A Study of the People

of

Pre-Roman Iron Age and Roman Britain

by

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A Study of the People of Pre-Roman Iron Age and Roman Britain

Abstract

Chapter 1 An introduction to what is known about the Pre-Roman Iron Age (PRIA), the Roman and Post-Roman periods and the people from written, archaeological and burial sources.

Chapter 2 The literary evidence about the people of Britain of this time is limited, but what is available may be expanded and built upon from other sources, such as epigraphy, tablets, settlements and their patterns, burials and cemeteries, anthropology, demography and palaeopathology.

Chapter 3 The Iron Age people of North Western Europe, called Celts by their Mediterranean neighbours, developed common cultures known in the order of their occurrence as Hallstatt and La Tène and their impact on the people of Britain and their language is examined.

Chapter 4 Contrary to the low population estimates of earlier historians, more recent evidence of land settlement in Britain, beyond the fringes bordering Continental Europe, disproves these claims for the PRIA and Roman Britain. In the Post-Roman period, population growth and stability are seen in decline. In support of increases and decreases in population growth an analysis of the evidence is presented.

Chapter 5 Studies using mitochondrial DNA would indicate that, genetically, the peoples of Britain have remained relatively unchanged. Genetic markers such as the
male Y-chromosome and profiling by the genomic matching technique (GMT) on DNA extracted from modern and ancient Britons, it is anticipated, would produce another scenario. Molecular genetics in population studies and their applicability to the ancient people of Britain are reviewed.

Chapter 6 Methods of extracting and analysing ancient DNA, including their limitations, are discussed. In principle GMT offers a new approach to kinship and population studies.

Chapter 7 A case study based on human teeth from the remains found in a small Romano-British burial site was carried out. Difficulties encountered through limitations imposed on the samples through quantity, probable inhibition and their possible resolution are presented. A successful analysis on similar material from a European site demonstrates the potential of the technology in contrast to the pitfalls.

Chapter 8 The population of LPRIA Britain was greater than has been postulated in the past. Evidence of increased settlement numbers, their productive capacity and a developing material culture, pre-existing the Roman period, provides a launching pad for population increases in Roman Britain.

Demic diffusion or residential movement of people bringing agriculture from the Levant to Britain is not supported by the present molecular genetic analysis of the European gene pool. The major component of the European gene pool as determined by genetic analysis is thought by some to have arisen from survivors of the last European glacial period, and not from demic diffusion of farmers from the Levant. Delayed by adverse climatic conditions, farming in Britain is said to have taken 5 or 6 millennia to arrive from the Middle East. From the gene pool analysis, I believe that agriculture in Britain was introduced through a combination of innate and colonising development that led to population growth long before the advent of the Romans.
Population growth in Roman Britain cannot be seen solely as a direct effect of the inclusion of foreign genes but due to the stabilising influence of a unifying administration.

The decline in the population in the Post-Roman period may be attributed to a variety of reasons, including system collapse, new invaders, climatic effects on food production and pestilence.

Future population studies using genetic markers such as GMT on aDNA extracted from the skeletal remains, particularly teeth, of contemporary LPRIA and Roman Britons will assist in elucidating the source of population expansion, that is, through either demic or cultural diffusion, or both.
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Bibliography
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ABBREVIATIONS

ACGT  
adenosine, cytosine, guanine, and thymine

*Acta Archaeologica Academiae Scientiarum. Hungaricae*

AD  
(anno Domini) the generally accepted date for the birth of Christ.

aDNA  
ancient deoxyribonucleic acid

AJA  
American Journal of Archaeology

American Journal of Human Genetics

American Journal of Physical Anthropology

Annals of Human Genetics.

Arch. J.  
Archaeological Journal.

BC  
before Christ.

BP  
before the present.

bp  
base pair.

CAH  
Cambridge Ancient History

Camb. Arch.  
Cambridge Archaeology.

CIL  
Corpus Inscriptionum Latinarum

CR  
Classical Review

CUP  
Cambridge University Press

DNA  
deoxyribonucleic acid.

GMT  
genomic matching technique.

HLA  
Human Leukocyte Antigen.

HMW  
high molecular weight.

Journal of Archaeological Science
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<td>Journal of Forensic Sciences</td>
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<td>LPRIA</td>
<td>Late Pre-Roman Iron Age</td>
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<tr>
<td>MHC</td>
<td>major histocompatibility complex.</td>
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<td>mt</td>
<td>mitochondrial</td>
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<td>OUP</td>
<td>Oxford University Press</td>
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<td>PBA</td>
<td>Proceedings of the British Academy</td>
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<td>PCR</td>
<td>polymerase chain reaction.</td>
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<td>Phil. Trans. R. Soc.</td>
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<td>London</td>
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<td>PRIA</td>
<td>Pre-Roman Iron Age.</td>
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<td>PSAS</td>
<td>Proceedings of the Society of Antiquaries of Scotland.</td>
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Chapter 1 Introduction

Preamble

In the history of Britain and its peoples, the period starting from the Late Iron Age to the end of Roman rule in the fifth century AD has proved to be of great significance to their descendants. Archaeologically, the Late Iron Age (LIA), known as the La Tène period, existed from about the fifth century BC until the Roman invasion of AD 43 (Cunliffe 1995, 119; Fitzpatrick 1996, 241). A subdivision, defined as the Late Pre-Roman Iron Age period (LPRIA), is designated by Millett (1992, 10) as the period spanning the introduction of coinage, wheelmade pottery and lowland nucleated settlements, from about the second century BC to the Roman conquest in AD 43. During this time there is little literary evidence of the people of Britain, and certainly no first hand reports apart from Caesar's. Ancient writers, historians and geographers saw Britain as the Ultima Thule of the classical world, and their knowledge of the people, until Caesar, was thin and at the very best second hand. What we know of that early period is dependent, therefore, on archaeological evidence obtained from the land, burial sites, coinage and pottery combined with some literary and epigraphic information, particularly from the Roman occupation.

Archaeology (cf chapter 4)

This period, before and during the Roman administration, may be divided into three major phases (James and Rigby 1997, 74). The first, before Caesar's expeditions of 55 and 54 BC, the second, the century or so between Caesar's bringing Roman power to the English Channel, and the actual invasion of AD 43, and lastly, Rome's period of rule. In the first phase there is evidence, particularly in Southern England, based on coinage, pottery and closer contact with continental Europe, of the tribal development
of polities and kingship, and the emergence of oppida or social groupings. The Romanization of southern France and the spread of its culture and trade with the later domination of the rest of Europe influenced the rise of the proto-state in Britain. The increasing wealth and its ostentatious display by a few among the British elite, who achieved it through new trade links to the Mediterranean, no doubt was instrumental in stimulating social change and increased production through improved technologies, either acquired or developed. The preliminary subjugation of Gaul by 51BC brought Britain closer to the Roman sphere of influence, with trading and cultural links driving the pace of change in people’s lives, not as a prime mover, but as a catalyst to evolving development in polity and production.

Increased production led to greater surpluses and population expansion, which enabled a more complex social organisation to develop, particularly in southern and eastern Britain. This is apparent from historical sources where reference is made by Caesar to Mandubracius, a son of the king of the Trinovantes and to Cassivellaunus, leader of the Britons, opposing his invasion in 54 BC.

"In the meantime the Trinobantes, the strongest state, perhaps in those parts – the state from which young Mandrubacius, in quest of the protection of Caesar had come to him on the mainland of Gaul, his own father held the kingship in
the state, but had been slain by Cassivellaunus, when he himself had escaped death by flight—sent deputies to Caesar, promising to surrender to him and to do his commands, and beseeching him to protect Mandrubacius from outrage at the hands of Cassivellaunus, and to send him to their state as ruler and sovereign lord” (BG V 20.1).

Historical references to Pre-Roman Britain, its peoples and culture made by Pytheas (cited by Strabo) and Caesar reinforce the archaeological record.

“...Pytheas declares that the length of Britain is more than twenty thousand stadia, and that Cantium is several days sail from Celtica:”

Strabo (Geog., 1. 4. 3)

"Britannia pars interior ab eis incolitur, quos natos in insula ipsi memoria proditium dicunt, maritima pars ab eis, qui praedas ac belli inferendi causa ex Belgio transierunt (qui omnes fere eis nominibus civitatum appellantur, quibus orti ex civitatibus eo pervenerunt) et bello illato ibi permanserunt atque agros colere coeperunt. Hominum est infinita multitudo creberrimaque aedificia fere Gallicis consimilia, percorum magnus numerus.

"The island part of Britain is inhabited by tribes declared in their own tradition to be indigenous to the island, the maritime part by tribes that migrated at an earlier time from Belgium to seek booty by invasion. Nearly all of these latter are called after the names of the states from which they sprang when they went to Britain: and after the invasion they abode there and began to till the fields.

The population is innumerable; the farm buildings are found very close together, being very like those of the Gauls; and there is a great store of cattle.”
Caesar (BG V 12)

Interiores plerique frumenta non serunt, sed lacte et carne vivunt pellibusque sut vestiti. Omnes vero se Britanni vitro inficiunt, quod caeruleum efficit colorem, atque hoc horridores sunt in pugna aspectu; capiloque sunt promisso atque omni parte corporis rasa praeter caput et labrum superius. Vxores habent deni duodenique inter se communes et maxime fraters cum fratribus parentesque cum liberis; sed qui sunt ex his nati, eorum habentur liberi, quo primum virgo quaeque deducta est.

“Of the islands most do not sow corn, but live on milk and flesh and clothe themselves in skins. All the Britons, indeed, dye themselves with woad, which produces a blue colour, and makes their appearance in battle more terrible. They wear long hair, and shave every part of the body save the head and upper lip. Groups of ten or twelve men have wives together in common, and particularly brothers along with brothers, and fathers with sons; but children born of the unions are reckoned to belong to the particular house to which the maiden was first conducted.”

Caesar (BG V 14)

LPRIA pottery and the distribution of coin types help to identify tribes or ethnic groups such as the Dobunni, the Durotrigues, the Iceni, the Catuvellauni, the Belgae and so on (Cunliffe 1978; 1974).

However, the evidence of coins for rulers of early Britain is at once substantial and yet elusive particularly where it is unsupported by other sources of information. (Braund 1996, 75).

The sources tell us nothing about the length of their reigns, the extent of their powers or where they were located. The imperialistic Cassivellaunus, because of a similarity of
personal and tribal names, has been assumed to be king of the Catuvellauni, but there is no confirmation from ancient sources. There also is no certainty that such a tribe as the Catuvellauni, thought to have been located somewhere in the Hertfordshire area, existed in the time of Caesar (Braund 1996, 68). Caesar makes no mention of them but Cassio Dio refers to them in his account of the Claudian invasion.

After the flight of these kings he gained by capitulation a part of the Bodunni, who were ruled by a tribe of the Catuellani; and leaving a garrison there, he advanced further and came to a river.”

