majority of temple sites. Zammit recorded material carefully and presented his findings to a wide community. Work by John Evans in the 1950s followed by that of David Trump in the 1960s provided new data, phasing, dating, and publications, enabling comparative studies of Malta and establishing the antiquity of the prehistoric sequence. Of the thirty or so known individual temples, there are about twenty complexes that remain sufficiently intact to assess their form and scale. They each comprise two to five structures, some of which are apsed temples and others of which are ancillary buildings. The reduced state of many sites means that interpretation is difficult, and few have been systematically excavated or studied. One area of potential research has been the orientation of the temples, which shows a consistent pattern: temples face south, southeast, or southwest, looking out from their entrances. Equally this orientation might be reversed (as in a Christian church), and then the view from the entrance of the Maltese temples would be looking north at the altars.

The repeated form of the temples and the clearly demarcated areas within them signal that they are not domestic houses but instead have a ritual function. The locking holes in doorjambs, the restricted lines of sight from the entrances to the areas within, the large ceremonial courtyards outside, and the apparently large quantities of exotic, rare, highly stylized artistic objects and decoration all suggest a ritual or cult use. Studies have focused on the role of ritual specialists, perhaps those portrayed in the so-called priest figurines, who may have controlled access and activity in the temple complex. The large quantities of animal bone stacked within Tarxien and the dumps of pots and bones at other sites, such as Ggantija, indicate the slaughter of animals and special feasting and consumption of food and drink on a large scale. The scale of prehistoric Maltese

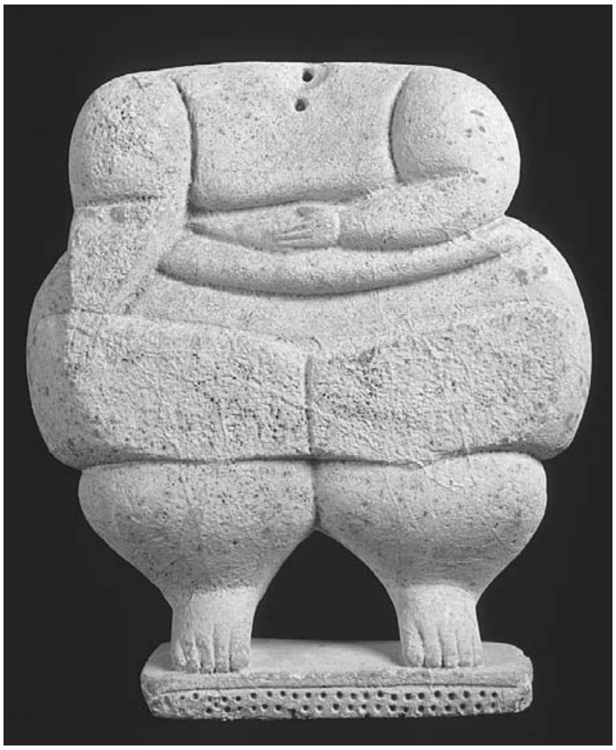

Fig. 2. This figurative statuette, now headless, once stood at Hagar Qim. Male and female forms at Neolithic temples could be standing, seated, or kneeling, and depictions ranged from realistic to highly symbolized. © ARALDO DE LUCA/CORBIS. REPRODUCED BY PERMISSION.

populations has been much discussed, since the rocky 314 square kilometers (121 square miles) could support only a limited population, estimated variously between five thousand and ten thousand people maximum. The twenty separate temple complexes may have served local communities of only three hundred to five hundred people and may have been built for a variety of different functions and cults.

Only two sites currently have associated burial hypogea—Tarxien with Hal Saflieni and Ggantija at Xaghra on Gozo with the Brochtorff Circle. Crude estimates at Hal Saflieni in about 1910 suggested on the basis of one recorded chamber a potential population of seven thousand buried people. The much disturbed (and still incompletely excavated) site of Brochtorff Circle produced more than 200,000 human bones, representing a minimum population of 800 people. As Colin Renfrew has shown, however, when the long time scale of use of these hypogea is tallied with the total number of individuals, the contributing population is quite small, with the addition of only a few corpses each year.

COMPARABLE SITES

The Maltese temples have no direct parallels and form a unique group of sites. The closest parallels are burial sites found in contemporary Sicily and Sardinia, where the tradition of rock-cut tombs evolved along with that of Malta. In Sardinia the Ozieri culture, in particular, is noted for elaborate hypogea, which involve several chambers and passages and the carving (and ochre painting) of such forms as bulls' horns. Figurines also were carved, and the small, fat, and detailed figures of the Late Neolithic Bonu Inghinu and the Ozieri flat steatite figurines offer a broad parallel to Maltese art. A large site in southeastern Sicily at Calaforno is a comparable burial complex.

SIGNIFICANT ADVANCES

The work at the Brochtorff Circle at Xaghra on Gozo (1987–1994) has enabled the first detailed study of the human populations of early Malta and has shown details of population structures, disease, health, and burial ritual that were hitherto unknown. Over the long occupation of the site, the buried population apparently became less well nourished, as shown by the state of teeth as well as through studies of child and infant bones, where deficiencies in vitamins and minerals appear to have been significant. This may be an indicator of overpopulation and general economic stress toward the end of the Temple period and may help explain the collapse of the Temple culture.

Other factors to explain the Maltese temples are under discussion, such as: the apparent lack of fish in the diet; the enormous physical investment in temple-building activity; the possible political structures that directed activities, tribute, redistribution, and production; and indeed the old explanation of invaders, famine, and disease. Advances in understanding depend on future fieldwork on settlement (evidence of which is elusive and mostly destroyed), genetics, economics, and environmental change. A major initiative, in the form of protective conservation legislation, has begun to ensure the future preservation of the sites, especially those inscribed as World Heritage Sites by UNESCO, at Ggantija, Tarxien–Hal Saflieni, Mnaijdra, and Hagar Qim.

See also **The Megalithic World** (*vol. 1, part 4*).

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CAROLINE MALONE

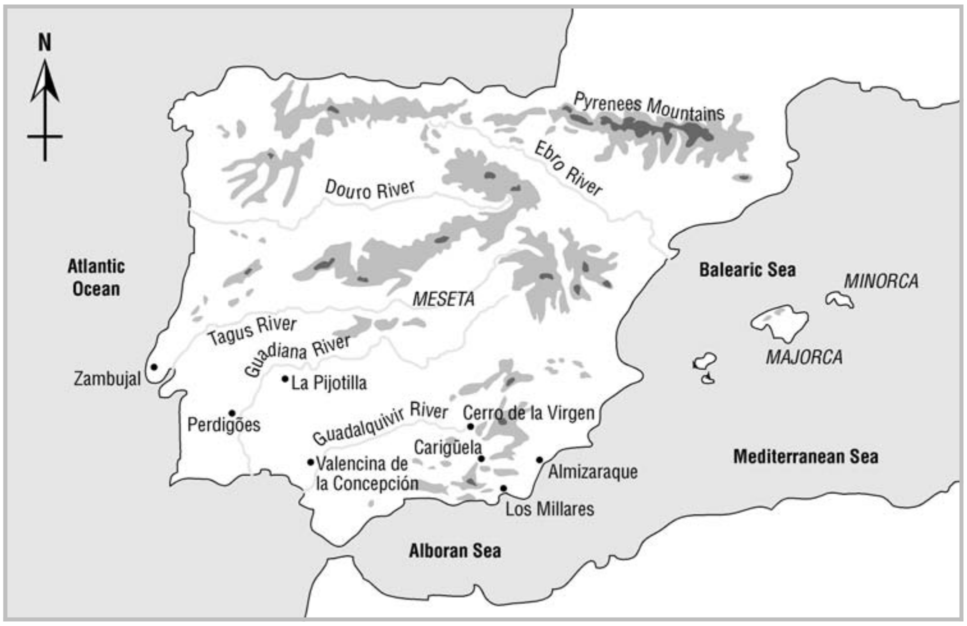
LATE NEOLITHIC/COPPER AGE IBERIA

FOLLOWED BY FEATURE ESSAY ON:

Since the late nineteenth century European prehistorians have pondered the significance of the megaliths, fortified settlements, and decorated figurines of the Late Neolithic and Copper Age of Iberia, including the Balearic Islands. Many early scholars, such as the French prehistorian Émile Cartailhac and the Belgian mining engineer Louis Siret, attributed the development of these cultural features to invasions by or contacts with distant eastern Mediterranean cultures, such as the Mycenaeans, Minoans, Phoenicians, or Egyptians. The development of radiocarbon and thermoluminescent dating in the 1960s, however, undermined these traditional frameworks and demonstrated that Late Neolithic and Copper Age Iberian cultures predated or were roughly contemporary with their supposed eastern Mediterranean inspirations. There is also no archaeological evidence that similar objects originated in the eastern Mediterranean at this time, as some prehistorians of the late nineteenth century also noted. For these reasons archaeologists interpret the cultural transformations of the Late Neolithic and Copper Age of Iberia as the product of local sociopolitical, economic, and ecological forces. There were certainly, however, exchange networks or contacts among groups within the Iberian mainland, among mainland groups and populations on the Balearics, and among Iberians and peoples in North Africa and the western Mediterranean in general. Archaeologists are engaged in assessing the nature of these interactions and their role in the evolution of late prehistoric Iberian societies.

CHRONOLOGY

The Late Neolithic and Copper Age of the Iberian Peninsula lasted from 4500 to 2200 B.C. The Late Neolithic (sometimes referred to as the Almería culture in southeastern Spain or the Alentejo culture in southern Portugal) dates from 4500 to 3250 B.C. and was associated with the construction of the first megalithic tombs and the establishment of hilltop settlements. The Copper Age (also known as the Chalcolithic, Eneolithic, Vila Nova de São Pedro [VNSP] culture, Los Millares [LM] culture, or Bronce I) lasted from 3250 to 2200 B.C. and was characterized by the development of copper metallurgy, fortified settlements, and new ceramic types, such as bell beakers. In the Tagus River estuary of Portugal and in southeastern Spain it is possible to subdivide the Copper Age into a pre-beaker, Early Copper Age (3250–2600 B.C.) and a beaker, Late Copper Age (2600–2200 B.C.). Those archaeological sites that provide the best chronometric evidence for cultural changes between the Late Neolithic and Copper Age are Zambujal, Penedo de Lexim, Castelo de Santa Justa, and Leceia in Portugal and



Selected sites in Late Neolithic/Copper Age Iberia.

Cerro de la Virgen, Montefrío, Horno de Segura, Carigüela, Terrera Ventura, and Moncín in Spain.

Comparable to the Late Neolithic and Copper Age of mainland Iberia was the Pretalayotic period on the Balearics (3000–1300 B.C.). During this time open-air and enclosed settlements were established, and megalithic monuments known as *navetas* and *navetiformes* (boat-shaped structures) were built. Beaker pottery also was introduced, and copper metallurgy began. The best-known sites from this period include Son Ferrandéll-Oleza and Son Matge, both on Majorca. At the end of the Copper Age in Iberia many settlements were abandoned, and burials ceased to be used. The causes of these discontinuities are unclear, but they may be related to climatic and environmental change, social conflict, or a realignment of the political order.

Much has been written about the chronology and architectural development of the Iberian megaliths. Traditionally prehistorians believed that the tombs developed in a continuous sequence, either from large and elaborate tombs to smaller ones or from simple, small ones to larger ones. Absolute dating of the Iberian megaliths suggests, however, that the evolutionary sequence may be more complex than is traditionally conceived. For example, some of the simpler megalithic cists are contemporary with the larger, more complex passage graves.

ENVIRONMENTAL SETTING

Iberia is a complex mosaic of different climates, topography, geology, and vegetation, and this diversity played an important role in the evolution, economies, and interactions of Iberian peoples. The existence of these diverse ecosystems contributed to the development of numerous distinctive, though related, culture areas in the Late Neolithic and Copper Age. These areas include those of northwestern Iberia, the Beira Alta and Beira Baixa provinces of Portugal, southwestern Portugal, southeastern Spain in Valencia, the Spanish Meseta, and the Balearics (principally Minorca and Majorca).

Iberia, including the Balearics, comprises two major environmental zones: an Atlantic north and west zone and a Mediterranean south and east zone. The Atlantic zone experiences relatively high rainfall (more than 1,200 millimeters per annum) and cooler temperatures, whereas the Mediterranean zone has less rainfall (less than 800 millimeters per annum) and a warmer climate. The mountain ranges of Iberia provided the geological and mineral resources used to make polished stone tools, beads, and metals and also acted as partial barriers to human groups. The coasts, estuaries, and rivers, which are rich in animal and plant resources, were attractive locations for human settlement throughout Iberian prehistory and served as important transportation and communication routes.

During the Late Neolithic and Copper Age the vegetation that dominated Iberia was deciduous woodland in more humid zones and climax evergreen woodland in more arid zones. Pollen studies suggest, however, that both climate change (increasing aridity) and anthropogenic degradation occurred during the Copper Age and that these factors caused a decline in arboreal species. A similar shift took place around 3000 B.C. on the Balearic Islands, with the appearance of olives (*Olea*) attesting to a phase of aridity. Also at this time the *Myotragus balearicus,* a small endemic goat, began the process of extinction, probably owing to both increasing aridity and human overexploitation.

SETTLEMENT AND BURIAL PATTERNS

Late Neolithic and Copper Age sites are known throughout the Iberian Peninsula, along the coast and in the interior (including the *meseta*) and in the uplands and lowlands. During the Late Neolithic human groups occupied caves, rock shelters, and open-air sites, particularly on hilltops at the confluence of rivers. During the Copper Age some of these hilltop sites were walled and had circular/semicircular towers, or bastions, built into their walls. Settlements were established in more arid and marginal zones during the Copper Age of both the mainland and the Balearics, and some form of water management or irrigation may have been required to farm in these zones. This expansion into more marginal landscapes is a trend also seen throughout much of western Europe, such as southern France, at the time.

The typical size of a settlement area during the Iberian Copper Age was 1 hectare, with population estimates for these settlements ranging from a dozen to more than 1,000 individuals. There are, however, larger sites, such as Los Millares in Spain (5 hectares), and some exceptionally large sites, such as Perdigões (16 hectares) and Ferreira do Alentejo (50 hectares) in Portugal and La Pijotilla (80 hectares) and Marroquíes Bajos (113 hectares) in Spain. Scholars have debated whether or not the larger sites, such as Los Millares, can be called "urban." Within the enclosed area of some of these settlements, specialized activities, such as pottery production and copper smelting, often took place. Circular houses (*cabanas*) were built regularly within and outside the settlement walls. Storage pits are a typical feature of Copper Age settlements; at the site of El Gárcel (Spain), more than three hundred such storage facilities were found. When these pits are located in stratified contexts (such as at the sites of Almizaraque and Ciavieja in Spain), they appear to have been used early in the sequence and then went out of use; it is presumed that storage in pottery vessels replaced the use of storage pits.

During the Late Neolithic and Copper Age there were two patterns in which settlements and burials were established. In western and northern Iberia settlements generally were separated spatially from burials. In southern Iberia, however, particularly in southeastern Spain and along the Guadiana River, tombs sometimes were located close to or as integral parts of settlement areas. Cemetery/settlement complexes are found at Los Millares, Valencina de la Concepción, and La Pijotilla (Spain) and Perdigões (Portugal). Based on a major study of the megaliths of the Iberian Peninsula, conducted by the German couple Vera Leisner and Georg Leisner, a great deal is known about the location and content of burials during the Late Neolithic and Copper Age. In addition to megaliths, burials of this time—which typically were collective—also were housed in caves, rock shelters, and rock-cut tombs.

ARTIFACTS AND ART

Many artifacts are characteristic of the Late Neolithic and Copper Age of Iberia, but because of the size of Iberia and the diversity of cultures that developed there, not all of these artifacts appear in all parts of Iberia. Furthermore, some objects may be found only in settlements and not in burials and vice versa. The typical artifacts of the Late Neolithic include ceramics known as *copos* (cups), with channeled decoration, found principally in Portuguese Estremadura. In southeastern Spain the appearance of *almagra* ware (pottery covered with an iron oxide slip) generally has been viewed as representative of the Late Neolithic, although archaeologists now recognize that *almagra* ware sometimes is found in later Copper Age contexts as well.

Objects found chiefly in Copper Age contexts include *Symbolkeramik* (pottery with incised ocular decorations), cheese strainers (*quejeiras* in Portugal and *queseras* in Spain), and ceramics with impressed *folha de acácia* (acacia leaf) designs and *bordos almendrados* (almond-shaped rims), the latter two types found principally in Portugal. During the Late Copper Age beakers of the earlier Maritime and All-Over Ornamented (AOO) types and the later Ciempozuelos (in central and southeastern Spain), Salamó (in Catalonia, Spain), and Palmela (in coastal Estremadura, Portugal) types are found. Also emblematic of the Iberian Copper Age are copper awls, fishhooks, and axes, although despite the name for this phase, the presence of metal objects is relatively rare on sites at this time. Objects found throughout the Late Neolithic and Copper Age of Iberia include polished stone tools (made of amphibolite, basalt, and dolerite) and flint blades, arrowheads, and daggers. Engraved slate plaques, primarily found in burials of southwestern Iberia, also are typical of this period.

During the Late Neolithic and Copper Age artistic expression in portable objects, monumental architecture, and rock art flourished. A wide range of artifacts, such as pottery (*Symbolkeramik*), engraved slate plaques, and *baculi* (the latter in the shape of shepherds' curved staffs), and cylindrical idols (made of bone, limestone, and clay) were decorated with geometric designs, anthropomorphs or deities, zoomorphs, weapons, and solar motifs. Megaliths (including menhirs and anthropomorphic stelae), caves and rock shelters, and open-air rock faces also were decorated with many of the same motifs as were found on the portable objects; sometimes they were engraved, and sometimes they were painted. Because of shared motifs throughout megalithic art and patterns in the placement of certain of these motifs, some scholars have suggested the existence of a megalithic art "code." Scholars also have noted the resemblance of megalithic Iberian art to megalithic art found in other regions of western Europe, such as Ireland, and posit that these similarities were the result of contact or exchange.

ECONOMY

During the Late Neolithic the herding of livestock and agriculture were practiced, but it was not until the Copper Age that a fully agricultural and sedentary lifestyle was established in Iberia. Groups farmed wheat and barley and supplemented their agricultural base by herding sheep, goat, cattle, and pigs; hunting wild game (such as boar and deer); gathering wild plants and plant products (such as acorns); fishing; and collecting shellfish, particularly along the Atlantic and Mediterranean coasts. Richard Harrison argued that during the Copper Age Iberia underwent a Secondary Products Revolution, as did other regions of prehistoric Europe. There is archaeological, botanical, and faunal evidence that agriculture intensified during this period, livestock began to be used for their secondary products (dairy, traction, and transportation), and viticulture and woodland management were carried out. There is some debate about whether irrigation was practiced. Some authors have argued that there is archaeological evidence for water management structures and for crops that would have required irrigation (such as flax in southeastern Spain). Other scholars have used carbon-isotope analyses of archaeological seed remains to reason that, with the exception of fava beans, there is no evidence that irrigation was practiced during the Iberian Copper Age.

Craft specialization during the Late Neolithic and Copper Age is indicated by the production of bifacially flaked flint tools, engraved slate plaques, groundstone tools, copper objects, and decorated ceramics. The precise nature of this specialization and its impact on social and political relationships are under investigation. For example, the small-scale inefficient technology used in the production of copper objects during the Iberian Copper Age suggests that metallurgical specialization was part-time, kin-based, and dispersed. Evidence for copper metallurgy was found at Zambujal (Portugal), Los Millares (Spain), and Son Matge (Majorca). Similarly Stašo Forenbaher's study of the production of bifacial stone artifacts from Portuguese Copper Age sites concluded that relatively few specialists would have been involved in the manufacture of these objects. Moreover because of the restricted types that they produced, they would have not have had a great impact on the economy. Sites that were involved in the specialized production of flint tools have been identified at Los Cercados, Las Canteras, Almizaraque, and Los Millares in Spain and at Casas de Baixo in Portugal.

During the Late Neolithic and Copper Age there was trade in unfinished and finished items made of stone (including flint, granite, amphibolite, dolerite, callais, and slate), ceramics, and copper. There also is evidence for exchange between Iberia and North Africa; on some Iberian sites North African ivory and ostrich eggshells have been found, and on sites in North Africa beaker ceramics sometimes are seen. The variety and concentration of goods at certain larger sites, such as La Pijotilla (Spain), suggest that they may have functioned as central places for the distribution of goods.

SOCIOPOLITICAL ORGANIZATION

During the Late Neolithic and Copper Age of Iberia marked social inequalities and differentiation appeared for the first time in Iberia. The precise nature of these social distinctions, however, is unclear. For example, whether individuals were distinguished by inherited social rank or whether some groups in Iberia could be classified as state societies are subjects under discussion. Archaeologists also differ in their opinions as to the factors that contributed to the social complexity in evidence during this period. Some have emphasized the water-management requirements of the arid zones of Iberia, whereas others emphasize population pressure or the trade of valued material or symbolic resources.

The variations in tomb types; their sizes, locations, and visibility; the number of people buried within them; and the quantity and quality of goods found with these individuals all suggest that Late Neolithic and Copper Age societies ranked and differentiated its members. For example, it seems reasonable to suggest that persons buried within some of the larger megaliths, such as the extraordinarily large Anta Grande do Zambujeiro in Portugal, with its 6-meter-high orthostats, or standing stones, were of a higher status than those housed in smaller megaliths. Similarly persons buried individually within a megalithic tomb probably were of a higher rank than those buried in larger groups. At the megalithic cemetery/settlement site of Los Millares, Spain, the tombs with the highest proportion of prestige goods were located closest to the settlement.

There are also important regional differences in burial elaboration and grave goods during the Late Neolithic and Copper Age. The richest and most varied tombs on the Iberian Peninsula are in the arid zone of southern Spain and the Mediterranean zones of central and southern Portugal (fig. 1). Tombs that are less varied and poorer in grave goods are situated in the Atlantic zones of Iberia, such as Galicia, Spain, and northern Portugal. Several scholars have suggested that this regional variability is related to the labor or risk involved in cultivating the landscape. In arid regions, where it was riskier to farm and where some form of water management or irrigation most likely was practiced, there were more opportunities than in more humid zones for aggrandizing persons to establish permanent control over agricultural systems and to emerge as elites, with political, economic, and ideological power.

Late Neolithic and Copper Age tombs in Iberia often were used over many hundreds of years to bury people. At times new tombs were built adjoining older tombs, such as at Farisoa 1, Portugal, presumably to house members of the same or related social groups. This behavior suggests that people at the time placed a high value on collective identities as well as on ancestral ties. Such continuities may have resulted from a need to legitimize family or lineage rights to land or resources.

There is both direct and indirect evidence for violent conflict during the Iberian Copper Age. The construction of elaborate systems of fortification with bastions, sometimes involving several lines of drystone walls (such as at Los Millares and Zambujal, see fig. 2), suggests that there was a need for defense and a heightening of political tensions. Weaponry, such as copper daggers, and painted images of armed people in caves also are indicative of militarism. More direct evidence of violent conflict has been found in the burials at Atalayuela, the Hipogeo de Longar, and San Juan ante Portam Latinam, all in Spain. At the Hipogeo de Longar, a tomb in which at least 112 people of different ages and sexes were buried with few grave goods, four persons were found with arrowheads embedded in their skeletons. At San Juan ante Portam Latinam, 289 people were discovered, and nine had arrowheads in them. At Valencina de la Concepción, Spain, bodies had been thrown into rubbish ditches within the settlement area, apparently without grave goods.