Dio (LX 20. 2)

Childe (1940, 222) interpreted burials and stray objects, characteristic of the La Tène tradition, found in East Anglia as the culture of ‘Marnian Chieftains’ who took control of the Hallstatt peasantry and later founded the Iceni tribe. This perception has been re-examined and the evidence for migration is difficult to substantiate (Megaw and Simpson 1979, 414; Cunliffe 1995, 23).

Population in the PRIA

Major sources of innovation and change giving rise to a population increase in prehistoric Britain have for long been ascribed to a migrationalist framework in which continental Iron Age societies spread to peripheral areas such as Britain (Hawkes 1931, 1959). Hawkes (1931) defined three major archaeological Iron Age cultures as Iron Age A, B and C. Iron Age A was based on the Hallstatt style material culture, Iron Age B on the La Tène style and Iron Age C on the distinctive cremation burial rite, wheel turned pottery and the late La Tène metalwork found in restricted areas of Britain. The invasion hypothesis was challenged by Graham Clark and F. R. Hodson (Renfrew 1987,
241) in the 1960s with the view that innovations and changes were due to internal growth, trade and cultural adaptation of Continental material goods and know-how, not the arrival of immigrants (Megaw and Simpson 1979, 412; Salway 1981, 7; Renfrew 1987, 241; Jones 1997).

The migrationary evolution of Iron Age culture in Britain arising from Continental colonizers or invaders, a view held by earlier writers, has been revised by present studies in favour of cross channel and other links through polities and trade. Support for this hypothesis is found in archaeology and the written evidence from ancient sources such as Caesar and Strabo.

*Qui eius consili principes fuissent, quod intellegerent quantum calamitatem Civitati intulissent, in Britaniam profugisse.*

“The leaders of the plot, perceiving how great a disaster they have brought on the state, have fled to Britain.”

Caesar (*BG II. 14*)

*Huiuwest civitatis longe amplissima autoritas omnis orae maritimae regionum earum, quod et naves habent Veneti plurimas, quibus in Britanniam navigare consuerunt et scientia atque usu nauticarum rerum reliquos antecedenterunt,*

“The Veneti exercise by far the most extensive authority over all the sea-coast in those districts, for they have numerous ships, in which it is their custom to sail to Britain, and they excel the rest in the theory and practice of navigation”

Caesar (*BG III 8*)

tαυτά δὴ κοιμάζεται ἐξ αὐτῆς καὶ δέρματα καὶ ἀνδράποδα καὶ κύνες εὐφυεῖς πρὸς τὰς κυνηγείας. Κελτοὶ δὲ καὶ πρὸς τοὺς πολέμους χρώνται καὶ τούτοις καὶ τοῖς ἐπιχώριοις.
"These things, accordingly, are exported from the island, as also hides, and slaves, and dogs that are by nature suited to the purposes of of the chase; the Celti, however, use both these and the native dogs for the purposes of war, too."

Strabo (Geog., IV 5. 2.)

Elaboration of these differing assessments of the attainment of cultural and technological advances by the Britons during this period of their history will be made in the following chapter. Implicit in any discussion on the development of an Iron Age culture is its relationship to or symbiosis with Celticism. An analysis of studies relating to the people, the culture and the language will be developed in later chapters.

Demographic studies earlier this century concluded that, apart from some areas in Britain such as Southern England, population densities were low. More recent studies, through the medium of aerial survey and photography, systematic field walking applied in extensive regional studies and excavation of specific farming sites have shown a ten fold increase in the number of Roman sites, including those so inhospitable that only severe population pressure would have forced their cultivation (Jones, 1996, 14-15; cf 1979). Early estimates of 0.5 to one million people (Collingwood 1929; Collingwood and Myres 1937, 180) during the height of the Roman occupation was based on a view that the province was significantly less developed than were its western provincial neighbours (Jones 1996, 13). Emerging consensus of a total population of 3-4 million (Jones 1979, 245; Millett 1990, 183; Burnham 1995, 127), and conceivably more, reflect the dramatic upward estimates of the extent and density of rural settlement. For these revised estimates to be feasible in the time frame of the Roman occupation, even with improved technology and government, would, I suggest, reflect the existence of a more numerous PRIA population and level of agriculture than previously thought.
possible. A survey of what evidence is now available to support this argument will be included later.

Population in the Roman Period (cf chapter 4)

Population growth was fostered by the Roman institution of public authority that provided better hygiene and health and created conditions and set up demands which contributed to intensive agricultural development as a means of meeting imperial taxes collected by the elite as an additional tier of tribute from the people (Burnham 1995, 131). Hillforts, symbols of internecine warfare, disappeared in the Roman administered or Romanized areas with the obvious advantage of reducing mortality rates among the indigenous population (Jones 1979, 236). The end of the Roman era brought conditions less favourable to population growth, and, with it, a disrupted public authority and a move away from the towns. For a while, the increased prosperity of the villas may have produced some stability before they, too, were submerged in the breakdown of Romanized society by events occurring in Western Europe.

In looking at population changes and the demography in LPRIA and Roman Britain, it is not proposed to consider in any detail an analysis of the economic effects of food production, trade and government. Rather, confirmation will be sought for a hypothesis that changes in the ethnicity or physical characteristics of the LPRIA and Romano-British people were the result of limited invasions over the millennia. These changes were to lead to genetic diversity of regional geographical locations and the development of innate or cultural diffusion of technologies with later enhancement during the Romano-British period.

Under Roman rule the indigenous population of Britain is thought to have expanded, but was this solely attributable to Roman know-how or had the process begun much earlier with Roman technology and systems giving it added impetus? The evidence of
earlier with Roman technology and systems giving it added impetus? The evidence of climate, public administration and diminished intertribal warfare during the period of the Roman occupation would suggest an environment conducive to a population in excess of the PRIA. Initially, the immediate result of the invasion would be a decline, particularly among the males, of the population as an effect of the warfare and its destructive consequences on food production. Drinkwater (1990, 210) highlights this in referring to Caesar’s conquest of Gaul between 58-51 BC and points to the massive scale of death and mutilation, enslavement and confiscation of property of the indigenous population that resulted. In Britain how many died in the Claudian campaign can only be guessed at. Following that invasion there are the tens of thousands of Boudiccan rebellion casualties.

*Ad septuaginta milia civium et sociurum iis quae memoravi locis cecidisse constitit.*

“ It is established that close upon seventy thousand Roman citizens and allies fell in the places mentioned.”

Tacitus (Annals XIV 33)

*Clara et antiquis victoriis par ea die laus porta: quippe sunt qui paulo minimus quam octoginta milia Britannorum cecidisse tradant, militum quadringentis ferme interfectis nee multo amplius vulneratis.*

“The glory won in the course of the day was remarkable, and equal to that of our older victories: for by some accounts, little less than eighty thousand Britons fell, at a cost of some four hundred Romans killed and not much greater wounded.”

Tacitus (Annals LXIV 37)
However horrifying were the results of the Roman invasion and the early occupation period on the Britons, a peak in the population during the late first and late second centuries AD with a decline in the third and fourth centuries is postulated (Jones 1996, 16). Available sources indicate that the warmer climate during this time would favour optimal conditions for agriculture and population growth than that for the PRIA. This would conform to the premise that an increase of one degree centigrade in average temperature can prolong the growing season by two weeks as well as affecting environmental conditions related to the scope and virulence of certain diseases (Jones 1979, 236-238).

**The Written Evidence**

From this apparent populous province of imperial Rome what do we know of the people of whom it was composed? The ancient writers (Caesar, Diodorus Siculus, Strabo, Tacitus) tell us something about them but few, apart from Caesar, had first hand knowledge. Birley (1979) using the epigraphic record supported by the limited historical evidence focuses on those among the Britons who were rulers, soldiers, government officials, traders and some of more common stock. From Allason-Jones (1989) we gain some insight into the lives of the women of Roman Britain and, like Birley, this is gained from epigraphic and other evidence from sources even more limited. For prehistoric and Iron Age Britain, Ehrenberg (1989), uses archaeological and sparse historical references to shed some light on the women of this time in history.

**The Burial Evidence**

Fortunately, we are not dependent on the written sources alone. The physical remains of the people themselves survive in quite significant quantities and can be analysed and interpreted. From anthropometric analysis, the people of the PRIA are seen as being descended from long-headed individuals of less stature, but more sturdy and muscular
than the present day Briton. The origin of this physical type is difficult to determine since, from whatever direction they came, they belonged to long-headed European stock. The prevalence of fair colouring in the east and dark in the west of England in modern times is not altogether due to Anglo-Saxon invasions but to older divisions between northern European influences in the east and southern European impacts on the west coming by way of the Atlantic coast (Collingwood and Myres 1937, 18). The Bronze Age is believed to have added a physical type of round-headed, brawny and rough browed, sometimes tall and dark, and found in patches along the western coasts and Ireland. The type was provisionally identified with tin and copper prospectors of the second and third millennia BC, who spread from the eastern Mediterranean. The east coasts from the Humber to Caithness show evidence of a round-headed physical type as discovered in the cist type graves (Fleure 1925, 47). Studies of the genetic frequencies of Europe, including Britain, would appear to add substance to the above (Bodmer 1993, 56).

In the Romano-British, period the people show little signs of Roman or Italian origin. Caesar’s legions in their brief forays into Britain would have had little impact on the genetic diversity of the native population. The legionaries of Claudius’ invasion force from the evidence of about 44 tombstones from the first and second centuries AD indicate that two came from Italy proper, 20 from Gaul, which included Cisalpine, Provincial or Lugdunese with another 22 from Spain and other regions of the Empire. This is in contrast to the traders who were primarily from Italy, Northern Italy and Greece. The later soldiers were exclusively from Germany and from areas where they differed little physically from the native population (Collingwood and Myres 1937, 182). As judged from the tombstone evidence the Italian element of the Roman army is unlikely to have had a great influence on the physical characteristics of Romano-
Britons. Historical evidence, however, is more informative, as it tells us that the four legions of Claudius were drawn from the Rhine and Pannonia (Frere 1991, 48).

Since legionaries were Roman citizens their origins would have been primarily Italy, Spain, Provence or in coloniae of citizens. Conversely, the ethnic origins of the auxiliaries would be more widespread as citizenship was not mandatory and their service could have been part of the treaty obligations of a conquered state or territory from anywhere in the Empire and beyond. Later transplantations of the inhabitants from other regions, for example, Burgundians and Vandals from the Upper Rhine in the third and fourth centuries AD would have added to the racial mix, as would the later broadening scope of Roman citizenship and legionary origins. Physical anthropology is more complementary to the later phases of Roman rule where, because of changes in burial practice from cremation to inhumation, skeletal analysis can be applied (Collingwood and Myres 1937, 182). A closer examination of what is known, and can be construed about the people of PRIA and Roman Britain, will be developed in further chapters.