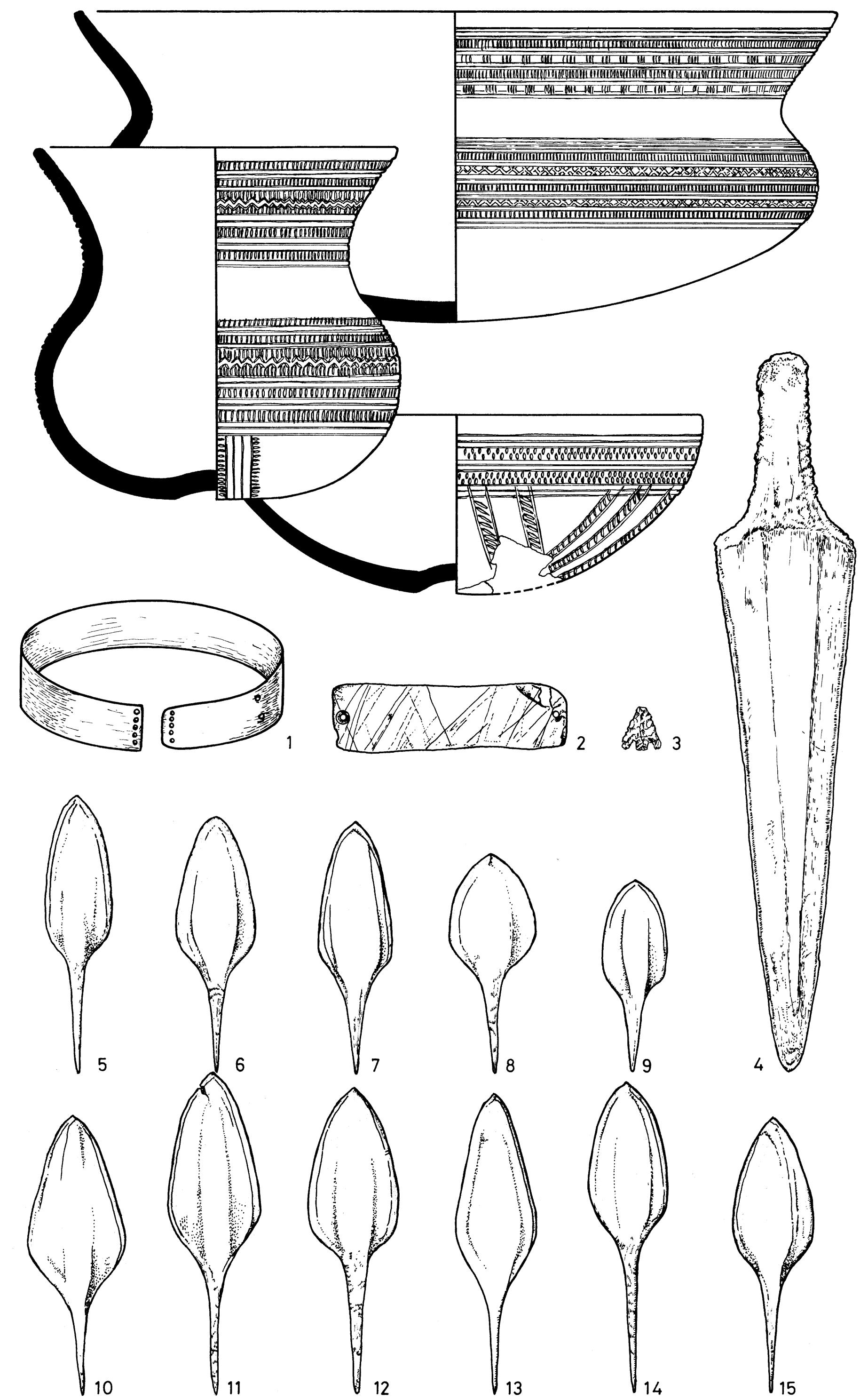


Fig. 1. Grave offerings from Fuente Olmedo, Spain, including Beaker ceramics, gold diadem, stone wristguard, flint arrowhead, and bronze Palmela points. FROM *THE BEAKER FOLK* BY RICHARD HARRISON, PUBLISHED BY THAMES AND HUDSON, LTD., LONDON. REPRODUCED BY PERMISSION.

Fig. 2. Hilltop site of Zambujal, Portugal, overlooking the Rio Sizandro. PHOTOGRAPH BY HERMANFRID SCHUBART, DEUTSCHES ARCHÄOLOGISCHES INSTITUT MADRID, #18-72-20. REPRODUCED BY PERMISSION.

IDEOLOGY AND RITUAL BEHAVIOR

The clearest evidence for ideology and ritual behavior can be seen in association with the burials of the Late Neolithic and Copper Age. Throughout this period people—sometimes numbering more than two hundred—were buried in collective tombs, including megaliths, caves and rock shelters, rock-cut tombs, and corbel-vaulted tombs. Toward the end of the period, during the Late Copper Age Beaker phase, there was a tendency toward individual burials, perhaps reflecting the emergence of a new social order in which the memory of individuals took precedence over the memory of groups. Systematic analyses of human remains from this period are rare, however, largely because skeletal remains are poorly preserved or have disappeared altogether as the result of the acidity of the soils in which many of the tombs are found.

Megalithic tombs in particular have been an important source of information about ritual behavior during the Late Neolithic and Copper Age of Iberia. Michael Hoskin recorded the orientations of hundreds of Iberian megaliths and noted their highly regular orientation, with their passages facing east at approximately the axis of the midwinter sunrise. This easterly orientation seems to be a common pattern among megalithic tombs throughout the Mediterranean and may reflect a common ideology about the significance of the rising sun, a shared timekeeping function of the megaliths, or some combination of these two factors. Megalithic tombs on the Balearic Islands tend to face toward the west.

Scholars also have noted that the chambers of most Iberian megalithic tombs were constructed with seven orthostats. Some researchers have suggested that the number seven held important symbolism for Late Neolithic and Copper Age peoples, although Victor dos Santos Gonçalves argues that the number seven may be simply the result of practical architectural considerations. An odd-numbered group of stones would be the result of erecting one stone across the passage entrance; given the size of the chambers, erecting six additional standing stones would be a natural consequence.

Funerary rites during the Late Neolithic and Copper Age of Iberia included both primary burials and the secondary treatment of corpses. In the case of some primary burials, the central part of the body was cremated to eliminate the viscera. In the case of secondary burials, clusters of bone groups, such as crania or long bones, were buried together. Fires sometimes also were set within the tomb chamber, probably to purify the interior of the tomb. Grave offerings often are found with the deceased, and some objects seem to have been especially made to accompany the dead, such as polished stone axes and adzes (often found unused in burials) and engraved stone plaques.

The engraved plaques, made on slate and schist, have been the subject of a great deal of research since the late nineteenth century. To date there are more than one thousand published plaques. Traditionally they were viewed as representations of the Mother Goddess, or Eye Goddess—a deity supposedly derived from the eastern Mediterranean. With the collapse of the "diffusionist" framework in the mid–twentieth century and considering the fact that only about 4 percent of the plaques depict eyed beings, the question of the function and meaning of the plaques, the majority of which have only geometric designs, has remained unresolved. Katina Lillios analyzed the distribution of these geometric plaques by design, tomb, and region and suggests that the plaques may have been ancient coats of arms and that their designs symbolically recorded the lineage affiliation and genealogical history of elite persons.

Another curious feature of Late Neolithic and Copper Age Iberian ritual is trepanation—the drilling and removal of a part of the skull. This practice appears to have been carried out while the person was alive, as indicated by the regrowth of bone surrounding the opening. Examples of trepanned skulls are known from Cova de la Pastora (Spain). Trepanation also is known from other late prehistoric cultures in Europe, such as those in France and Britain. Whether this practice was part of a healing process or was used to remove a piece of the skull for use in other rituals is unclear.

Like megalithic burials, menhirs, such as Penedo Comprido (Portugal), and stone circles, such as Almendres (Portugal), also were important features of the symbolic world of Late Neolithic and Copper Age Iberia. Some of the menhirs are phallic, which may reflect their association with fertility (as in later Iberian folklore) or with power. Some menhirs have engravings of solar motifs, which, when viewed in light of Michael Hoskin's research on the patterned orientations of megaliths, may suggest that ancient Iberians tracked the movements of celestial bodies for agricultural or ritual cycles, as many ancient groups in western Europe also may have done.

See also **The Mesolithic of Iberia** (*vol. 1, part 2*); **Milk, Wool, and Traction: Secondary Animal Products** (*vol. 1, part 4*); **Los Millares** (*vol. 1, part 4*); **Bell Beakers from West to East** (*vol. 1, part 4*); **El Argar and the Bronze Age of the Iberian Peninsula** (*vol. 2, part 5*); **Iberia in the Iron Age** (*vol. 2, part 6*); **Early Medieval Iberia** (*vol. 2, part 7*).

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KATINA T. LILLIOS

LOS MILLARES

Settlement and funerary records of the ancient Mediterranean offer evidence that the third millennium B.C. was a time of both warfare and increasing social inequality in the region. One of the key sites where such evidence occurs is at Los Millares, in the middle Andarax Valley, Almería province, in the Andalusia region of southeast Spain. The site comprises a fortified settlement, located on a promontory and further defended by outlying forts, and a cemetery of megalithic tombs located immediately outside the fortifications and on the same promontory. The site was discovered and excavated originally in 1892 by Louis Siret. Modern excavations have been carried out by Martín Almagro and Antonio Arribas in 1953–1957 and then by Arribas and Fernando Molina beginning in 1978.

The settlement itself occupies an area of 5 hectares and was fortified by four dry-stone walls, which have either been excavated or are visible from aerial photographs. The inner wall defines what excavators call a "citadel" area on the tip of the promontory above the River Andarax, with evidence for stratified occupation deposits. The second wall surrounds an area with further huts with stone foundations and timber superstructures. One of these huts, rectangular in shape, contains evidence for both the smelting and casting of copper artifacts. Some 80 meters beyond this lies the third wall, which is a more imposing structure: as a result of at least five phases of rebuilding, the wall reaches a maximum thickness of 9 meters and has external towers, some of which are more than 6 meters in diameter. The fourth, exterior wall lies some 50 meters farther out and seals off access to the settlement from one side (on the River Andarax) to the other side (the Rambla de Huéchar) of the promontory, a distance of more than 400 meters. External bastions are located at 11- to 15-meter intervals, and in two cases they contain evidence for copperworking. At its peak the main entrance consisted of a barbican structure, with two walls projecting 12.5 meters beyond the wall, and traces of an external ditch. A large density of circular structures is indicated within this wall. According to preliminary reports of the excavations since 1978, the earliest occupation at Los Millares was mainly confined to the "citadel" and areas surrounded by the second and third walls. Exterior structures and deposits were then incorporated in the fortified area by the construction of the outer wall. By the end of the occupation the settlement area had contracted to the "citadel" and the area immediately around it.

At least thirteen contemporary, small structures interpreted as "forts" have been found on the crests of hills to the south and southwest of the settlement, as well as to the southeast on the opposite side of the Rambla de Huéchar. Large-scale excavations have been carried out in Fort 1, which was constructed in more than one phase and consisted of a central tower, two concentric walls with external bastions, and two external ditches. The area enclosed by the walls had a diameter of 30 meters, whereas the area within the outer ditch was 50 meters wide. Within Fort 1 there was evidence for areas of flintworking and copperworking and the production of flour using grinding stones set on stone platforms.

Between the main settlement and the forts to the south of the site was a cemetery of more than 80 megalithic stone tombs, the majority of which had central chambers of 3 to 4 meters in diameter, with false vaults and entrance passages. The tombs were built using dry-stone construction and covered with retaining mounds of stone and earth. Communal burials, normally of up to thirty and exceptionally more than one hundred individuals, were placed in these tombs, along with artifacts of copper, stone, bone, pottery, flint, and nonlocal materials such as ivory and ostrich-egg shell (both from North Africa). Although the cemetery was in use at the same time as the settlement and forts, the exact chronology of tomb construction and use is unclear. Radiocarbon dates from the settlement, the cemetery, and Fort 1, as well as from contemporary, related sites in southeast Spain span the period c. 3000–2250 B.C.

The fortifications, domestic structures, and communal tombs of Los Millares clearly represent an increase in labor investment compared with the preceding Neolithic occupation of the region. The funerary evidence suggests unequal access to wealth items between different kinship or descent groups, and those tombs with the largest concentrations of such wealth items are located nearer to the settlement. It is debatable how far such social groups controlled the production of wealth items and of basic subsistence. There is limited evidence for specialized production. The majority of lithics were produced from local raw materials, but there is also evidence of interregional exchange and production in excess of presumed needs for projectile points and grain in Fort 1. The source of this grain is unknown, but it may be tribute from settlements in the immediate hinterland of Los Millares. These settlements were all visible from the forts and in turn their inhabitants were able to monitor areas outside the visibility of those living at Los Millares. Along with other evidence, this suggests the existence of increased social tensions, but not yet the emergence of exploitation and social classes.

Los Millares is the largest and most impressive fortified settlement of the third millennium B.C. in southeast Spain. Such settlements are now known to have been more numerous than was thought in the mid-twentieth century. They are also known to extend from southeast Spain through Andalusia and then north through Portugal and western Spain to the Douro Valley. In all nearly one hundred such sites were known by the end of the twentieth century, although there is great variation in their size, form, function, construction methods, longevity, and association with funerary sites. Los Millares has the advantage of larger-scale excavations (only Zambujal, in central Portugal, has been the subject of comparable fieldwork) and the potential to yield answers to a range of questions on the relationship between production and social inequality in prestate societies in Iberia, as well as shedding light on the broader context of the Mediterranean at this time.