Complementary Evidence

Using the disciplines of physical anthropology, molecular biology and linguistics an attempt will be made in chapters 2, 3, and 4 to determine and define what these can contribute to the demography of the people living in the temporal and spatial period of the study. What can they tell us about individuals and communities, and what limitations do the technologies and interpretations inherent in these sciences impose?
Chapter 2 The Evidence

Introduction

Traditionally, what is known of the people of LPRIA and Roman Britain has come about from the written evidence in the form of literary sources, inscriptions from tombstones, monuments and other texts on stone, metal (army records and discharges etc), curse tablets and wood (writing tablets). Palaeodemography and molecular archaeology, however, also can be used to inform us about the people of PRIA and Roman Britain in terms of their environment, physical appearance and genetic make-up. For example, the studies on the remains of those found in various burial sites (Whimster, 1981; Wait 1985; and Watts 2001) and cemeteries such as Trentholme Drive (Wenham 1968) Cirencester (McWhirr et al 1976), Lankhills (Clarke 1979), Skeleton Green (Partridge 1981), Poundbury (Farwell and Molleson 1993) as well as the analyses from modern population genetics and their relation to their antecedents. Palaeodemography is defined as being concerned with the vital statistics of prehistoric and protohistoric societies (Brothwell 1972/73, 75). These vital statistics comprise the size and reproduction of populations, their biological and social structure, fertility and mortality conditions which go to make up their demographic patterns (Acsádi and Nemeskéri 1970, 51). Much of what has been determined has come from analyses of epitaphs, burial remains, archaeological and anthropological findings to which we can now turn.

Literary

By the middle of the second century BC, from the evidence of coin typology and distribution, movements of people and spheres of tribal influence can be distinguished,
but, in terms of individuals and their actions, the history of Britain cannot be written. Not until the invasion by Caesar is it possible to write of people as reflected in contemporary historical writings and numismatic evidence, much of which is anecdotal, incomplete and possibly deliberately misleading (Cunliffe 1991,107).

Caesar is one of the few extant sources who actually visited the British Isles and on whom later writers such as Strabo and Cassius Dio based most of their writings. Caesar (BG V, 12.) informs us that the people in the interior of Britain claim to be indigenous to the land while those from the coastal districts are immigrants from Belgic territory. Further, he tells us that they are similar to Gauls with a large population. Later he describes the people of the interior as being pastoralists, unlike those of Cantium (Kent), whose way of life is not dissimilar to the Gauls. He presents those in the interior as primitives who dye themselves with woad and practice polyandry (BG V 14). In the later works of Stabo and Cassius Dio, possibly with the benefit of information from expatriates and of the Britons themselves, either as visitors or enslaved, more is told about the Islanders.

Strabo refers to the Britons’ lack of horticultural and farming skills and of his personal sighting of them in Rome. They are described by him as taller and not as blond as the Celts as well as being a foot and a half taller than the tallest in Rome. He sees them as being less sophisticated than the Celts and lacking basic skills in using milk to make cheese. Politically, he refers to a society ruled by chieftains.
Those Britons living in northern Britain, perhaps in the Scottish Highlands, are seen by Cassius Dio as even more barbaric than their southern neighbours are and without the benefit of clothes.

"They dwell in tents, naked and unshod, possess their women in common, and in common rear all their offspring."

Dio (LXXVI, 12, 1-2)

He describes them as living on their flocks, game and fruits with no cities or farms. Archaeological evidence of the LPRIA (Hingley 1992) indicates farming skills in the lowland regions comparable to those inhabitants of Gaul and refutes the ancient sources who, perhaps, added more colour than accuracy to their commentaries.

Tacitus, an historian of the late first/early second century AD, writing presumably with first hand knowledge of Britain gained from his father-in-law Agricola, erstwhile governor of Britannia, claims that earlier writers embroidered the facts.

'Ita quae priores nondum comperta eloquentia percoluere rerum fide tradentur. "Where my predecessors relied on graces of style to make their guesswork sound attractive, I shall offer ascertained fact." (Agricola, 10)'

While continuing the skewed location of Spain relative to Britain he describes the contrasting physical characteristics of the inhabitants as suggesting immigrations from adjacent locations in continental Europe (Agricola, 11 [cf. P.25]).
The climate, he says, is unsuitable for the cultivation of crops grown in warmer climes such as olives and grapes, but Britain has a soil that produces grain and feed for cattle.

\[ \textit{Solum praeter oleam vitemque et cetera calidioribus terris oriri suetapatiens frugum pecudumque fecundum: tarde mitescunt, cito provient; eademque utriusque rei causa, multus umor terrarum caelique.} \] (Agricola, 12)

He gives few details about the location of people or of major events of the time.

In any assessment of the literary evidence of extant writers an awareness of the environment, political or otherwise, in which they were associated is a necessary adjunct to interpreting their reports from other complementary analyses. Caesar, as we know was a soldier writing of his campaigns with his own agenda to pursue. Strabo, a geographer, no doubt reflected the biases of his time and peers. Cassius Dio, a contemporary of Septimius Severus and at whose suggestion he wrote his Histories, describes the natives of northern Britain in fanciful terms as primitive savages. Perhaps by so doing he was providing propaganda for Severus’ difficult campaigning in that region. Again, archaeological findings do not support his portrayal of a hunter-gatherer society. Finally, Tacitus, a Roman Senator, in writing about Britain has as his main theme the life of Agricola and is endeavouring to restore posthumously or publicise his father-in-law’s public life, that is as Governor of the Roman province of Britannia. He describes Agricola’s campaigns in the north and of the different tribes found there. Unfortunately, contrary to his introduction about giving “ascertained fact” (Agricola 10) to his story, he gives few of them on actual places and significant incidents (Ogilvie and Richmond 1967, 35). It may be that his other works such as his Annals and Histories provided that evidence, but unfortunately the relevant chapters are lost to us.
Epigraphic

Researchers, in studies involving sex and age structures of the population, ages at death for both sexes, survival, and on this basis, life expectancy of the Italian region, have used the *Corpus Inscriptionum Latinarum (CIL)*. Similar analyses on Romano-British epitaphs have been done on ages at death by Kennedy (p. 50) and places of origin (Birley 1979, 18). Epigraphic evidence, however, relates primarily to the Roman or Romanized population and not to the rural people. It is further restricted to Romanized locations, and where suitable stone for tombstones and other monumental work was available. Some 2,000 or more tombstones of the period have been found in Roman Britain and give information unfettered by vicarious mediation of the facts. They also provide data on what people did in their society and from where they came. The commemoration of the deceased by a gravestone was not popular in civitas capitals inhabited by Celts (Britons). Regions where most inscriptions can be found do not coincide with centres of Celtic population (Biro 1975 16,19). On the evidence of inscriptions of the first half of the third century, a culmination of the Romanization of the Britons is seen in those found along Hadrian’s Wall, *RIB 531, RIB 1349, RIB 1481, and RIB 2004* (Collingwood and Wright, 1965). A major part of the names found inscribed on the tombstones is *Aurelius* (Richmond, 1958, cited by Biro 1975, 32), which lends support to this conclusion. Further, the incorporation of natives into the auxiliary forces and their deployment to that region offers another possible explanation. The location of these auxiliaries saw the emergence of miniature garrison towns to house their families with the adoption of Roman funerary practices and included memorials to women and children, *RIB 529 and 530* (Collingwood and Wright, 1965). In those areas distant from direct Roman influence, such as the villa estates, there is a lack of inscriptions. Cultural differences and illiteracy of the majority of the inhabitants
may explain this deficiency, as those commemorations would be meaningless and without significance to them. They, also, would provide no pre-eminence to the wealthy or literate among them. As the population moved from the towns in the fourth and fifth centuries the epigraphic practice declined, and practically disappeared, after the Romans finally left the province.

**Defixiones**

Curse tablets inscribed on lead, some 130 of which have been recovered from a sacred spring at the temple of Sulis Minerva at Bath (Tomlin 1988) as well as a few others from the temple of Mercury, Uley (Hassall and Tomlin 1996), a supplication to the god Neptune in the Humble estuary (Tomlin 1997) and one at Ratcliffe on Soar, Nottinghamshire (Hassall and Tomlin 1993), are

> social and religious documents of primary significance in many ways, including the history of writing, of language (Celtic, Latin and the Romance languages) and of literacy. (Reynolds and Volk 1990, 379).

They tell of the character of the people who dedicated them and of their absorption into the Roman Empire. Tomlin (1988, 79) sees them as "a microcosm of the speech habits of Roman Britain". They show Celtic text written in Latin alphabet and are overwhelmingly concerned with stolen property in contrast to elsewhere in the Roman Empire. It is believed that many of the tablets were written on behalf of suppliants asking for the intervention of the deity in their quest for retribution on the perpetuators for their crimes. For example the defixio from Uley reads:

(reconstructed text) carta qu(a)e Mercurio donatur ut manecilis qui per[i]erunt

> ultionem requirat; qui illos invalavi<1>t ut illi sangu(in)em [e]t sanitatem
tolla[t]; qui ipsos manicili[o]s tulit [u]t quantoci<ci>us illi pareat quod deum

Mercurium r[0]gamus [...]ura
q[...]jos.nc.u[2-3]lat.

"The sheet (of lead) which is given to Mercury, that he exact vengeance for the gloves which have been lost; that he take blood and health from the person who has stolen them; that he provide what we ask the god Mercury [...] as quickly as possible for the person who has taken these gloves." (Hassall and Tomlin 1996, 439-440)

The curse tablets are from the second to fourth centuries AD (Adams 1993) and probably commissioned by persons below the provincial elite but doubtless people of property (Tomlin 1988, 74).

Tablets

The writing tablets recovered from the early forts at Vindolanda (Bowman and Thomas 1983; Bowman 1994) and, now, Carlisle (Tomlin 1998) give us some first hand information about life during the Roman occupation of the northern frontier at Hadrian's Wall. The period covered by the tablets was from AD85 to cAD130. From various locations in the forts at Vindolanda, such as the praetorium, the barracks, adjacent streets and latrines thin wooden, veneer-like, tablets were recovered. Military information about the strength and activities of the units stationed there is to be found among them. There is also extensive correspondence of a prefect and fort commander, Flavius Cerialis, as well as domestic correspondence of his wife, Sulpicia. The latter tells us about everyday matters in the life of a Roman family. Other ranks, like centurions and a decurion, are also among the correspondents. From the writings we learn of the presence and identity of other officers, their wives, families and domestic establishments. Accounts and lists of foodstuffs provided and of how the people of the forts were fed and of what extras were available to them are to be learned in translating these messages from Roman Britain. There are descriptions of religious festivals,
birthdays and other events in the life of the garrison. More of the tablets are being uncovered and interpreted to add to our knowledge of the lifestyle and everyday activities of those serving Rome on the British frontier (Bowman 1994). In general, they tell us little about the native people of Roman Britain as opposed to a few of the Romans, unlike the curse tablets, which are a source of information about the native population.