See also **Late Neolithic/Copper Age Iberia** (*vol. 1, part 4*).

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ROBERT CHAPMAN

CORDED WARE FROM EAST TO WEST

The term "Corded Ware culture" (*die Schnurkeramikkultur*) was introduced by the German archaeologist Friedrich Klopfleisch in 1883. The name is taken from cord impressions found on the surface of vessels found in archaeological sites across a large portion of central and eastern Europe. Researchers were able to recognize relatively early, at the beginning of the twentieth century, that the Corded Ware phenomenon was widespread and culturally important. Subsequently, a number of groups that inhabited the region in the third millennium B.C. have been identified as belonging to the Corded Ware culture.

Cord impressions were easy to identify on the surface of vessels. It should be noted, however, that later research has revealed that cord ornamentation was connected not only to the Corded Ware culture; it was also known to the Funnel Beaker culture, Globular Amphora culture, and various steppe cultures. In addition, not every Corded Ware vessel had this ornamental decoration. However, a basic list of artifacts associated with the Corded Ware culture was compiled in the early twentieth century and included stone axes, beakers, amphorae, arrowheads, and flint flakes. These were usually found in single-burial tombs covered by a barrow. An important observation concerned the orientation of the body according to gender. Most often the body was placed on an east-west axis with the face turned south, but men were placed on their right side (with the head to the west), while women were laid on their left side (with the head to the east). It must be stressed that they were not accompanied by traces of permanent settlements.

In the annals of archaeology, the first part of the twentieth century was a time when each archaeological culture was identified with a specific people who had definitely described sociocultural characteristics. So it happened in this instance. Soon literature on the subject contained the obligatory hypothesis about the nomadic-warrior character of the "Corded Ware People" and their key role in the Indo-European migration into central and eastern Europe.

In the 1930s archaeologists began studying the stylistic sequences within individual regions. In the lead of this movement were Danish (C. J. Becker in 1936; P. V. Glob in 1945) and German (K. W. Struve in 1955) archaeologists, who studied the northern area of the Corded Ware culture that was considered a separate unity called the Single Grave culture (*die Einzelgrabekultur*). The typological and chronological charts they created are still used as the basis for ordering other regional groupings of Corded Ware. Significant modifications appeared only at the end of the twentieth century, when carbon-14 and dendrochronological dating methods were used on a wider scale.

THE OLDEST SITES AND THE GENESIS PROBLEM

The question of the origins of the Corded Ware culture has absorbed the attention of many archaeologists. In the mid-twentieth century, it appeared that the initial phase of Corded Ware was similar across

Europe at roughly the same time, and thus the concept of a "Pan-European Horizon" (also known as the "A-Horizon") emerged. The Pan-European Horizon was characterized by distinctive amphorae, beakers, and axe forms, with single burials under barrows sometimes surrounded by a palisade. The existence of an early Pan-European Horizon of Corded Ware has come into question, however, for it appears that the artifact types associated with it persisted into later periods alongside other artifact types. It now appears that the origins of the Corded Ware culture must be addressed regionally and that accurate dating of finds is essential.

Many different views have been voiced concerning the genesis of the Corded Ware culture. There is a division between archaeologists who allow for participation in this process by pastoral societies of the steppes near the north shore of the Black Sea and those who think that Corded Ware is a core central European phenomenon. In both camps, there are many differing views. Among the advocates of a steppe origin, the differences center on the degree that the "steppe factor" played in the genesis of Corded Ware culture, while those who favor central European roots are divided as to where specifically in central Europe the genesis of Corded Ware took place. With the passage of time, there has emerged a tendency to tone down the debate, which was quite polarized in the first part of the twentieth century. The net effect of this process was that it strengthened the position of those hypotheses that link these formerly antagonistic camps within the framework of a single model.

One can make a list of the similarities that Corded Ware shares with other cultures that preceded it in central Europe. Deserving of stress is the scale of similarities to the Funnel Beaker culture. On one hand, both the Corded Ware and Funnel Beaker cultures covered similar territory; both attribute importance to battle-axes; both give priority to beakers and amphorae among their vessels; and both employ a similar ceramic technology. On the other hand, in the context of central Europe, the Corded Ware culture also had foreign characteristics. These include the priority of single burials, the building of barrows, a lifestyle that used temporary settlements, and a renaissance in the use of the bow (resulting in the numerous finds of flint arrowheads).

TERRITORIAL EXTENT AND CHRONOLOGY

Knowledge about the Corded Ware domain has been in flux for many years. The domain was a central and eastern European phenomenon. Its western boundary was the Rhine River. To the south it reached the Alps and occupied the Upper Danube River basin to the mouth of the Morava River. It was present in Moravia, and it reached Wolyn and Podolia along the northern curve of the Carpathians. In the east it was found in the upper basin of the Dnieper River and the upper Volga. Its northern border ran through Scandinavia and the German shores of the North Sea to the mouth of the Rhine.

Corded Ware chronology is based on ceramic ware, though in the north, battle-axe types are also important. The oldest ceramic artifacts of the A-Horizon include beakers and amphorae. As Corded Ware developed, greater regional differentiation took place. Artifacts from the later years of the culture can be described as the horizon of local groups. At that time the individual Corded Ware agglomerations were so varied that only knowledge about their genesis allowed archaeologists to treat them as part of a single cultural whole.

An absolute chronology of Corded Ware is based on accurate dating using the carbon-14 method, although there are enclaves (Switzerland and southwestern Germany) that have very accurate dendrochronological dates. In general, carbon-14 dating places Corded Ware throughout the third millennium B.C. There is, however, definite regional differentiation as to the beginning and ending dates.

The earliest-known carbon-14 dates for Corded Ware come from Kujavia and Małopolska in central and southern Poland. These include a grave at Krusza Zamkowa in Kujavia and a barrow at Średnia in Małopolska dating to the transition from the fourth to the third millennium B.C. Carbon-14 dating of the remaining central European regions shows that Corded Ware appeared after 2880 B.C. Around that time, in 2725 B.C., the first pile settlements (dwellings built on pilings at the edge of lakes) appeared in the Alpine foothills. Such sites have yielded materials characteristic of Corded Ware. The latest dates, about the middle of the third millennium B.C., are from the Russian Plain. The most likely hypothesis, then, is that Corded Ware first appeared (on the transition between the fourth and third millennia B.C.) in the central part of its domain and spread from east to west. In 2725 B.C. it reached its southwestern edge. About 2500 B.C., Corded Ware spread in another direction, to the northeast, and it is eventually found on the upper Volga.

Dates for the disappearance of the Corded Ware culture also vary. The pile settlements with Corded Ware in the Alpine foothills, which yield the most accurate information, disappeared about 2440 B.C. The years between 2300 and 2100 B.C. were a period during which the Corded Ware culture ended in most regions, especially in the southern part of its domain (basins of the Danube, Upper Rhine, Elbe, and Vistula). Only in the Russian Plain did it last until 2000 B.C.

In many regions (from the Lower Rhine basin to Kujavia and Małopolska), the Corded Ware culture appeared alongside the late periods of the Funnel Beaker culture. In the area between central Germany and the Russian lowland, one can observe a long period where it existed alongside the Globular Amphora culture. In Kujavia, this lasted through the entire development of the local Corded Ware culture. In the western part of its domain (to the Vistula River), one can observe its contemporaneity with the Bell Beakers, a period lasting to the middle of the third millennium B.C. To the east of that river, Corded Ware appeared among various groups of the Pit-Comb Pottery cultures (also known as the East European Forest Neolithic). In sum, Corded Ware was a phenomenon that lasted nearly one thousand years, during the entire third millennium B.C., and encompassed all of central and much of northeastern Europe.

INTERNAL DIFFERENTIATION

The Corded Ware culture shows great regional differentiation, most visible in the typological attributes of the ceramic ware. Because of this, researchers separate out many groups and archaeological cultures within its borders. Their list is not permanent, and from time to time, some entries are eliminated, while others are added.

The Corded Ware variants most solidly grounded in literature are as follows: the Single Grave culture; the Protruding Foot Beaker culture; Corded Ware of the Alpine Pile Dwellings; Central German Corded Ware; Bohemian-Moravian Corded Ware; Małopolska Corded Ware; Złota culture; Battle-Axe culture; the Rzucewo culture; Middle Dnieper culture; and the Fatianovo culture.

The structure of the Corded Ware domain is thought to have been influenced by many factors. The first is linked to long-lasting regional development. Most of the "corded" agglomerations took in regions with long traditions of regional development that went back to the beginnings of the Neolithic. The second factor that influenced the shape of Corded Ware regionalization was the network of far-reaching trade routes, and the Corded Ware agglomerations were usually situated on its nodal points. The third factor was the location of sources of raw materials. Most important to the Corded Ware peoples were supplies of flint, stone (especially that used for the manufacture of axes, such as amphibolite, basalt, diabase, and gabbro), and amber. Metal, basically only copper, did not play a major part in the Corded Ware culture, although simple copper ornaments may be found in the Corded Ware graves in the southern and central parts of its domain.

Single Grave Culture. Research into the Single Grave culture played a key role in the course of research into the whole of Corded Ware. On its basis, a typology of basic Corded Ware objects and finds was worked out. The Single Grave culture is known mainly for graves covered by barrows, in which one individual was laid in the fetal position on an east-west axis. In addition to the barrow burial rite introduced by the Single Grave culture, other types of tombs (mainly megalithic) dating to a previous time in prehistory were still being used by this group. The grave goods in the burials became standardized. The constant elements were the battle-axe and the beaker. In addition, flint axes were placed in the graves along with flint flakes and amber objects, among which the most spectacular are disks several centimeters in diameter with a central hole. There are few visible traces of settlements, though it is thought that there was significant progress in this regard during the Single Grave era. Dwellings were being built in the form of post houses of a light construction. The basic method of subsistence was the raising of livestock (especially cattle). Pollen diagrams indicate that open areas (pastures) increased as forest was cleared. In the pollen diagrams there is no indication of an increase in grain cultivation. During the development of the Single Grave culture, the practice of making sacrifices by depositing artifacts in swamps continued from previous cultures.

Protruding Foot Beaker Culture. The Protruding Foot Beaker culture is the best-known part of the Corded Ware story. It is found along the Lower Rhine, in a key place for long-range contacts between the British Isles and the Alpine area, as well as along the Atlantic shore to the Baltic Sea. There exists an accurate typology of its basic object: the beaker. Much is known about the culture's settlements. To assure proper living conditions (that is, a dry place on the wet landscape of the Rhine Delta), permanent settlements were built on artificial platforms consisting of layers of shells, organic remains, and clay. The dwellings were rectangular huts of post construction. The funeral rites were characterized by the presence of flat graves as well as barrows, in which according to the Corded Ware custom, only one individual was laid. The Protruding Foot Beaker culture is also important because in 1955 Johannes D. van der Waals and Willem Glasbergen were able to demonstrate stylistic links that its beakers shared with the Bell Beakers. This became a basis for one of the main models for the genesis of the Bell Beakers called the "Dutch Model."

Corded Ware of the Alpine Pile Dwellings. The Corded Ware culture in Switzerland and Southwest Germany is known exclusively from pile dwellings, a rich source of information about many aspects of life thanks to the excellent way in which the artifacts have been preserved, especially organic ones. These include many objects made from bone (including pins and discs), food remains, and remains of the wooden structures. The custom of building settlements on pilings on the shores of lakes was known earlier in this area of Europe, and the Corded Ware people were only another, and by no means the last, users of the technique. Thanks to the large number of wooden elements that were preserved, good chronological data exists for each of these settlements. It is known with accuracy the year and season (spring, autumn) when the structures were built, repaired, and abandoned. In this part of Europe, the appearance of Corded Ware did not change the lifestyle of the inhabitants. They were farmers who busied themselves in planting grain and raising animals, mainly cattle and pigs. They also took advantage of other opportunities offered by the rich lakeshore environment, practicing fishing, hunting, and gathering.

Central German Corded Ware Culture. The Central German Corded Ware culture is known mainly from flat, single-burial graves, where the body was placed in the classical Corded Ware position (on an east-west axis with the face to the south; women on their left side with the head pointing to the east, men on the right side with the head pointing to the west). The usual cemetery consisted of from several to dozens of graves. Many types of vessels richly ornamented with cord impressions were placed in the graves, along with faceted battle-axes. Infrequently, there were also copper items in the shape of wire decorations and beads.