*Settlements and Patterns*

Archaeological evidence deduced from environmental and ecological studies sheds some light on the demography of population growth and expansion through what can be determined from land cultivation and plant remains. The development of technology allowing cultivation of hitherto inaccessible land for agronomy and pastoralism would be a response to increased population needs (Boserup 1975, Grigg 1979) and not the reverse. It has been argued that population growth can cause intensification of agriculture by acting as a spur to communities to change their methods and to transform them into much more advanced and productive societies (Grigg 1979, 65). Population studies of present day developing countries support this hypothesis (Boserup 1975, 264) and its application to LPRIA and Romano-British communities would not be unreasonable. Evidence of widespread change in the balance and intensity of LPRIA agriculture is seen in the maximum utilisation of prehistoric and protohistoric field systems, thought by Millett (1990, 11) to be brought about by an increasing population. Stimulus for these developments, in concert with an expanding population, would come from the evolution of a more stratified society and the increasing number of people not engaged in food production (Millett 1990, 11; Greene 1986, 127).
Burials

Burial remains provide useful data for the demographic analysis of prehistoric and ancient people. There are, however, problems in the interpretation of the data. For example, how representative of the wider community is the burial material excavated? What social factors bias the burial such as: Who were the people interred in the cemetery? Were they rulers or ruled, kith or kin, male or female, adult or child, separated or together in death?

An important factor in demographic studies on the people of the LPRIA and Roman Britain is the method of the disposal of the dead (Whimster 1981; Wait 1985; Philpott 1991). Physical anthropologists, from skeletal remains, are able to ascertain in varying degrees the sex, age, stature, kinship, race, nutrition and disease-state of the deceased. In Britain, during the period studied burial practices varied as they did in Europe with cremation more common until the third century AD when inhumation became fashionable under the cultural influence of Rome (Philpott 1991; Morris 1992; Collingwood and Myres 1937, 183).

Burial rituals also varied in the PRIA and provided little material for analysis. In the south east of Britain cremation, prevalent at the time in Gaul, was widely practised by all levels of society in that region, although increasing evidence of other burials such as pit, hillfort and ditch inhumations in the region has become evident. They show few manifestations of grave goods, which may be one of the principal reasons for their being ignored (Whimster 1981, 5). Conversely, in East Yorkshire, as seen in the barrow burials of the so-called Arras culture (Stead 1979, 1991), inhumation, with status defined by funerary inclusions, is found and also in the south west of England (cf chapter 3, La Tène in Britain). The evidence of disposal methods, apart from scattered
inhumations and cremations, used between c 1000 to 400 BC is almost non-existent
(Whimster 1981, 50). It may be argued that the existence of a burial rite, which left no
visible archaeological trace, persisted up to and beyond the Roman Conquest
(Whimster 1981, 190; Morris 1992, 47). A likely explanation is that excarnation was
practised with the body left to rot. It was then disposed of in pits or by scattering it over
the countryside, in rivers, or the sea, with or without post cremation of the remaining
cadaveric residue (Ellison and Drewett 1971, 192; Frere 1991, 12, 294; Cunliffe 1995,
108; James and Rigby 1997, 66). Physical anthropological analysis of the skeletal
remains is made difficult by the effects of cremation, the dislocation of the skeleton
and the limited grave goods which would aid the determination of population
demography.

Cemeteries

Studies of the cemeteries excavated since the middle of the last century have been able
to tell us something about the people of the LPRIA and Roman Britain. Among the
larger cemeteries excavated such as Danebury, Maiden Castle and South Cadbury
(Wait 1985, 89-90), Yarnton in Oxfordshire (Hey et al 1999), Trentholme Drive in
Yorkshire (Wenham 1968), Lankhills in Winchester (Clarke 1979), Cirencester
(McWhirr et al 1982) and Poundbury (Farwell and Molleson 1993), physical
anthropological analysis reveals something of the demography of the people of that
period.

In my survey of the cemeteries under study I have referred more to Trentholme Drive
than to other major burial finds such as Lankhills, Cirencester, Bathgate and
Poundbury. Trentholme Drive, I believe, because of its history as a cemetery for the
Roman fortress at York and its 4:1 male to female ratio of burials, offers a valuable
subject for a molecular genetic study of the indigenous population. The early burials
could provide a means of comparing the genetic pattern of the presumed foreign (possibly of Latin origin) males with that of the assumed dominant native female remains. From this analysis, the hope would be to establish an ancient British gene pool to use in further population studies on the people of PRIA and Roman Britain.

Trenholme Drive, a cemetery containing a mixture of cremation and inhumation burials from the second to the fourth centuries AD, reveals that the skull measurements of the skeletal remains show a homogeneity among the female occupants. They are characterised as long headed with a low, near vertical, forehead broadly similar to those of the other cemeteries, and no doubt representative of the autochthonous population. The male cranial dimensions, however, are more varied, although the largest group among them is comparable to the female, there is a wider diversity with the broad headed group which comprises 20 per cent in comparison to 2.4 per cent of the females. Though, fundamentally, the population in the main was not dissimilar to other Romano-Britons there was evidence of other racial groups based on this analysis. It has been suggested that a group with sloping foreheads, broad faces and high cheek bones is representative of the eastern Mediterranean while those of the more pronounced long headed type are indicative of Scandinavian origin (Wenham 1968, 156). The small female group is postulated as being the result of miscegenation over three centuries. Trenholme Drive is situated close by the legionary fortress of York and, on this basis, it is possible to assume that it may have been a military cemetery. A complement with a ratio of four males to one female (Wenham 1968, 147) adds weight to this assumption.

342 inhumations, with additional 50 cremations, were excavated at Trenholme Drive but no crania of positive Roman origin were revealed. If legionaries of Roman origin were buried at Trenholme Drive, it is more than likely that they would be found
among the cremated of the late first to early third centuries and not among the inhumed of the later centuries. That being so, the disrupted skeletal remains would make identification difficult if not impossible. Archaeological and historical studies imply that the later occupation forces were recruited mainly from northern Europe and Britain itself making an analysis of racial types hard because of their similarity to the civilian population (Collingwood and Myres 1937, 182).

*Anthropology*

Interpretation from burial remains of such features as sex, age, stature and pathology is dependent on the bony structures of the body. That is, unless the deceased has remained in a super dry, frozen and/or anaerobic environment where the soft tissues are preserved from autolytic and putrefactive change, since its interment until the present. Examples where this has occurred may be seen in the Lindow Men, with the oxygen free and biologically sterile waters of the bog at Lindow Moss, Cheshire, in which they were deposited, some 2000 years ago, thus preserving them (Turner 1986, 9-13). Where there is soft tissue preservation it is possible to determine secondary sexual characteristics, stature or robustness, colour of hair and pathology unrestricted to bone. This is not possible where the only tissue left is bone, and in most cases degraded or disintegrated, leaving only a chemical outline where the chemical content or acidity of the soil, wherein it lay, accelerated the decomposition process.

Depending on the nature and sufficiency of skeletal material, it is possible from the structure of the pelvis, the skull, the teeth and general robustness of the bones to infer the sex of adults but less so in children (Brothwell 1971, 112). Difficulties, however, may arise from pelvic measurements, as we know from those of Bantu origin where differences between sexes are not as evident as in modern Europeans. Similarly in using measurements of the circumference of the tibia where 80 per cent accuracy has
been obtained, much depends on racial characteristics. The length of the bone seems more important for sexing whites (Renfrew and Bahn 2000, 424). In a study of 61 children of known sex from Spitalfields London, Schultkowski (1993, 199) achieved a 70 – 90 per cent separation of male and female infants. A morphognostic analysis of the sexually distinctive traits in the mandible and ilium, such as a prominent chin, an anteriorly wider dental arcade, and a narrower and deeper sciatic notch in boys, enabled this separation to be made. It was noted in the Spitalfield findings of 18th to 19th century human remains, that the dental dimensions of all teeth had a low level of sexual dimorphism so that juveniles could not be sexed from tooth size. In contrast, however, the Poundbury Romano- British sample is highly dimorphic and allowed the sex of juveniles to be determined from the dimensions of permanent teeth (Molleson and Cox 1993, 23).

Assessing the age at death by anthropometric means can only with any certainty determine that the deceased was young, adult or old no matter how confident are the claims of the experts. However, teeth provide much useful information concerning the biological age of the subject, which is determined by the replacement of milk teeth, the eruption of permanent dentition, and the effects of wear dependency or foodstuffs consumed and general nutrition. Using these features for modern people, with some variation, works well. Scanning electron microscopy of the enamel of the teeth shows growth ridges from which an estimate of age may be made. This has to be proven in more ancient material. Bones and the fusing of the epiphysis, the articulating end, to the bone shaft is useful in estimating the age of the young. The thickness of the skull and the fusion of the sutures also provide useful information since it thickens with age, but is thin in immature skeletons and becomes thin in old age. Fragments of bone when examined histologically can provide some indication of age by noting changes in bone
structure, which become visible with age. Analysis of modern specimens has achieved accuracy to within five years (Renfrew and Bahn 2000, 427).

The height and weight of skeletal remains may be determined by factoring into the formula the effects of long term decomposition of the corpse. By formula, the height is measured from the long bones to give accuracy to within five centimetres depending on the racial characteristics of the remains. Australian Aborigines and Africans have long legs which constitute 54 per cent of their stature as against Asians with 45 per cent (Renfrew and Bahn 2000, 428). An approximation based on what has been deduced from the skeleton as to sex, height and age may be made about its weight or build on similar data for modern humans.

Physical anthropological studies on the skulls of the people of PRIA and Roman Britain have shown the cephalic index (percentage ratio of breadth to height) to be of greatest significance in differentiating their racial affinities. This index of 75 separates them from the round headed peoples of modern France, central Europe, and northern and southern Italy, and closely relates them to the prehistoric peoples of Sweden, ‘the Reihengruber’ people, the Merovingian and Belgian Franks and Anglo Saxons, in contrast to the broad headed Romans (Buxton 1935, 36-40). Fleure (1925) in his ‘Peoples of Europe’ sees the Britons as being long headed and intermediates in character between the so-called Nordic and Mediterranean races. They are seen as being tall, gaunt, and dark in parts of Scotland and North Wales and almost Mediterranean in South Wales and Ireland while elsewhere ‘betwixt and between’. In the later Roman period, when cremations gave way to inhumation, the evidence points to a physical constant type, where the head is moderately long with a flattish top and a cranial capacity similar to the average modern population; somewhat less in stature but as a rule sturdy and muscular. Viewed in physical anthropological terms, these
measurements are not sufficient to distinguish the native British population from their Western European invaders. There are parallels in the confusion of literary sources in regard to distinguishing Germans, Belgae and Celts who are separated, not in a cultural or physical basis, but by language (Jones 1996, 18). Genetic differences have been noted between the populations of the east and west of Britain in modern times. It is postulated that the physical influences of fair colouring on the people of the southeast of Britain came earlier than the Anglo-Saxon invasions and existed in the Roman period as did the darker phenotype of those on the west such as the Welsh (Potts 1976, 246; Richards et al 1996, 194).

Tacitus (Agricola 11) says

*Ceterum Britanniam qui mortales initio coluerint, indigenae an advecti, ut inter barbaros, parum compertum. Habitas corporum varii atque ex eo argumenta. Namque rutilae Caledoniam habtantium comae, magni artus Germanicam originem adseverant; Silurum colorati vultus, torti plerumque crines et posita contra Hispania Hiberos veteres traiecisse easque sedes noccupasse fidem faciunt; proximi Gallis et similes sunt; seu durante originis vi, seu procurrentibus in diversa terris positio caeli corporibus habitum dedit.*

"Who the first inhabitants of Britain were, whether natives or immigrants, is open to question: one must remember we are dealing with barbarians. But their physical characteristics vary, and the variation is suggestive. The reddish hair and large limbs of the Caledonians proclaim a German origin; the swarthy faces of the Silures, the tendency of their hair to curl, and the fact that Spain lies opposite, all lead one to believe that Spaniards crossed in ancient times and occupied that part of the country. The peoples nearest the Gauls likewise resemble them. It may be that they still show the effect of a common origin; or
perhaps it is the climatic conditions that have produced this physical type in lands that converge so closely in the north and south. On the whole, however, it seems likely that Gauls settled in the island lying so close to their shores.”

History from the writings of Tacitus would appear to lend support to the genetic hypothesis.

Demography

The excavation of Romano-British cemeteries has provided physical evidence of the people of that period through an analysis of their remains. It has been possible through physical anthropological means to derive some idea of the life expectancy among the sexes of the inhabitants of these cemeteries. Data obtained from Trenholme Drive have shown that 77 per cent of the population died before the age of 40 and out of 290 burial remains only 65 were aged 45 years and over. Out of 55 individuals who had reached the fifth decade only 8 of them were women. Although the accuracy of age assessments has been questioned, it is of note that 15 per cent of the remains examined did not reach 20 years of age. This estimate does not include infant deaths where they probably never received a formal burial or their skeletal remains did not survive to the 20th century (Wenham 1968, 147-150). Calculation of the stature of the cemetery inhabitants was based on a formula for modern humans, and it was found that the average height of a male was 170 centimetres and for a female 154 centimetres. This for the male was comparable for the average height of an Englishman in 1968, but the modern female is about 7.5 centimetres taller than her ancient counterpart. The taller average height of the Trenholme Drive male compared to males found in other cemeteries may be due to differences in ethnicity to the Briton of the period. The shorter average height of the female skeleton, in line with others found elsewhere and presumed to be native, would be more in keeping with her ethnic male partner.
Alternatively, the ethnicity and nutritional qualities of the male may be unchanged to his modern descendant, while the female has developed in stature through better nutrition and health care; stature is 90 per cent inherited and 10 per cent nutrition and environment (Brothwell 1981).

The data available suggest, for the period up to the Industrial Revolution, that the average life expectancy of populations did not exceed 40 years (Brothwell 1971,119). Based on epigraphic evidence the average age at death in the Roman province of Britannia was 34.6 years for males and 27.8 for females (Acsádi and Nemeskéri 1970, 222). In rural areas outside of Rome life spans based on occupation showed a range from 26.3 for male and 24.5 for female slaves to 33.7 and 31.5 respectively for the male and female manumitted population. These figures show a higher life span than those of similar groupings do in Rome (Acsádi and Nemeskéri 1970, 224). Could it be that urban life in an ancient city like Rome was less conducive to longevity because of population density in a confined and less hygienic environment, prone to epidemics and disease brought by itinerants? Comparison of data obtained by anthropometric analysis of skeletal remains from various excavated Romano British cemeteries shows that few at Trentholme Drive would have lived beyond their fortieth year with most deaths occurring in the third and fourth decade (Wenham 1970, 147-8). These statistics in general are reflected in those from Cirencester, Lankhills and of smaller cemeteries (Parkin 1992, 51-54). Work on the Spitalfields Project, the excavation of about a thousand skeletons from the crypt of Christ Church, Spitalfield, who died between 1729 and 1852, has cast doubt on the validity of these estimates. The Complex Method of Acsádi and Nemerskeri (1970) was used to assess age changes in the humerus, pubis and femur as well as the cranial sutures and then subjectively determine the age of human remains disinterred. Those determined as being less than 40 years were found to
be over-aged and those over 70 years under-aged when compared with their real age derived from the coffin plate. Less than 70 per cent of the samples analysed were correctly aged to within five years of real life (Molleson and Cox 1993, 167). Frier, quoted by Parkin (1992, 41), in his demographic analyses sees greater validity of results derived from skeletal as opposed to tombstone data. Both, however, suffer from the same potential errors of apparent differences in mortality, due on the one hand to differing customs of commemoration and on the other to selective burial practices. The burial practices in relation to people of different age, sex and social class can affect the reliability of the data derived from their skeletons as in life expectancy and mortality (Parkin 1992, 43). The determination of age in the skeleton, like the living body, is affected by the physical appearance and variation evident in bones, diverse parts of the body or from different people and times. There also are problems arising from the preservation of the skeleton itself and from the effects of its environment. This makes any assessment no more than an approximation. Generally speaking, in many cases, particularly in cremations, the skeleton or its parts can only be classified as infant, adult or aged. There is still a high level of variability and subjectivity in the analysis even in the face of increased sophistication in methodology and expertise. Environmental, social and overestimation of the individual's age at death may distort indications of age. Others, however, have argued that most adult skeletons are systematically underaged (Parkin 1992, 48). Sexing the remains, as has been described, is most reliably done from examining the pelvic bones with less reliable results using other parts of the skeleton. Assessment of sex is frequently by the inclusion of supporting male or female personal items such as weapons, belts and jewellery in contrast to more feminine articles of combs, mirrors and jewellery in the burials.
Unlike age, sex is more readily discerned in adult bones than among immature remains (Brothwell 1971, 112).

Romano-British cemeteries like Trentholme Drive, Cirencester, Lankhills and Poundbury, show a male to female sex ratio 4:1, 2.2:1, 1.5:1, and approximately 1:1 respectively. In the case of the first two the unequal ratio may be attributed to the fact that the cemeteries were garrison burial areas favouring male occupancy (Watts 2001, 336). The Lankhills and Poundbury ratios may be one of durability of female remains and/or to cultural responses to mixed burials particularly in the disposal of infants at death. Like Lankhills, the sex ratios at Poundbury and Bradley Hill are very even with a high percentage of children which may be a late Roman phenomenon (Farwell and Molleson 1993, 222).

_Palaeopathology_

Valuable information may be obtained about the pathology of the people of the PRIA and Roman Britain by examining their remains excavated from surviving burial sites. Evidence of health, diet and physical appearance is more difficult when only dry bones are all that remain of the deceased. Even the survival of the bones is dependent on where they were deposited and on the condition of the cadaver at death. Preservation is determined by such factors as the physical, chemical and biological milieu affecting the cadaver. Rates of decay are inversely proportional to the size, sex and age of the bones; small bones and cancellous bones, female and infant and aged bones deteriorate more rapidly than the denser skeletal frame of the adult male. Temperature and pH affect preservation with low temperatures and neutral or slightly alkaline soils slowing the degenerative process. Bacteria, whether exogenous or endogenous to the cadaver, are factors in accelerating decomposition (Boddington _et al_, 1987).
A common finding in palaeopathology of the skeletal remains in ancient burial sites is the number of fractures seen. A study of known ancient Greek skeletons found that at least 10 per cent had fractures and about 4 out of 5 were males (Morris 1992). Significantly this is not an uncommon finding in males from Romano-British cemeteries such as Trentholme Drive, Lankhills and Skeleton Green (Wenham 1968, Clarke 1979, Partridge 1981). Osteo-arthritis is also another frequent finding among adult remains of both sexes. Gout, a Roman disease, has been noted in British burials of the period. Thalassaemia and anaemia have been diagnosed from changes seen in the cranial vault of individuals living at the time, suggesting iron deficiency due to poor diet, haemorrhage and/or parasitic infestations e.g., malaria. Tuberculosis, on osteological evidence, is not thought to have been a serious threat until Roman times while leprosy, as an epidemiological problem, is not considered earlier than the late Saxon period. It is noted, however, that a diagnosis of leprosy has been made from the legs and feet of a Romano-British skeleton at Poundbury (Reader 1974). Syphilis, even if pre-Columbian, is unlikely to have been a general threat before Medieval times (Brothwell 1972/73, 86).

Many diseases do not produce pathognomically diagnostic signs in bone or display changes due to bodily disorders or function, e.g., Cromwell's warts, multitude of soft tissue injuries, appendicitis, meningitis, smallpox, etc (Roberts and Manchester 1995). The plagues and diseases that have afflicted humans in pre-history and history rely on the reporter's description for a diagnosis, which is largely conjectural and dependent on the lucidity of the report for an evaluation to be made in terms of modern medicine. Recently an analysis of the DNA extracted from human teeth and bone obtained from ancient burial sites has revealed the presence of microorganisms like bacillus pestis and the tubercle bacillus. This discovery offers an exciting new challenge to detect
systemic disorders, which would otherwise be undetected in ancient remains

(Drancourt et al 1998, Rollo and Marota 1999). A discussion on the application of molecular archaeology will be expanded in a later chapter.
Chapter 3 Celts, Culture and Language

Introduction

As stated by Tacitus (Agricola11) the people of Britain close to Gaul were not dissimilar in language and physical characteristics to their Continental neighbours, unlike those Caledonians to the north of the island, with reddish hair and large limbs, whom he believed to have a German origin. He does not say whether the language of the Caledonians was different from those Britons living across the Channel from Gaul, or from those people, the Germans, of whom they are said to resemble. Caesar, as we have seen, claims that the Britons were indigenous to the island, except for those in the coastal districts that came as immigrants from Belgic territory.

Although, in the Latin, the people are referred to as tribes of Britain, it is unlikely that they would have called themselves Britons in the collective sense, but rather by their kin or tribal origins. The ancient writers referred to the people of northwestern Europe as Celts but nowhere do they speak or write of the people of Britain as Celts except to say that they spoke in Celtic (Renfrew 1987, 220; Collis 1997, 196; James and Rigby 1997, 84; Sims Williams 1998, 507). Whether the Celts existed as an ethnic or distinct cultural group in north west Europe linked only by language is a matter of controversy (Collis 1996, 1997; Megaw and Megaw 1992, 1996). Three usages of Celtic are seen as fundamental in the construction of Celticity in the PRIA (Fitzpatrick 1996, 242). They are (1) literary sources, (2) material culture and (3) language.

Literary Sources

Ephorus, an early historian, (FHG I, 243-244) tells us that the Greeks conceived the ancient barbarian world, when seen from Greece, as being likened to the four points of
a compass. In the north were to be found the Scythians, in the east the Persians, with the Libyans to the south and the Celts in the west. However, there is no evidence in this location that the inhabitants thought of, or called themselves, Celts. This was an appellation, in its various forms of Keltoi, Celtae, Celti, Galli or Gaul, given by Graeco-Roman writers of the period to describe outsiders, particularly those on their northwestern frontiers. Though there was a certain similarity in material culture and language, there was no large-scale political unity and the people so called did not refer to themselves as such (Champion 1995, 88). The only reference to a group calling themselves Celts is Caesar’s:

\[
\text{Gallia est omnis divisa in partes tres, quarum unam incolunt Belgae, aliam Aquitani, t tertiam qui ipsorum lingua Celtae, nostra Galli appellanter.}
\]

“Gaul is divided into three parts, one of which is inhabited by the Belgae, another by the Aquitani, and a third by a people called in their own tongue Celtae, in the Latin Galli.”