An interesting find in this group was the grave at Göhlitzsch. On one of the stone slabs forming the grave there was engraved the image of a reflex bow and quiver. It is one of the earliest representations of this technologically advanced form of bow. This confirms the significance of bow-hunting equipment in the entire Corded Ware culture. Relatively little is known of the economic base of these people. The fact that they lived in a region that had a long agricultural tradition might be an indicator that they engaged in farming practices, especially the raising of animals.

Bohemian-Moravian Corded Ware. Bohemian-Moravian Corded Ware is known mainly from large cemeteries consisting of flat graves. At the largest of these, in Vikletice, 164 graves were explored. This probably testifies to the longevity of the settlement in the area by Corded Ware peoples. It is a fact, however, that few traces of settlements have been found. The grave goods are mostly ceramic ware. Often an individual would be buried with many vessels, mainly amphorae and beakers but also cups, pitchers, pots, and bowls. Rich corded decoration is found mainly in Bohemia, while in Moravia, undecorated ceramic ware was more common. The lack of decoration was especially pronounced during the earliest periods of development. Among the battle-axes there are also found faceted axe heads. Compared with other sites, there are relatively few bow-hunting artifacts, such as flint arrowheads. Other objects placed in the graves were flint axes (whose edges are the only smoothed parts), flakes, stone maces, pendants made of animal teeth, and simple copper decorations.

Małopolska Corded Ware. Małopolska Corded Ware in southern Poland is known mainly from cemeteries, where at most a few dozen individuals were buried (the largest number of graves in one place totaled sixty-four at Żerniki Górne). These were single-burial graves, mostly flat. Barrows were also numerous, but they did not form unified cemeteries. Instead, they often followed one after another along the crest of a rise in the terrain. The individual was placed on a north-south axis, opposite the east-west arrangement found in the other Corded Ware regions. A characteristic of the Małopolska Corded Ware culture is the so-called catacomb tombs, consisting of a vertical shaft dug in the loess subsoil, at the bottom of which was a chamber where the body was placed. Usually the grave goods consisted of one or two vessels, heart-shaped arrowheads, flakes, and stone objects, such as battle-axes. The few settlements found exhibited impermanent dwellings. The thesis that the Małopolska Corded Ware culture had a pastoral character is widely accepted, not only on a theoretical basis but also on the basis of physical evidence.

Złota Culture. The Złota culture is a local Małopolska phenomenon linked to the larger circle of Corded Ware. It is known from multiple-burial graves lined with stone slabs in which individuals were laid in the fetal position with many grave goods, primarily ceramic ware. Much of this pottery had complex cord decoration (e.g., wavy cord impressions) and various forms that were connected not only with Corded Ware but with the Funnel Beaker, Globular Amphora, and Baden cultures. In addition, the objects found in the Złota graves included amber items, such as rectangular plates, various types of buttons with a V-shaped hole, and tubular beads. There were also flint axes with a smoothed edge, flint arrowheads, pendants made from animal teeth (especially dog teeth), bone awls, and beads made of shell. The Złota phenomenon is dated to the first part of the third millennium B.C. It still creates much controversy and to date has no single interpretation.

Fig. 1. Characteristic battle-axes reminiscent of boats belonging to the Boat-Axe subgroup of the Corded Ware culture. © THE NATIONAL MUSEUM OF DENMARK. REPRODUCED BY PERMISSION.

Battle-Axe Culture. The Battle-Axe culture is also known as the Boat-Axe culture (*die Bootaxtkultur*). It is located in southern and central Sweden and southern Norway. Artifacts from this culture were found mostly in graves, and the most characteristic items are battle-axe heads, especially examples with an extended shaft sleeve, that curve upward at each end like the prow and stern of a boat. There also exist remains of settlements that were composed of lightly constructed huts of rectangular shape and post construction.

Rzucewo Culture. Unlike the other Corded Ware groups, the Rzucewo culture (also known as the East Baltic Coastal culture or *Haffküstenkultur*) is known mainly from its substantial settlements, which were often built on pilings and situated on the shores of lakes or Baltic bays. From these settlements have survived many artifacts, some made of organic materials. From them also have survived many items of ceramic ware that are typologically differentiated, among which are shallow bowls (most likely lamps that burned animal fat). Another characteristic of the Rzucewo culture is flint scrapers with a smoothed working edge. The working of amber was very important in this culture. There were mines and workshops where several typical items were produced, among them buttons with a V-shaped hole. The people supported themselves by exploiting the rich environment of their seashore niche (fishing, shellfish collecting). Sea mammals (seals and porpoises) were an important item on their menu, whereas agricultural products were of lesser importance. This lifestyle was known earlier on the southeastern shores of the Baltic. It was, for example, practiced by the Narva culture of the Early Neolithic period.

Middle Dnieper Culture. The Middle Dnieper culture is known mainly from graves, both barrow and the flat form. The most common orientation is on the north-south axis. Grave goods include chiefly beakers, often with round bottoms, flint axes, stone battle-axes, and infrequently, items made of amber and copper. A few settlements are known to have existed, built with rectangular shelters partly sunk into the ground. The Middle Dnieper culture was considered by some researchers to be the link connecting Corded Ware with steppe cultures.

Fatianovo Culture. The Fatianovo culture is the most northeastern and the chronologically latest of the Corded Ware groups. Its emergence is connected to influences from the west and southwest that came from other Corded Ware groups. It is known from cemeteries consisting of flat graves, where the placement of the body differs from most Corded Ware burials elsewhere. The body was laid on its back, usually on a north-south axis. Grave goods consisted of stone battle-axes, flint axes, and bulbous vessels with round bottoms, most often decorated with cord impressions only on their upper parts.

GENERAL CHARACTERISTICS OF CORDED WARE

Corded Ware was a phenomenon that covered a large area, from the Rhine in the west to the Volga in the east, from the Danube in the south to the Arctic Circle in the north, and it lasted about a thousand years. The terrain it occupied had a highly differentiated ecology. Before the appearance of the Corded Ware culture, this region was a place where many cultures with varied beginnings developed. The characteristic attributes of the Corded Ware culture were partly a legacy of previous cultures and partly something totally new for inhabitants in that part of Europe.

It is time to pose the basic question: what was Corded Ware? But this must be supplemented by a second question: was Corded Ware the same thing in all regions? The second question must be answered negatively. The Corded Ware culture in the Alpine region and the Rzucewo culture on the southeast Baltic are clearly different from the rest of the Corded Ware domain. These were instances linked to specific ecological niches that had been exploited in a similar fashion over long phases of prehistory. In this framework, Corded Ware is one of many episodes and by no means the last. It does not seem likely that the appearance of Corded Ware in these areas could be ascribed to the immigration of a new population. Both instances, however, indicate something extremely important: the attractiveness of the Corded Ware way of life for Neolithic societies. Another example of this was the late northeastern expansion (that is, the Fatianovo culture) into areas that were ecologically and culturally different from those found in central Europe.

In the remaining parts of the Corded Ware domain, the culture can be treated as a moderately homogenous whole despite the many regional differences seen in the typological attributes of the artifacts. The primary evidence of homogeneity is the widespread use of single-burial graves. Though this type of grave was known in many regions of central Europe earlier in the Neolithic, it had fallen into disuse. Just prior to development of the Corded Ware culture, the prevailing burial rite was multiple-person graves, whose most visible examples were the megalithic tombs. Corded Ware did not make a break with this tradition—megaliths were still used—but the preferred method of burial was the grave with a single body. This change reveals the beginning of the individualization process. This phenomenon is one of the cornerstones of modern Western civilization. It depended on the establishment of the individual as an active element in social change, in contrast to the groups of early farmers whose real identity lay in being a member of the community. Individualization was a necessary phase on the way to discovering a specific concept of personal freedom within European civilization.

Another element to consider is the role of sex in Corded Ware burials. Throughout Corded Ware culture, there was a definite opposition to placing men and women in the same positions in graves (most often women were laid on their left side with the head pointing east, whereas men were laid on their right side with the head toward the west). On this basis researchers conclude that the internal organization of the Corded Ware people was based on a definite assignment of gender roles. The right to burial was not equal for both sexes. There were many more male burials, fewer female, but the rarest were those of children (they were often buried together with an adult). While the issue of gender variations is meaningful, it is not as important as the individualization process reflected in the burials.

The building of barrows, an activity that has numerous religious connotations, harks back to the idea of a holy mountain, an eternal axis, and a place of conjunction between heaven and earth. This shows that there was a significant belief in the afterlife. That theory is confirmed by the frequency with which amber, a material thought to be of a heavenly nature, appears among the grave goods. The presence of weapons in the form of battle-axes (less often of axes for chopping wood), archery sets, and knives (whose remains consist of flint sherds) show that Corded Ware societies placed an emphasis on the warrior role, suggesting that the hunter-warrior had the highest status in society.

Another characteristic of Corded Ware culture is indicated by the beakers, often richly decorated and well-made drinking vessels. Their presence in the graves indicates that this activity had a ritual character. The development of such customs in Neolithic societies of central Europe was observed by Andrew Sherratt. He showed that the ritual drinking of beverages (probably of an intoxicating nature) has deep local roots, reaching as far back as the Funnel Beaker culture, and was known after the passing of Corded Ware, for example in the Bell Beakers.

An intensive search for prehistoric settlements, much of it taking place near the end of the twentieth century, resulted in the discovery of a small number of sites in various parts of the Corded Ware domain. The surprising fact was that the traces found were very similar to each other. The settlements, as a rule, were small with light-post construction used in the building of rectangular dwellings.

The unavailability of data (due especially to the lack of settlements) has limited the ability to reconstruct the economic basis of the Corded Ware culture. At the same time, it is possible to interpret this situation as evidence supporting the idea of a migratory lifestyle. Other data serves to confirm this. The pollen profiles correlate the presence of Corded Ware with an increase in grasslands and a decreased activity in the growing of grain. Scarce osteological data indicates that cattle and small ruminants were important. Fundamentally, then, it appears that most Corded Ware groups should be treated as animal breeders or even herders. The exceptions to this rule are the inhabitants of the pile dwellings in the Alpine lands and on the Baltic shore and the groups in the northeastern portion of the Corded Ware domain.

A picture emerges of an animal-breeding society, whose members wandered with their herds over a relatively large territory. Their social structure was organized on different roles for men and women, where men held the superior position. A major role was assigned to a group of adult men: the hunter-warriors who raised their prestige through the possession of ornamental battle-axes, knives, and bow-hunting equipment and who participated in ritual drinking using decorative beakers. The world of their spiritual beliefs was connected to the supernatural.

The genesis of the Corded Ware culture must have been a protracted and complicated process that involved representatives of the traditional central European cultures as well as peoples who came from the steppes near the Black Sea. It does not seem probable that the action of local factors could be limited to any of the regional enclaves. The main local element in the genesis of Corded Ware was the Funnel Beaker culture. The second influence was the steppe societies, but at this time it is not possible to determine whether it was a direct migration of people from the steppes near the Black Sea or the steppe characteristics reached the northern European lowlands through the agency of eastern or southern neighbors. Two possible routes could have played a role in this process: a northern route that connected the lowland with the steppes through Wolyn and the Upper Vistula basin and a southern route running from the steppes near the Black Sea to the mouth of the Danube, then upriver to the Tisza basin and across the Carpathians toward the north (similar to the so-called third-wave migration of barrow-building ["Kurgan"] peoples described by Marija Gimbutas). It is not known which of the two may have played a greater role in the process.

CORDED WARE AND THE INDO-EUROPEAN QUESTION

It may be said with regard to the Indo-European problem that the Corded Ware culture was in the right place at the right time. The widely accepted hypothesis that the people of the Corded Ware culture were animal breeders or herders appeals to the imagination of the researchers as far as the oldest Indo-Europeans are concerned. Corded Ware is also the first culture in central Europe whose characteristics are visibly linked to the Indo-European examples.

As for the Corded Ware role in the process of bringing Indo-European influences into Europe, the archaeologists have no single view. This depends on the model, and of these there are many. Most often the Corded Ware culture is considered to be the archaeological representation of a part of the Indo-European peoples—that is, the ancestors of the Balts, Celts, Germans, Italian peoples, and Slavs. In this sense, Corded Ware sites reveal the process of the Indo-Europeanization of all of central, northern, and northeastern Europe.

SUMMARY

Two conclusions can be stated about the Corded Ware culture. The first is somewhat surprising. It turns out that the actual knowledge of this phenomenon has not changed much since the beginning of the twentieth century. A much larger base of sources has been thoroughly analyzed using modern methods, but the core of the knowledge about Corded Ware remains the same: archaeologists still think that this was a culture of animal breeders and possibly herders.