Caesar (BG I. 1)

In the chronicles of the Greek historians such as Hecataeus (cited in Herodotus \textit{Histories} II.143), writing about 500 BC, and of Herodotus in the 5\textsuperscript{th} century BC, an allusion is made by them to a people they name as Celts.

\[
\text{ποτάμος ἀρξάμενος ἐκ Κελτῶν καὶ Πυρήνης πόλιος ῥέει μέσην σχίζων τὴν Εὐρώπην ὅι δὲ Κελτοὶ εἰσὶ ἔξω Ἡρακλέων Στηλέων, ὄμουρέονι δὲ Κυνηγοῖσι, οἳ ἔσχατοι πρὸς δυσμένων οἰκέουσι τῶν ἐν τῇ Εὐρώπῃ κατοικημένων.}
\]

“That river flows from the land of the Celtae, and the city of Pyrene through the very midst of Europe; now the Celtae dwell beyond the pillars of Heracles,
being neighbours of the Cynesii, who are the westernmost of all nations inhabiting Europe.”

Herodotus (II 33)

Later writers such as Livy,

*De transitu in Italiam Gallorum haec accepimus: Prisco Tarquinio Romae regnante Celtarum, quae pars Galliae tertia est, penes Bituriges summa imperii fuit; ii regnum Celtico dabant.*

“Concerning the migration of the Gauls into Italy we are told as follows: While Tarquinius Priscus reigned at Rome, the Celts, who make up one of the three divisions of Gaul, were under the domination of the Bituriges, and this tribe supplied the Celtic nation with a king.”

Livy (5. 34)

and Polybius,

> "The Celts, descending on Etruria, overran the country devastating it without let or hindrance and, as nobody appeared to oppose them, they marched on Rome itself."

Polybius (*Histories* II 25.1)

refer to the Celtic expansions during the fourth and third centuries BC (Green 1995, 4).

A Greek, Poseidonios, who lived from 135 to 51 BC, whose histories have survived only in fragments, is credited with contributing to the extant works of Diodorus Siculus and Strabo (Renfrew 1987, 219). Poseidonios was one of the few ancient writers who visited Gaul, Spain and possibly Britain. His accounts of the Celts is rational and
scientific in understanding that differences between peoples may be a reflection of disparate environmental factors. Further, he has the advantage of having lived among the Celts. Succeeding chroniclers, historians, geographers and poets promote a picture of the Celt as a primitive, heroic, terrifying, boorish drunken, archaic and yet romantic figure and not the sophisticated Graeco-Roman. As Rankin (1995, 32), however, says -

*Our attempts to see the Celts through classical eyes are focused through the lens of a literature written by an educated class whose understanding was in many ways shielded from the input of factual information by the influence of rhetorical training.*

**Material Culture**

Celtic Europe, archaeologically, is differentiated from previous prehistoric cultures by its employment of iron as a commonly utilized metal (Green 1995, 4). This Iron Age is thought to have developed from the previous Bronze Age of the mid to late second millennium BC and known to archaeologists as the ‘Urnfield’ tradition because of the distinctive burial rites. In these rites, the deceased were cremated and their remains placed in pots which were then buried in flat cemeteries. The new Iron Age cultures are commonly defined under two separate headings.

**The Hallstatt Culture**

The first evidence of iron working in Europe was that found in a cemetery site called Hallstatt after the small Austrian town where it was located (Chapman 1992, 7). The Hallstatt culture has been dated to the eighth century BC where new metallic items associated with horse accoutrements and riding, all indicative of warrior horsemen, appear. These early Iron-Age horsemen were armed with long slashing swords made of bronze and iron. Hallstatt, the site of salt mines, was a trade and control centre for the trading routes to the classical world, which in return supplied wine and luxury items
such as bronzeware and pottery and prestigious glass drinking vessels. The elite were inhumed in this large cemetery where their burial goods comprised extensive quantities of rich metalwork including weapons and luxury goods such as jewellery and feasting equipment, some of the latter coming from the Mediterranean (Cunliffe 1997, 52). The Hallstatt material culture, which spread throughout Europe to Britain (see figure 1), is seen by some archaeologists and others to be the earliest evidence of European Celts (Green 1995, 5; Mallory 1989, 106).

Figure 1. Europe in the Hallstatt period.

By this stage the Celtic languages were spoken over much of western Europe and two major zones of innovation were developing in Iberia and west central Europe. Both were in active contact with the west Mediterranean zone and with metal rich Atlantic zone.

Cunliffe 1997, 271
The dissemination of the culture to Britain may have been through limited invasions from the Continent or more likely spread by itinerant metalsmiths or through trade where it acquired a local style or creation. Trade in the Hallstatt sphere maintained the status and control of the elite in a socio-economic system whereby they procured rare and valuable commodities.

Figure 2. Centres of power Hallstatt to La Tène.

Map showing the shift of centres of power from c.700 to c.400 BC. The rich “horsy” burials of the Hallstatt C period focused on the region from Bohemia to the Upper Danube. Hallstatt D power represented by the west Hallstatt chiefdom zone developed further west in the sixth century. Early La Tène aristocratic cultures emerged in three zones – the Marne, Moselle, and Bohemia – on the northern periphery.

Cunliffe 1997, 64

The elite then was able to manipulate their distribution and maintain its power by apportioning lesser valuable items to those lower in the pecking order in return for goods and services. A prestige goods economy, such as this, is reflected in the rich burials (see figure 3) of the period.
An exchange network in the tradition of the Hallstatt culture was not restricted to the Continent. The arrangement found its way to Britain, where weapons, such as swords, developed by Continental craftsmen, were copied with local innovations in design and decoration. In the later La Tène period this was to apply to a wider range of commodities. These artefacts, as has been said, did not arrive in Britain in the hands of
migrating Celts from Europe, although some may have with raiding parties, but are thought to have been part of an elite dominated exchange system. Gifts were exchanged between equals in the upper echelons of society and downward between paramount leaders and their dependants. That men and equipment moved across the sea between Britain and the Continent there is no doubt, but more likely in the context of diplomacy, rather than aggression. The flow of goods was not always one way as confirmed in the discovery of British swords and daggers on the Continent, unlike the archaeologically invisible items like woollen fabrics and garments, metals and even hunting dogs cited in the sources (Cunliffe 1995, 23).

La Tène Culture

Hallstatt culture gave way in the fifth century BC to the more artistically and refined La Tène culture. In one form or another, this lasted until much of Europe was occupied by the Romans in the final century BC (Chapman 1992, 7). La Tène takes its name from the site at Lake Neuchatel in Switzerland where precious items of war equipment, other implements and animals were deposited as votive offerings. The La Tène phase of the Iron Age Europeans or Celts demonstrates a warrior society who buried their dead with their weapons, and among the elite, replaced the four wheeled wagon of the Hallstatt culture with a light two wheeled cart or chariot.

Iron Age Culture in Fifth Century BC

Trade in the Hallstatt period found an outlet through the Greek colony of Massilia (Marseilles) and the Danube in the east. As the La Tène period emerged the Hallstatt culture declined, and the centres of power shifted from the old west central Hallstatt to its immediate northern periphery, a region in the north stretching from the Marne to Bohemia. The Hallstatt salt mines, which produced a major trading commodity for the period, ceased production about 400 BC (Cunliffe 1997, 66). A combination of
competitive trading in the mid and western Mediterranean between Greek and Etruscan, overdevelopment in people and settlement and aggressive peripheral communities, brought an end to the Hallstatt culture in the fifth century BC. The vulnerable route from Marseilles was broken soon after 500 BC (Collis 1984, 113) and it is suggested that the readjustments in trading from the Mediterranean states caused social dislocation north of the Alps by upsetting the balance of the prestige goods economy. It is further suggested that Greek interests turned more to the west with the lucrative Iberian market so leaving the northern markets to Etruscan control (Cunliffe 1997, 66-67).

**Hallstatt Art**

Evidence of the art style of the Hallstatt period in the earliest Iron Age in Europe, from the eighth to the seventh centuries BC, is geographically widespread among the grave sites of a mounted warrior and metal working society (Megaw and Megaw 1990, 25). Their art is shown in the decorated weapons, horse and wagon ornaments and fittings and various exotic and everyday items. Although iron was used widely for tools and weapons such as the long swords of these Iron Age horsemen, bronze, because it was more easily worked, was used alongside other materials such as gold, ivory and amber in their decoration.

Hallstatt art, in the form of gods, people, animals and geometric designs, may be seen as figurines, elaborately ornamented drinking vessels, urns, pails and the many manufactured items interred with the remains of these ancient people.

**La Tène Art**

The La Tène tradition is characterized by fine art, employed principally in the embellishment of metalwork and influenced by themes and art forms both from the classical world and the Near East. This art is dominated by abstract, geometric designs
incorporating images of the natural world such as foliage, animals and human faces and represents the floruit of the Celtic civilization (Green 1995, 6). Like the Greeks and Etruscans before them, the La Tène craftsmen took over the rich art, which flowed, from the Near East. In the form of palmettes, lotus flowers, lyre patterns, human faces and mythical beasts, they converted the tight stylised approach of the Graeco-Romans into a dynamic intricate abstract art. (see figure 4)

Figure 4. Human faces hidden in the decoration of two terret rings from northern France, now in the Musée Nationale des Antiquités, Saint-Germain-en-Laye, Paris. The half visible face has been referred to as 'the Cheshire Cat Style'. After drawings by Paul Jacobsthal. Cunliffe 1997, 113

The new Iron-Age art style became the main medium for La Tène decorative metalwork, including pottery, in the form of jewellery, weapons, harness fittings, ceremonial drinking vessels, etc, and found its way from the southeast to the northwest where it was copied and innovated. The La Tène period was a high point in the interaction of the cultures north and south of the Alps (Collis 1984, 123). The art form was fostered by the Iron Age or Celtic aristocracy as part of conspicuous giving and
consumption, a form of potlatch (Cunliffe 1997, 216) for only the wealthy could support and patronise this art and the craftsmen who perpetuated it.

*La Tène in Britain*

Evidence of La Tène burial practices has been found in eastern Yorkshire and dated to the third and fourth centuries BC (Stead 1991, 184). These funerary practices have become known as the Arras culture because of square barrow burials and grave goods found in lands near the Yorkshire village of Arras and not the French town of similar name (Stead 1979, 7). Individual interments of men and women among the elite such as those that took place within these square ditched enclosures were accompanied by grave goods as have been described previously (Cunliffe 1997, 161). Other barrow burials varied greatly, as did the occupants’ wealth and status as evidenced by the range of goods found with them. The variations included burials with few items, warrior graves with weapons and those of chieftains with chariots or two wheeled carts. The Arras burials have been related to La Tène cultural influences through cart and square ditched enclosures. They are not matched to any one area and differ from the funerary tradition in Champagne as much as Champagne does from the Belgian Ardennes or Middle Rhine. Nearly all the Arras culture burials were in a crouched position, an extension of the native Iron Age tradition, though some were found in an extended position. This is in contrast to continental La Tène burials where they are usually extended with crouched or even flexed burials the exception (Stead 1991, 184). The Arras pottery, included with the grave furnishings, is a local product and the metalwork shows the influence of northern France but with a simpler range and style (Wait 1995, 500). An invasion theory has been ascribed to the occurrence of the Arras culture in East Yorkshire by the apparent regional differences in funerary practices from the rest of Britain to that common in Western Europe. Few, today, would support an invasion
theory; rather the rite may be interpreted as an emulation of an exotic burial tradition of a local elite (Cunliffe 1995, 22).