The second conclusion is that the Corded Ware culture played a most important role in long-term social development. The appearance of individualization, as illustrated in Corded Ware burials, was an undoubted breakthrough. With this development, the individual (especially the adult male, the hunter-warrior) became an active object in the process of social change. The field for competition between individuals began to open. An increasingly complicated social hierarchy developed, and with it grew the demand for items and raw materials that raised the status of their owners. This entire process was coded into the rituals of the culture. As these rituals grew more complex, they increased the social differentiation of the group. From this there was but a small step to stratification and the creation of social classes. In this way, the Corded Ware culture opened the gate through which the early prehistoric societies of central Europe started their march toward modern European culture.

See also **Archaeology and Language** (*vol. 1, part 1*); **Late Neolithic/Copper Age Central Europe** (*vol. 1, part 4*); **Neolithic Lake Dwellings in the Alpine Region** (*vol. 1, part 4*); **Consequences of Farming in Southern Scandinavia** (*vol. 1, part 4*); **Bell Beakers from West to East** (*vol. 1, part 4*).

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(TRANSLATED BY PETER OBST)

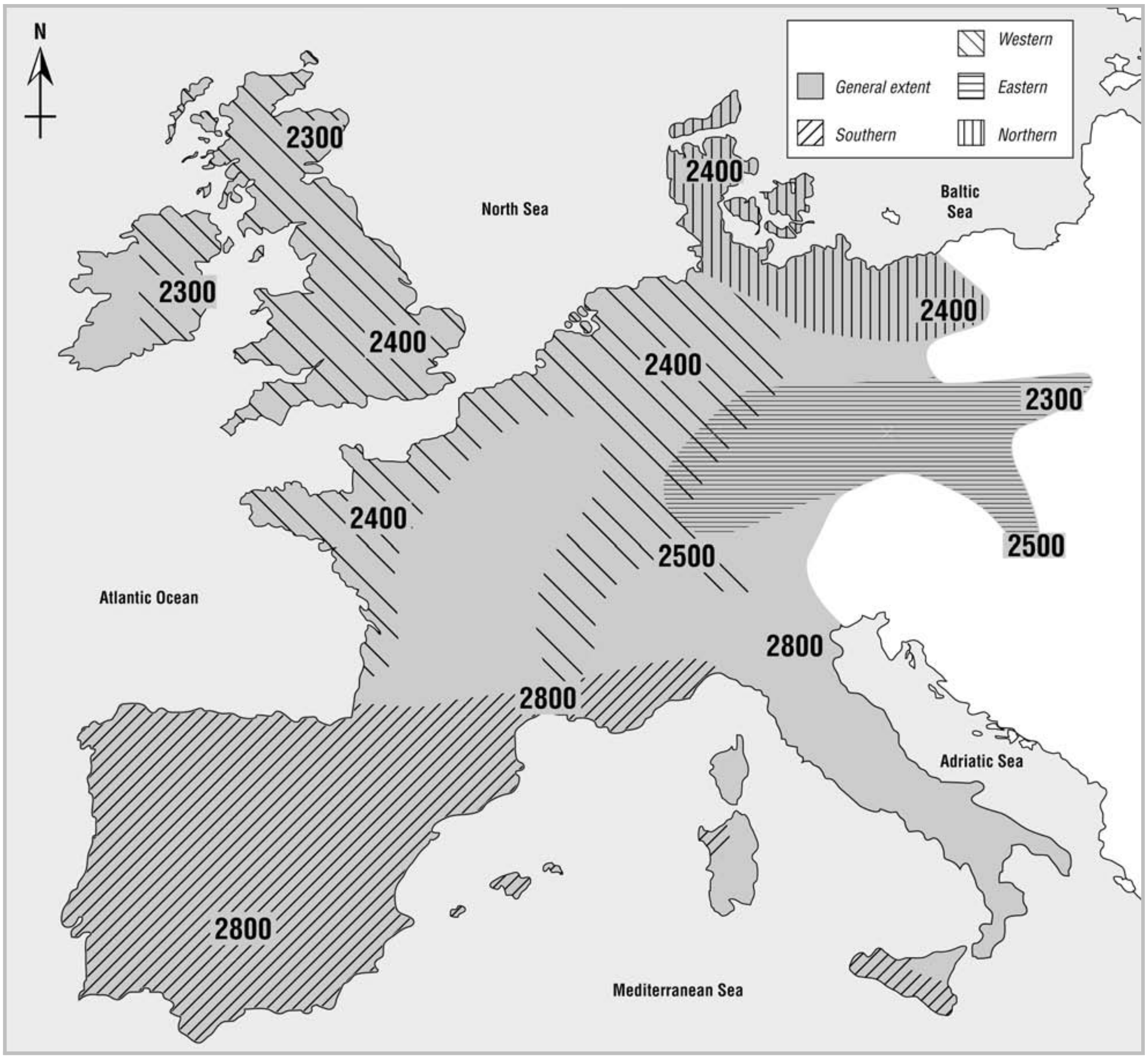
BELL BEAKERS FROM WEST TO EAST

One of the most puzzling archaeological phenomena of prehistoric Europe is the widespread appearance of a specific form of ceramic vessel, a decorated, thin-walled, handleless drinking cup known as a bell beaker, throughout western and central continental Europe and the British Isles during the second half of the third millennium B.C. The bell beakers were often found in male burials that also included archer's wrist guards of polished stone, V-perforated buttons (with two holes drilled from one side at an angle until they converged to form a single V-shaped channel), and copper daggers. Archaeologists refer to this phenomenon as the "Bell Beaker complex" or, more efficiently, simply as "Bell Beakers."

Bell Beakers came to the attention of archaeologists at the end of the nineteenth century when researchers from various countries became aware of the very richly decorated vessels whose shape was reminiscent of an inverted bell. In the early twentieth century, archaeologists throughout western Europe began to adopt a naming convention using the word "bell." In France, these vessels came to be called *Vases Campaniformes,* and the German prehistorian Paul Reinecke conformed to the terminology used by Germany's western neighbors by introducing the term *Glockenbecher*. In the British Isles the term "Bell Beakers" was introduced by Lord Abercromby in the study he published about the phenomenon in 1912.

As the nineteenth century became the twentieth, researchers made the first basic determinations about Bell Beakers. A collection of artifacts characteristic of this phenomenon had been assembled. It was ascertained that these artifacts were most often found in graves throughout western and central Europe. Chronologically, Bell Beakers were assigned to the end of the Neolithic (often called the Copper Age). These first determinations made researchers aware of the extraordinary geographic spread of Bell Beakers and the richness of objects that characterized it. At the time, Bell Beakers were presumed to be the culture of a single people who had spread very quickly across the expanse of western and central Europe over a relatively short time, so the main problem for researchers was to find the place where this culture originated. Most archaeologists of the early 1900s considered the "Beaker People" to have been very mobile and warlike folk, who occupied themselves with raising animals and conducting trade. In some discussions they were described as itinerant traders who spread the knowledge of metallurgy to central and western Europe.

The first all-encompassing model for explaining the genesis of Bell Beakers was proposed by Spanish researchers Pedro Bosch-Gimpera (1926) and Alberto del Castillo Yurrita (1928). In archaeological literature, their theory is called the Spanish Model. It stated that the Bell Beaker phenomenon started on the Iberian Peninsula and from there its peoples, practicing trade, expanded as far as central Europe. Later research, concentrating on the typology of finds in various regions, complicated the picture of Bell Beakers. A breakthrough in this regard were the studies published in 1955 by Dutch researchers J. D. (Johannes D.) van der Waals and Willem Glas-



Extent of Bell Beakers in Europe, the earliest dates of their appearance, and their provinces. Dates are based on radiocarbon dating of short-lived samples (based on Müller and van Willigen 2001). PROVINCES FROM HARRISON 1980; EXTENT FROM CZEBRESZUK AND SZMYT 2003.

bergen that presented a scheme of evolution for the bell beaker vessels. In their opinion this form developed from the beakers of the Corded Ware culture on the Lower Rhine. In the literature this view is known as the Dutch Model. They proposed that there had been an entire sequence of stylistic transformations in the beakers. Those taken to be the oldest were transitional types of beakers called "corded-bell." In addition, there were vessels decorated on their entire surface with cord impressions, which were called "all-over-corded" beakers, or AOC. Beakers ornamented on their entire surface were termed "all-over-ornamented" beakers, or AOO. The next form, an unmistakably bell-shaped phase of typological development, was the so-called Maritime beaker. At the end of the sequence were beakers of the Veluwe type. Subsequently, the Maritime beakers were found to be the stylistically oldest form of bell beaker in all the key Bell Beaker regions of Europe. To this day, the Maritime bell beaker remains a basic component in understanding the internal chronology of the Bell Beakers.

Fig. 1. Reconstruction of a Bell Beaker burial from southern England with the skeleton in typical contracted position accompanied by a beaker and a copper dagger in a stone-lined pit. THE ART ARCHIVE/SALISBURY AND S. WILTS MUSEUM/EILEEN TWEEDY. REPRODUCED BY PERMISSION.

About the same time that the Dutch Model was formulated, Edward Sangmeister proposed the so-called Reflux Model of Bell Beaker origins and distribution. Typological studies done in many regions showed that not all Bell Beaker attributes were connected with Spain, one of the main problems being the fact that corded decoration was absent there. Sangmeister proposed that after the initial phase of Bell Beaker development and expansion from the Iberian Peninsula in the direction of central Europe, a second phase of development took place, this being the "reflux" or reverse flow of Bell Beakers back to the Iberian Peninsula in a new version that had been enriched by central European contributions. Sangmeister, like some of his contemporaries, was becoming aware that it was increasingly difficult to find a single region where Bell Beaker attributes originated.

In the 1970s the Dutch Model gained strong support because a series of carbon-14 datings confirmed its typological sequence. It was an argument that convinced most archaeologists, mainly on the Continent, to accept the Dutch Model. At approximately the same time in the British Isles, new concepts were gaining voice. These addressed concepts far removed from the traditional question about the genesis of an archaeological culture linked to a specific people. Archaeologists such as David L. Clarke called on their colleagues to address the issue of the Bell Beakers from new perspectives. This general appeal was followed by concrete proposals, examining Bell Beakers as a result of processes that were being played out in the social or religious spheres rather than representing the actual movements of peoples. Colin Burgess proposed that Bell Beakers be analyzed as a cultural "package": a collection of artifacts displaying a single type of cultural behavior, which in this instance involved the custom of communal libations. This concept was further developed by Andrew Sherratt, who proposed that Bell Beakers reflect the introduction of fermented beverages and the social privileges associated with the consumption of alcohol. Stephen Shennan devoted much attention to the thesis that Bell Beakers are not a classical archaeological culture but a gathering of specific objects that appear in various cultural contexts.

Such perspectives resulted in a change of approach in research on the Bell Beakers. The questions of the genesis and "Beaker People" became less important to archaeologists. The term "Bell Beaker culture" was no longer used, and archaeologists substituted "Bell Beaker phenomenon," "beaker package," or simply "Bell Beakers." Interpretations of the phenomenon reached for a totally different concept of understanding and generally placed Bell Beakers in the frame of a large cultural change that took place as the Neolithic Age passed to the Bronze Age and social stratification was emerging.

ARCHAEOLOGICAL CHARACTERISTICS AND SPATIAL DIFFERENTIATION

Characteristics of archaeological information on Bell Beakers should be viewed on two levels, taking into consideration: the attributes unique to the phenomenon over the entire area where they appear and attributes specific to individual regions. This division is most apparent among pottery. The collection of Bell Beaker vessels is divided into those that are richly ornamented and those that lack ornamentation. Most of the ornamented vessels are various forms of bell-shaped beakers that provide a classic indicator of the Bell Beaker phenomenon and are known throughout its entire domain. Yet all unornamented vessels and a small part of the ornamented ones have a regional quality, and their local, non-beaker genesis is often mentioned. At the very outset it is necessary to mention that there are a limited number of non-ceramic artifacts that also fall into the first group—those that are found throughout the Bell Beaker domain. The rest of the attributes that describe various cultural characteristics find their place in the second category. For example, there is no single type of grave or settlement that was typical for the entire Bell Beaker phenomenon.

CORE BEAKER ATTRIBUTES

The basic artifact that gives its name to the phenomenon is the bell-shaped beaker. It is a carefully made vessel, having smooth surfaces that are usually an intense orange color, which has a marked resemblance to metal vessels made of copper or gold. The walls of the beaker are relatively thin, which is another point of resemblance to metal vessels. There are many types of bell beakers, such as those mentioned above: AOO, AOC, Maritime, or Veluwe type. Generally, the tendency for stylistic change in bell-shaped beakers lies in the changes in their proportions (from tall and slender to more squat) and the growing intricacy of the decoration.

An important characteristic of the bell-shaped beakers is decoration known as "zoned ornamentation." Looking from top to bottom, one can see bands of ornamentation on the vessel separated by bands without ornamentation (see fig. 1). The decoration was done using four basic techniques: cord impressions in damp clay; engravings with a sharp tool; impressions made with a comb; and less often—and primarily in southwestern Europe—application of red paint. The ornamentation was often incrusted with a white substance. There are many varieties of zoned ornamentation: narrow bands characteristic of the Maritime beakers; wide bands in both single- and multiple-band configurations; and the so-called metope decoration, in which the ornamentation is contained in a wide band that recalls in its layout the friezes of classical Greek buildings.

The second group of objects characteristic to the Bell Beakers was the archery set. Archery must have had a deep cultural significance, because in addition to the flint arrowheads known from earlier cultures, we have been able to find stone plates thought to be archer's wrist guards and the so-called shaft straighteners. The flint arrowheads exhibit a very high quality of manufacture. They have a complicated shape and are covered with a regular surface retouch. Several varieties are known: tanged arrowheads, the so-called heart-shaped points, and triangular arrowheads. Specific to Bell Beakers are stone archery plates that protected the wrist of the hand holding the bow. It is a formally rich group of objects, often decorated, which consisted of both four-hole and two-hole types.

The so-called shaft straighteners were used to polish the arrow shaft. They consisted of two stones, each of which had one flat surface with a single straight groove in it. When the two stones were placed together with their grooved sides facing each other, an opening resulted through which it was possible to pull the shaft.

With Bell Beakers, cutting weapons, mainly daggers, first appeared in Europe. These were commonly made of copper and their characteristic typology was uniform throughout the entire Bell Beaker area. This type is described by the term "tanged dagger." The fact that copper was used, a relatively soft metal, indicates that these had ceremonial rather than utilitarian uses. In the northeast part of the Bell Beaker domain (from Jutland to the regions on the lower Vistula River) flint daggers were manufactured on a large scale.

An invention of Bell Beakers are the so-called dagger scepters or halberds, in which the metal edge similar to that of a dagger is mounted transversely on a wooden handle. We know them from the British Isles and central Europe, and they are widely interpreted as insignia of authority and, more generally, symbols of high social rank.

Another metal product, the so-called Palmela points are known mainly in southwest Europe. A single unequivocal explanation of their use has yet to be formulated. The larger examples could have been used as daggers, while the smaller ones were definitely arrowheads.

Other objects of sheet metal (copper and gold) are also associated with Bell Beakers. These are in the form of earrings (hair decorations), lunulae, and other less-frequently seen objects, such as flat axe heads, awls, or pins.

Buttons with a V-shaped opening were made from various materials, not only horn and bone but also from various semiprecious stones (e.g., jet) and amber. They were of various shapes, but most commonly were round. In the southwestern Bell Beaker area, buttons of the Tortuga type were also made. Both types of buttons are considered to have served as necklace beads, parts of headdresses, or as decorations sown onto garments.

Still another form of object specifically connected to the Bell Beakers are models of bows made from bone, horn, or boar tusks. They are found mainly in central Europe and appear to have been connected to the religious sphere of life, a confirmation of the high regard given to bow hunting.

SPREAD AND REGIONAL DIFFERENTIATION

The line that divides Europe into areas with and without beakers runs along the Vistula River south to the Moravian Gate, as far as the Central Danube in the vicinity of Budapest, then makes a wide curved turn to the shores of the Adriatic in the region of the Po River delta. The area with Bell Beakers takes in not only a large part of Europe west of this line, but also parts of northern Africa in Algeria and Morocco.

This area is unevenly covered with Bell Beaker sites. They are mostly found in settlement centers—places that have a long tradition of regional development, where settlements of prehistoric societies concentrated over many periods. In the entire Bell Beaker domain there are no examples of sites being found in areas that had a marginal cultural significance in previous times.

There are dozens of regions in Europe and Africa that have concentrations of Bell Beaker settlements. A general geographic apportionment of Bell Beakers was proposed in 1980 by Richard J. Harrison. He divided the beaker area into three main provinces: southern, western, and eastern. In central Europe, this general apportionment should be supplemented by one additional province—the northern—encompassing the area between Jutland, in Denmark, and the lower Vistula River.

The Southern Province. This province takes in the entire Iberian Peninsula, southern France, the Balearic Islands, Sardinia, and Sicily, and it also includes the enclaves in northern Africa (Morocco and Algeria). Especially characteristic to this province are the following objects: Palmela points and V-perforated Tortuga buttons. Characteristic among the ceramic ware is the squat shape of the beaker that typologically corresponds to the S-shaped profile bowls (e.g., Palmela-type bowls) and the frequent painting of the vessel surfaces with red paint.

In this province are found fortified settlements, such as Zambujal and Vila Nova de São Pedro. These settlements had stone walls, bastions, and moats carved into the rock. Their beginnings are connected to earlier cultures, but there is no question that they were used during Bell Beaker times. Traces of metallurgical works were found in many settlements, especially for copper and gold. The southern province is noted for its high production of metal objects. These included daggers, earrings, flat axe heads, Palmela points, awls, and other items.

The funeral rites included single and multiple burials. Many of the dead were placed in rock-cut tombs and in various types of megalithic tombs. These were usually complicated constructions that included hallways and round chambers (similar to the *tholos* constructions found in the Aegean area). The dead were placed in the fetal position, on their sides, directly on the rock. Caves and grottos were also used for burials.

The Western Province. This province includes the Atlantic shores of France, the British Isles, the entire Rhine basin as far as Switzerland, and the lower part of Germany to the west of the lower Elbe. In this area three main concentrations can be identified: in Brittany, southern England, and on the Lower Rhine. The first two are characterized by the presence of many objects from the megalithic tradition. Combined with Bell Beakers, the megalithic tradition reached its peak, the best example being the "beaker" phase at Stonehenge. In Brittany there is a visible connection to the Iberian area in the form of the Palmela point found there. Characteristic to the western province is the large number of metal items made of copper and gold. These include halberds, lunulae, daggers, and flat axe heads. These are all objects that had definite prestige and insignia value. Burials continued to be made in various types of megalithic monuments, especially in Brittany. In the British Isles and on the Lower Rhine the graves are mainly single burials, with the body placed on its side in the fetal position, often covered by a barrow. In this province we also have much evidence of settlement sites. This is mainly in the form of traces of rectangular post houses. In the British Isles we find a greater variety of house types.

The Eastern Province. This province includes the areas of the upper and central Danube (up to Budapest), the Bohemian-Moravian basin, and the upper basins of the Oder and Vistula Rivers. Among the most characteristic objects found in the eastern province are the model bows made from bone. There were also many copper daggers. In this province, Bell Beakers come into contact with the Balkan Early Bronze Age tradition, and vessels from both traditions appear in the same context.

Bell Beaker artifacts in this area come mainly from single-burial graves where the body was placed in the fetal position and positioned on a north-south axis. The placement of the body (the direction of head and the orientation of the face) was dependent on gender, although the rules governing orientation were regional in nature. For example, in Moravia men were placed on their right side, women on their left side, whereas in Bohemia the positions were reversed. A specific feature of the burial rites in this province is the frequent use of cremation, which was most likely a continuation of earlier traditions from the Balkan area where this custom was known during the Neolithic. Remains of permanent settlements with dwellings are known only in the vicinity of Budapest and consist of large post houses.

The Northern Province. This province includes Jutland in Denmark, then stretches through northern Germany to the lower Elbe, then across northern Poland to the lower Vistula basin. A characteristic attribute of this province is the intense manufacture of flint daggers. Numerous metal items, especially lunulae and halberds, indicate a connection with the western province. A key factor in reconstructing the placement of the northern province in the framework of Bell Beakers is amber. Here were the main centers where amber objects were manufactured and exported to other localities.

This area has yielded many finds of Bell Beaker settlement sites. These often consisted of rectangular huts, built using post construction techniques, with a partly sunken floor. An analysis of house construction in Jutland showed that the Bell Beaker phase was not a time of radical changes but rather a continuation of the steady developments that had been taking place since the beginning of the Neolithic. Bell Beaker burials are known from both the megalithic tombs as well as from a few individual burials where the body was placed in the fetal position.

In the above geographic division of Bell Beakers there are no sharp, definite lines of demarcation. There are many regions that can be characterized by their own Bell Beaker attributes. One such center, for example, is the area on the Saale River in eastern Germany where the attributes of the western and eastern provinces were combined into a unique whole.

METALLURGY

In all the places where Bell Beakers appear we also see the development of metallurgy. This consisted of the working of copper and gold, where most of the objects are made from hammered sheet metal (lunulae, earrings, pins) or simple casting methods (daggers, flat axe heads, Palmela points, halberds). From a typological viewpoint one can speak of a Bell Beaker style that has a uniform character that takes in the whole of the Bell Beaker domain—a rather large area. This was the oldest single-origin style for metal objects in Europe. In addition to the manufactured objects, we are also familiar with the tools used for metalworking. These are of the "smithy" type, mainly stone anvils of various sizes and chiseling tools. Bell Beakers represent a breakthrough where the majority of European societies adapted to the widespread use of metal. Thus began an era where metal objects were always present in society, along with the techniques for working the material. (Earlier there had only been sporadic episodes where the use of metal objects was widespread, for example, in the horizon of the Lengyel, Polgár, and Brześć Kujawski cultures, c. 4500–4000 B.C.)

CHRONOLOGY

In the archaeological literature, there exists a widely held theory about the principal trends in the stylistic development (i.e., the relative chronology) of Bell Beaker ceramic ware. At the beginning were the Maritime beakers, after which follow various types of ceramic ware that have a regional dimension characterized by more squat proportions. A principal change has occurred in our knowledge of the duration of the Bell Beaker period. The image of Bell Beakers as a short-term event that took place at the end of the Copper Age and the beginning of the Bronze Age is a thing of the past. Accurate chronological data from carbon-14 testing of samples from various regions show that Bell Beakers were a long-lasting and dynamic phenomenon. An analysis by Johannes Müller and Samuel van Willigen published in 2001 took into consideration selected carbon-14 determinations on short-lived substances such as bone and plant seeds while omitting samples from long-lasting sources such as wood charcoal. Results of this dating provide a picture of an extended Bell Beaker development period having various features in different regions. Its earliest beginnings were in the southern province (Iberian Peninsula, southern France, and northern Italy) about 2800 B.C. The latest dates extend into the first centuries of the second millennium B.C. and are found in the western and northern provinces. Chronological data show that the development of Bell Beakers took place from the west (more specifically from the southwest) toward the east and northeast.

POSITION OF BELL BEAKERS IN THE PROCESS OF CULTURAL CHANGE

While searching for an explanation for the Bell Beaker phenomenon one must take into consideration not only the characteristic attributes described above. Two other aspects are of importance: the cultural base on which the Bell Beaker phenomenon was shaped and the world of the early Bronze Age cultures that succeeded the Bell Beakers.

Three basic varieties of cultural base can be named: the megalithic world, the Corded Ware culture, and the Late Neolithic/Early Bronze Age cultures of Carpathian culture basin. In the megalithic zone of western Europe, the Bell Beakers made use of megalithic tombs as well as single graves. Various forms of stone tombs were used, several of which can be seen in the famous cemetery of Sion-Petit Chasseur in Switzerland. In the time of the Bell Beakers there was a flowering of megalithic constructions in the form of complex circles and avenues. These are widely known from examples in southern England. Stonehenge, for example, was developed to its fullest during the Bell Beaker era. Therefore, it can be said that in the megalithic zone, the appearance of Bell Beakers does not break the megalithic tradition, but rather brings it to its apogee.

Likewise, in places where the Bell Beakers came in contact with the Corded Ware culture, the two coexisted. However, there is a definite contrast between the cultural behavior of Bell Beakers and that of the Corded Ware culture, which can be described as a dialectic connection between them. This fact can be best observed in the burial rites. For example, in the Upper Danube both the Bell Beakers and the Corded Ware culture used the same form of mortuary expression (single burial, the body in the fetal position lying on its side, with the two genders placed in opposite ways), but the two groups differ in the specific placement of the bodies.