Stead (1991, 184) proposes that the continental influence of cart burials and square barrows in East Yorkshire may have been brought by a well connected immigrant evangelist whose wealthy converts adopted the practice in the fourth century BC and by the third century BC it had spread to the masses. Although the rite may have persisted in some areas into the first century AD, elsewhere it came to an end a century before the conquest of Yorkshire by the Romans (Stead 1991, 184).

A recent discovery of a chariot/cart burial at Newbridge on the outskirts of Edinburgh, the first certain example outside of Yorkshire, is suggested as being an earlier burial rite to that of the east Yorkshire. It parallels those of the Continental burials of the fifth to fourth centuries BC with the chariot/cart buried intact unlike those more common in east Yorkshire where they are dismantled and the cart body inverted over the remains. The Newbridge burial contrasts markedly from the Continental and Yorkshire burials by the absence of a barrow or evidence of any enclosure around the burial (Carter and Hunter 2002, 414).

The similarity of the Arras burials in Yorkshire to those of west European La Tène is strong and a connection is difficult to deny, yet a lack of another form of imitation cannot be accounted for nor can a simple immigration originating from the Continent be found (Megaw and Simpson 1979, 414). A likely explanation may lie in long lasting cross-Channel contacts where neighbouring chieftains or leaders may have employed mercenaries or where there was an interchange of military support as part of kin or treaty obligations. The arrival of the late La Tène culture, as seen in the Aylesford Swarling burials similarly was identified by A. J. Evans in 1890 (cited by Cunliffe 1991, 108) as the result of pre-Caesarian Belgic invasions based on coin evidence and
not one of culture creep. Later work showed that the pottery and cremation burials could not be as early as 50 BC, and were definitely post-Caesarian (Cunliffe 1991, 133). The Aylesford cremation burials are regarded as an imitation from the Continent since similar burial rites at Welwyn were well established from the third century BC and paralleled those on the Continent with richly furnished graves. These furnishings included imported goods as well as local variations of La Tène metalwork and pottery (Megaw and Simpson 1979, 416-419). Sites throughout southern and eastern England were well located in the LPRIA to exploit trading advantages with their Continental neighbours.

Language

Although the ancient world did not name the Britons as Celts their language was said by Tacitus (Agricola 11) to be Celtic –

Eorum sacra deprehendas (ac) superstitionum persuasionem; sermo haud multum diversus, in deposcendis periculis eadem audacia et, ubi advenere, in detrectandis eadem formido.

“In both countries you find the same ritual and religious beliefs. There is no great difference in language, and there is the same hardihood in challenging danger, the same cowardice in shirking it when it comes close”.

How did the Britons come to speak Celtic? Celtic as a language belongs to the Indo-European family of languages, and as such is closest to the Italic group. Linguists have postulated that both languages have a common Italo-Celtic origin. They have further hypothesized that this link is broadly equivalent to two other groups, one from which the Baltic, Slavic and Germanic languages evolved. The other group is said to be ancestral to the Greek. When Celtic began to be distinguished from the Italo-Celtic grouping is the source of many debates. An extreme view has the main Celtic speaking groups in place as
early as 3000 BC while a more conventional stance opts for a separation and development of the Italic and Celtic in the period 1300-800 BC within the regions where they were to be spoken (Cunliffe 1997, 21).

Celtic in British Isles

Indo-European languages are said to have arrived in the British Isles about 3500-4000 BC brought by Neolithic farmers who over several millennia had spread their agriculture, language and genes throughout Europe from their origin in the Near East (Bodmer 1993, 56; Cavalli-Sforza et al 1994, 264; Renfrew 1996, 82). There is, in fact, no direct evidence from archaeological material on language before the advent of writing, but Renfrew argues:

*that language replacement can take place only in specific circumstances that depend on the social structure of the people involved.*


The Celtic language dispersal to Britain and Ireland has been proposed as developing in the Late Bronze Age, 1300-750 BC with a homeland in the Rhine-Danube area consistent with archaeological evidence (Cunliffe 1997, 270). A number of ethnic groups who occupied central Western Europe spoke a series of dialects which linguists have labelled Celtic. This group, called P Celtic, is thought to have emerged and spread with the development of the Hallstatt culture, 750-450 BC and people speaking this dialect are known to have made contact with Mediterranean and other trading areas. Another trading group, the Celtiberian, is also known to have traded with the Mediterranean and the Atlantic zone. Both groups were providing the metal-hungry Mediterranean with raw materials from the metal-rich Atlantic region that stretched from Andulasia to the Shetlands. The Hallstatt and Celtiberian were in isolation to each other but occupied central positions in the northwest/southeast trading routes. The
Celtiberian dialect, an older form of the P Celtic of the Hallstatt, is thought to have disseminated as a lingua franca by a technico-religious caste of metalsmiths and traders (Cunliffe 1997, 270-272).

*Continental and Insular Celtic*

The recorded Celtic language, of which, P Celtic may have been the most common (Fitzpatrick 1996), is divided into two broad groups, Continental and Insular.

Continental Celtic is recognised from place and personal names recorded by classical historians on coins and from a small number of inscriptions. Three or four branches of Continental Celtic are recognised, Celtiberian, Gallic, Lepontic and a fourth from the Middle Danube area. In the period from the fifth century BC until the end of the millennium, events in the Celtic world were to lead to a decline in the speaking of Celtic. Events contributing to the decline were the collapse of the Hallstatt culture which was followed by the later Celtic migrations ending around 200 BC to the Mediterranean and across Europe as far as the Black Sea and Asia Minor. From 200 to 50 BC Celtic communities in Europe were overtaken by the expanding Roman empire, Germanic pressures from the north and the Dacian encroachments from the east (see figure 5). The Celtic world was transformed by leaving only the Insular Celtic speaking communities of the far West free (Mallory 1989, 96; Cunliffe 1997, 270). Renfrew concludes

> that very little would be known about Celtic languages were it not for the British Isles. (1987, 227)
This period saw the Celtic communities under increasing pressures from the Romans but also to a lesser extent from the Dacians and Germans. By AD 400 Celtic languages survived only in the Atlantic zone.

Cunliffe 1997, 274

*Insular Celtic*

*Insular Celtic* comprises two dialects, Q Celtic, the more ancient form, and P Celtic. The main difference between the dialects is the proto-Indo-European ‘k’ sound, written as a ‘c’ in Irish (Goidelic) and as a ‘p’ sound in British and Welsh or Gaulish (Brythonic) (Mallory 1989, 107). A proto-Indo European language, a precursor to Celtic, is thought to have been brought to the British Isles by Neolithic farmers or colonisers, the people who built Stonehenge and the other great megalithic monuments of Europe. Renfrew (1989, 89) sees the early history of Europe as a series of transformations and evolutionary adaptations on a common proto-Indo-European base and not the result of external migrations or invasions into Europe. Far from the changes being the result of an influx of people from outside of Europe, he believes that these developments and transformations took place in a Europe where an agricultural economy had been established, and where the language was Indo-European. In other
words, this was the result of a series of complex interactions by a largely indigenous population. Goidelic Celtic is seen to have developed as an early lingua franca diffusing from Iberia along the Atlantic sea routes to Britain and Ireland as part of the on-going trade in metals and other products (Cunliffe 1997, 155). An early common Celtic is assumed and it is not known when the P/Q division occurred. Two hypotheses are suggested: 1. Later P Celtic speaking invaders from the Continent displaced the earlier natives of Britain and Ireland in the south and east. Or 2: P/Q dialects were derived from a split in a single phoneme in insular development, and developed separately on either side of the Irish Sea at a relatively recent date (Chapman 1992, 9). Alternatively, it is claimed that the Goidelic Celtic dialect remained unchanged in Ireland while in Britain with its close contact with Gaul, both geographically and in trade, the P.Celtic of the Continent became dominant between the sixth and third centuries BC.

Celtic in Roman Britain

Celtic in the Roman Conquest period of Britain and after it ended remained P.Celtic until the 7th century AD when it had largely been replaced by Anglo-Saxon (Chapman 1992, 12). On the Continent where, as has been said, it had been abandoned by the fifth century AD, Latin became strongly entrenched (Cunliffe 1997, 262). In Brittany, there was resurgence sometime after the fifth century AD as a result of Anglo-Saxon dominance in the Romano-British areas of Britain, and the arrival of Celtic speaking refugees from southern Britain. In the formerly Roman occupied areas of Britain and perhaps in the lowlands of Scotland P.Celtic was spoken, particularly in rural areas, that is, until replaced by Anglo-Saxon. It was preserved from extinction by being spoken in remote Wales, Cornwall and the Isle of Man in varying levels of fluency and in use until the present day. Goidelic or Irish Celtic remained largely unaffected by
Roman or Anglo-Saxon depredation and there is historical evidence in the fifth century AD of its transplantation to the West Coast of Scotland (Renfrew 1987, 226; Mallory 1989, 166). Northeast Ireland and southwest Scotland are geographically close and, before the recorded people movement of the fifth century AD, trade and social links, no doubt, were ongoing throughout the millennia from Neolithic times. Archaeologically, this has been determined by finds of similar stone axes and megalithic structures on either side of the Irish Sea. An argument has been made for the migration of the Irish Celts or Gaels to Argyll and the Western Isles, sponsored by some post-Roman power. The aim was for them to act as a political and military buffer zone between the Celtic speaking Britons of Cumbria, Galloway and Strathclyde from the Picts to the north. Eventually over the next few centuries Gaels combined with the Picts and people of Strathclyde to create a dominant language north of the line between the Forth and the Clyde. The Gaels to the north and the Anglo-Saxons in the south gradually eclipsed the Britons. The once common British Celtic by the seventh century AD was isolated to three peninsular forms of the language, Cornish, Welsh and Cumbrian. Today only the modern Welsh can claim to speak a language that is seen as a descendant of the Celtic once spoken throughout areas now known as England, Wales and Scotland (Chapman 1992, 10-12).

Mallory’s (1989, 23) statement, I believe provides a fitting conclusion to this segment on the language of the people of PRIA and Roman Britain:

> people speaking originally the same language but separated by large distances are unlikely to maintain parallel changes. Where we find great similarity of speech over a large area we can normally assume a recent expansion since the factors of time and distance will normally reduce a single language into a continuum of mutually related but increasingly different languages.
In other words geographical separation and cultural development of Celtic speakers created divisions in a once common language of Iron Age northwestern Europe.
Chapter 4 Archaeological and Historical Demography

The primary foci of demographic research, that is, population growth, composition of a population and the spatial distribution of a population (Willigan and Lynch 1982, 2-3) have been referred to briefly earlier in this study. These foci can assist in developing an understanding of the size of the population, its birth and mortality rates as well as life expectancy and their relationship to the cause and effect of the Roman conquest of Britain.