In the Carpathian culture basin there was interaction between Bell Beakers and the oldest groups of the Early Bronze Age (successors to the Vučedol culture). These contacts developed differently from those in the Corded Ware zone, but similarly to that in the megalithic regions. There are no visible cultural barriers in the development of contacts, which on the level of archaeological practice is problematic for the researchers: there exist many contexts where it is difficult to assign items definitely to one or the other cultural tradition.

Given this evidence, it is difficult to describe the appearance of the Bell Beakers as an invasion that led to radical disruptions in the process of historical change. However, this general picture does not exclude the possibility that in some regions the genesis of Bell Beakers was combined with the phenomenon of migration. One example of this process can be seen in the part of southern Poland known as Małopolska.

In examining the Early Bronze Age cultures that appeared immediately after the disappearance of the Bell Beakers, significant trends are evident. In this domain were the earliest places in Europe (outside the Aegean area) where bronze was made. The list of cultural successors to Bell Beakers is long. Among them are the Wessex, Únětice, Polada, Armorican, Rhône, and Montelavar cultures. Each is characterized by its own style of bronze artifacts, rich deposits of metal objects, an elaborate, stratified society, and an extensive network of cultural contacts. It is difficult to imagine that this prosperous civilized zone was only coincidentally contiguous with the domain of Bell Beakers.

WHAT WERE THE BELL BEAKERS?

It is not accidental that the question is "*what* were" and not "who were" the Bell Beakers. The latest research confirms the traditional view that Bell Beakers spread from west to east and, more specifically, from southwest to northeast. But the dimensions, from the geographic and the chronological perspective, preclude the possibility of explaining this phenomenon as the expansion of a "Beaker People." In some exceptional instances we can speak about the anthropological characteristics of people who are associated with beaker ware, a situation which we have in Małopolska. In a general comparison, however, the individuals associated with the Bell Beaker "peoples" exhibit great variation in anthropological types and represent a large number of the major European cultural groups from the third and the beginning of the second millennia B.C. While the theory of a "Beaker People" has been discarded, this does not preclude the fact that some migration did occur within the Bell Beaker domain. A spectacular example of this is the rich burial of a man in Amesbury, not far from Stonehenge in southern England. On the basis of isotope testing of the man's teeth, archaeologists concluded that he had spent his youth in the Alpine regions, while his son, buried nearby, was a native Briton.

What were Bell Beakers? The main characteristics are as follows:

- They were distributed throughout half of Europe, covering an immense area roughly equivalent to that now occupied by the countries of the European Union.
- The history of Bell Beakers is contained in a time frame that extends for more than one thousand years (though in specific regions the time frame is always shorter).
- They were a phenomenon with internal dynamics. Starting in the southern province they spread from west to east and lasted the longest in the northern province and in the British Isles.
- The central feature of Bell Beakers was a set of artifacts connected with the drinking of specific beverages, war, and hunting.
- These objects were always carefully made, thus having an intrinsic cultural value for their users and are most often found in graves in which a single body was laid in the fetal position on its side.
- The general typological evolution of Bell Beaker artifacts is similar in all regions; their forms

are rather unified in the beginning (as can be seen in the Maritime beakers) but in time acquire regional differentiation.

- Bell Beakers are closely linked to metallurgy, mainly of copper and gold. As a consequence, metallic items became common across a wide expanse of prehistoric Europe, leading to the manufacture of the first stylistic metal objects on the Continent.
- The Bell Beaker phenomenon was culturally mobile and moved with great ease from region to region but was concentrated in the established settlement centers.
- Bell Beakers quickly combined with traditional forms that existed in the various regions. As a result, the appearance of Bell Beakers created no radical interruption in the process of cultural evolution.
- In the places reached by Bell Beakers, there was a period of civilized prosperity that continued even after the phenomenon had disappeared during the Early Bronze Age.

What then were Bell Beakers? Among the proposed answers, archaeologists now assign a greater role to social factors. These concepts are mainly being developed by British archaeologists. Researchers treat Bell Beakers as a cultural "package." A significant element of this package must have been the libation ritual where the bell-shaped beaker was used. The remaining elements of this package, such as the archery set or the dagger, belong to different spheres of life: war and the hunt. Andrew Sherratt has argued that the beakers were used for the consumption of an alcoholic beverage, probably beer or mead, as part of a growing pattern of warrior feasting and hospitality. The characteristic artifacts of the Bell Beaker complex may well have served as status symbols of an emerging elite whose presence became clearer in the Early Bronze Age of the second millennium B.C. Such theories point to Bell Beakers as an important part of the long process that formed the warrior caste in the societies of later prehistoric Europe. The phenomenon became the basis for the creation of the first permanent hereditary elites among the inhabitants of Europe.

See also **Early Metallurgy in Southeastern Europe** (*vol. 1, part 4*); **The Megalithic World** (*vol. 1, part 4*); **Sion-Petit Chasseur** (*vol. 1, part 4*); **Corded Ware from East to West** (*vol. 1, part 4*); **The Early and Middle Bronze Ages in Central Europe** (*vol. 2, part 5*); **Bronze Age Britain and Ireland** (*vol. 2, part 5*).

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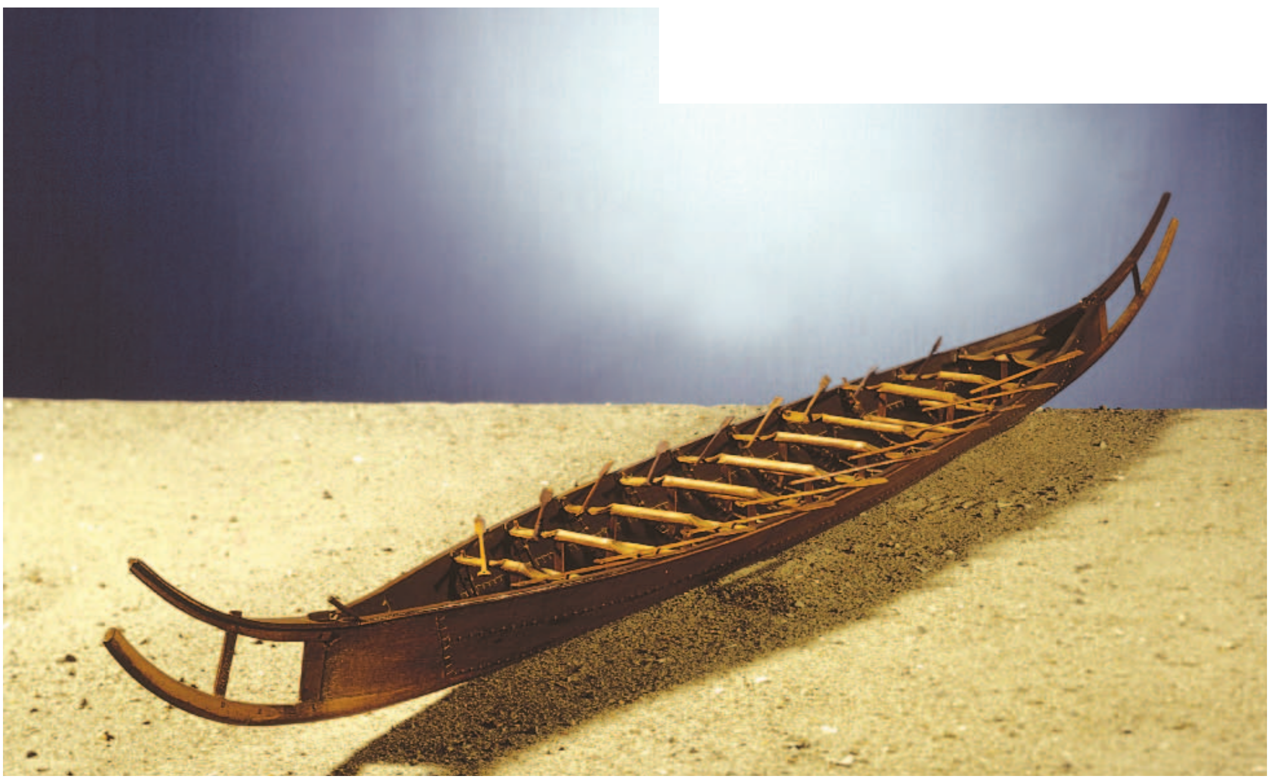
(TRANSLATED BY PETER OBST)

Europe
URAL MOUNTAINS
Faeroe Islands
Shetland Islands
Orkney Islands
Gulf of Bothnia
Gotland
Oland
Bornholm
North Sea
Baltic Sea
Isle of Man
English Channel
ATLANTIC OCEAN
CARPATHIAN MTS.
ALPS
PYRENEES
APPENNINES
DINARIC ALPS
Adriatic Sea
BALKAN MTS.
Black Sea
CAUCASUS MTS.
Caspian Sea
Aegean Sea
Ionian Sea
Mediterranean Sea
Balearic Islands
Corsica
Sardinia
Sicily
Malta
Crete
Cyprus
N
0 200 400 mi.
0 200 400 km

Tollund Man The bog body of the Iron Age man from Tollund Mose in central Jutland, Denmark, c. 220 B.C. His body was deposited in the bog, presumably after being hanged, and was preserved under a thick layer of peat until discovered in 1950.

TOP RIGHT: **Hochdorf** Reconstruction of the Hochdorf chamber, a richly outfitted grave from c. 550 B.C. Grave goods, such as the gold ornaments, bronze couch, and rich textiles found here, give evidence of the social status of the buried. ROSE HAJDU, FOTOGRAFIE, STUTTGART. REPRODUCED BY PERMISSION.

BELOW: **Hjortspring** Model of the boat deposited in the Hjortspring bog, southern Denmark, c. 350–300 B.C. The original boat, of which little remains, was more than 19 meters long. © THE NATIONAL MUSEUM OF DENMARK. REPRODUCED BY PERMISSION.



BELOW: **The Mesolithic of Northern Europe** Excavations at the Late Mesolithic stratified shell midden at Norsminde, Jutland, Denmark. Such deposits contain the leftover shells from consumption of shellfish by hunter-gatherers. COURTESY OF SØREN H. ANDERSEN, NATIONAL MUSEUM OF DENMARK. REPRODUCED BY PERMISSION.

TOP RIGHT: Arene Candide Reconstruction of life inside Arene Candide in northwestern Italy during its Middle Neolithic heyday, c. 4700–4000 B.C. ON CONCESSION OF MINISTERO PER I BENI E LE ATTIVITÀ CULTURALI–SOPRINTENDENZA PER I BENI ARCHEOLOGICI DELLA LIGURIA. REPRODUCED BY PERMISSION.

BELOW: Neolithic Sites of the Orkney Islands Decorated stone artifact from the Neolithic site of Skara Brae, Orkney Islands, c. 3100–2500 B.C. © ADAM WOOLFITT/CORBIS. REPRODUCED BY PERMISSION.

TOP LEFT: **Copper Age Cyprus** Cruciform figurine, a symbol of fertility, from Yiacia, c. 3000 B.C. Height: 15.3 cm. Department of Antiquities, Cyprus. Reproduced by permission.

OPPOSITE PAGE: The Iceman The Iceman on display at the Bolzano museum after being frozen on the Tirolean Alps over 5,000 years ago.

TOP RIGHT: Boyne Valley Passage Graves The Great Mound of the megalithic passage grave from Knowth, Ireland, was built more than 5,000 years ago.

BELOW: Trackways and Boats The Neolithic trackway at Sweet Track is an elevated pathway that ran nearly 2 kilometers across swamps in Somerset, England, almost 6,000 years ago.

TOP RIGHT: **Bell Beakers from West to East** Bell-shaped beaker with plain and decorated horizontal zones from Late Neolithic burial near Salisbury in southern England, c. 2200 B.C. THE ART ARCHIVE/DEVIZESMUSEUM/EILEENTWEEDY. REPRODUCED BY PERMISSION.

MIDDLE RIGHT: **Bell Beakers from West to East** Late Neolithic flint dagger from southern Sweden, c. 2000 B.C., that imitates forms of metal daggers characteristic of Bell Beaker assemblages in central Europe, including the simulated mold mark on the handle. THE ART ARCHIVE/HISTORISKA MUSÉET STOCKHOLM/DAGLI ORTI. REPRODUCED BY PERMISSION.

BELOW: **Corded Ware from East to West** Cord-impressed vessels from southern Scandinavia in forms typical of the Corded Ware/Single Grave/Battle-Axe cultural complex of the mid-third millennium B.C. THE ART ARCHIVE/HISTORISKA MUSÉET STOCKHOLM/DAGLI ORTI. REPRODUCED BY PERMISSION.