Population Growth

For most of human history, population growth has been slow and gradual with the major build-up of world population growth occurring in the last 300 hundred years (Swedland and Armelagos 1976, 2). A rate of growth has been estimated as being 0.1 per cent per annum from the time of the Agricultural Revolution, about 10,000 years ago, until the Industrial Revolution in the eighteenth century when the rate increased to 0.3 per cent per annum (Renfrew and Bahn 2000, 453). Various forms of agricultural intensification and technological development, as well as a shift towards urbanization, produce a marked increase in population (Keeson 1985, 59). Findings, such as these, correlate well with present estimates of population growth in Roman Britain as discussed in the first chapter.

As we have seen in the previous chapter on the evidence available about the people of LPRIA and Roman Britain, the population was a mixed one. Questions as to the composition of the mix and how many people lived in those times may be answered in part by what history and archaeology have to tell us about them. Unfortunately, for the
time under study, we do not have the wealth of information that is available today about the demography of the people in the present world. Censuses, we know, were taken by the Roman conquerors, mostly for taxation purposes, but these records, alas, are not available to us. Before the Roman period most of northern Europe was virtually non-literate. Writing, when it was adopted by the Celtic world in the late first millennium BC, appeared almost entirely in the Greek or Latin (Green 1995, 15, 4; Chapman 1992, 7), Iberian and Etruscan alphabets (Ellis Evans 1995, 10), as a number of inscriptions (see figure 6) in Celtic, Celtiberian and Lepontic found in Gaul (France), Spain and northern Italy illustrate.

![Figure 6](image)

A bilingual inscription in Latin and Celtic from Todi, Italy, dating to the second century BC. Museo Gregorino Vaticano, Rome (Cunliffe 1997, 22)

**Coins and Writing**

What of Britain? Coins bearing Latin inscriptions with the names of rulers and tribal locations in southeastern Britain are early examples of writing being adopted in PRIA
Britain. From these coins the political development in this region, between the campaigns of Caesar and Claudius, has largely been reconstructed. Commius, following his flight from Caesar and his establishment of a kingdom based in Calleva (Silchester), is credited with creating Britain's first dynastic coinages (Cunliffe 1991, 123-124). Inscriptions, termed Pictish, written in Ogam, have been interpreted as Celtic and sometimes in a language that is not. The Ogam alphabet is thought to have been invented in Ireland in the fourth century AD and imported to Scotland (Renfrew 1987, 227). Only when a writing system was adopted was it possible for the surviving Celtic oral traditions to be recorded in Irish as Christianised versions by the monks in the eighth century AD. The earliest extant collection is a compendium of these tales called "The Book of the Dun Cow" which dates from around AD 1200 (Anon. 1994, 19). In short, there is no native written record before its introduction by Rome.

The Druids

From the classical literature, we learn from Caesar (B.G. 6.13-14) that the Druids were one of the two elite social classes in Gaul, the other being the equites or nobles.

*Sed de his duobus generibus alterum est druidum, alterum equitum.*

They had a wide range of social responsibilities which included officiating at sacrifices, acting as judges and arbiters of disputes, teaching that the soul does not die and instructing the young in their doctrines. This they did by committing the doctrines to memory, as they believed it strengthened their diligence in study and prevented them from falling into the wrong hands. For public and private documents, they used Greek characters to record them. Caesar (BG 1.29) also tells us that he found documents in the Helvetian encampment written in Greek characters.

*In castris Helvetiorum tabulae repertae sunt literis Graecis confectae et ad Caesarum relatae,*
These documents listed names of individuals and the number of emigrants capable of bearing arms as well as the number of non-combatants, a grand total of 368,000

*Summa omnium fuerunt ad milia CCCLXVIII.*

of whom 92,000 were under arms (BG. I: 29). The Druids also were exempt from taxes and warfare. The division of the Gallic elite into Druids and equites created factions of differentially acquired and achieved status with interests which may have been contrary to each other. The decline of the Druids and the antipathy of the Roman emperors towards them in the pre and conquest period are seen through their representation as a religious elite whose interests and traditional values were incompatible with those of Rome (Chadwick 1997, 73). This was quite different from that of the other sections of the indigenous elite who were amenable to the process of Romanization and the fostering of a community interest between Rome and themselves (Webster 1999, 16).

*Censuses*

Censuses, in one form or another, were obviously taken by societies less literate than the Greeks and Romans and, in the instance quoted by Caesar, we have evidence of one carried out by the Helveti. No Roman government edicts or imperial orders are known to us to explain why censuses were ordered or the use to which they were put by the authorities, for example, Roman Egypt. Modern scholars generally see their purpose as an information base for tax lists and taxation itself (Bagnall and Frier 1994, 26-27). The list compiled by the Helveti would have been necessary logistically to plan their migration into Gaul and to ensure a successful relocation of the horde. Tribal chieftains or kings in PRIA Britain presumably carried out similar exercises to be informed of the level of tribute, either in produce or manpower, required to maintain their power base. The population of PRIA Britain, apart from their priests, whose recourse to written records was culturally limited, would appear to have had no writing. Any record, were
it to exist, would have been transcribed from oral chronicles by later literate historians, and to date we have none. For both periods we are left with what may be extrapolated from the archaeology and the history of these eras to determine the demography of the LPRIA and Roman Britain. Birley (1981, 300-304) in the Fasti of Roman Britain notes the names of census officials who, in Hadrian’s reign, were not of procurator status, thus possibly reflecting the importance of the office at that time. Data, were it available today, would be underestimates as they are unlikely to have included those Britons of no tax value nor those in regions uncontrolled by Rome.

LPRIA Britain

The evidence in regard to the demography of the people before the Roman conquest is scanty and, at best, unreliable. Reliance on the extant literary sources would have us assume that only people located along the south east coast of Britain had any political, agricultural and technical skills presumably obtained by contact through trade, social interchange and limited migration from the more sophisticated communities across the Channel. The inhabitants beyond this fringe were much more primitive, little better, in the eyes of the Roman and Greek commentators of the day, than savages. Caesar’s limited campaigns to Britain in 55 and 54 BC see him confronted by an opposition, commanded by a war leader, Cassivellaunus, who had an army comprising various tribal leaders or kings and their followers (Millett 1990, 20). The size of the force can be gauged by the inclusion of 4,000 chariots in the defending army pitted against Caesar’s 5 legions and 2,000 cavalry in his later expedition (Cunliffe 1995, 79; Frere 1991, 21). Caesar’s first expedition to Britain in 55 BC, intended as reconnaissance, comprised 2 legions, each, nominally with a complement of 4,800 infantry and 120 cavalry (Wiseman and Wiseman 1980, 91). When the uncertainties in Gaul at the time of both campaigns are considered, this may have been a situation when the legions
might have been under strength both as invaders or as an occupying force for Gaul. An invading force, such as Caesar put together, and his description of a densely populated region of people, must surely indicate some level of sophistication on the part of the Britons and give lie to the contemporary reports.

*Archaeological Evidence*

It is evident that if we are to learn anything about the demography of the LPRIA we must look to other than the historical sources and see what can be gleaned from the archaeological findings. The ‘archaeological method’ lies in the analysis of tangible materials which can be used to calculate or infer the gross number of people constituting a specific group as well as its sex, age and population movement (Cook 1972, 1). These tangible materials, the result of human physical activity in their original location, comprise artefacts together with houses, temples, engineering works, tombs, burial mounds, settlement sites and villages which can be used to extrapolate regional population numbers. It has been shown (Millett 1992; Cunliffe 1991, 1995, 1997), and outlined in the previous chapter, that evidence of settlements, pottery, coins, cemeteries, climate and food production extended beyond the southeast of England to support a hypothesis of a substantial and productive LPRIA population. The burial practices of the LPRIA, previously described, which included cremation and excarnation, do not lend themselves to providing reliable demographic statistics for analysis. Analyses for the Roman period, which will be discussed later, although slightly better based, may provide some indication of what population numbers may have been. For the occupation, the population has been suggested as unlikely to have been higher than 5 - 6 million or lower than the Domesday figure and of the some 2.77 million in 1541, the first year for which documentation supports a national estimate (Fulford 1984, 131; Millett 1990, 185).
From archaeological and historical evidence towns as such did not appear until the Romanization of Britain, although proto-urban centres like Camulodunum supporting administrative and social functions existed (Millett 1984, 67). From this premise, if we assume that the population in the LPRIA was essentially agricultural, we can ignore Millett's calculations for the urban and military populations in his estimates for Roman Britain (Millett 1990, 185) and instead use his rural figures based on a minimal occupation rate of 20 people per agricultural site multiplied by the number of sites. Rural site densities surveyed throughout England and Wales by various authorities led Millett to conclude a mean density of 0.8 sites per square kilometre for the period (see table1, p. 60). From the available land area calculated to be 115,983 square kilometres for England and Wales and multiplying it by 0.8 he determined approximately 92,750 sites (Millett 1992, 185). Assuming a minimal occupation level of 20 people per site, based on extended families, we then may make an estimated rural population for LPRIA Britain of 1.85 million. The English population calculated from the 1931 census results (Whitakers Almanac 1998, 112), a period between two world wars, equates to approximately 85 per cent of the total British population. Using Millett’s calculation of 1.85 million for the rural population of Roman Britain might not an additional 277,500 be added for the people living in regions of Britain outside Roman control, that is, Scotland? Therefore, a reasonable estimate for the population of LPRIA Britain could be that of Roman Britain without the Roman army and its followers and those living in towns and villages. In other words, a productive rural sector as reported by Caesar (BG V 12), and implied by revised settlement patterns in the LPRIA (Millett, 1990, 11) for the British Isles, equating to the estimated rural population of 1.85 million of Roman Britain. A population of this magnitude would be in keeping with the later population growth of Roman Britain.
Table 1. Rural site from survey densities

<table>
<thead>
<tr>
<th>Area</th>
<th>Type of Information</th>
<th>Density</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedfordshire</td>
<td>Sites and Monumental Record</td>
<td>0.2 sites/km²</td>
<td>Simco 1984</td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>Sites and Monumental Record</td>
<td>0.1 sites/km²</td>
<td>Wilkes &amp; Elrington 1978</td>
</tr>
<tr>
<td>Winchester District</td>
<td>Sites and Monumental Record</td>
<td>0.1 sites/km²</td>
<td>Schadla-Hall 1978</td>
</tr>
<tr>
<td>Basingstoke Area</td>
<td>Non-intensive survey</td>
<td>0.6 sites/km²</td>
<td>Millett 1983a, fig. 1</td>
</tr>
<tr>
<td>NW Essex</td>
<td>Intensive survey</td>
<td>1.3 sites/km²</td>
<td>Williamson 1984</td>
</tr>
<tr>
<td>Maddle Farm</td>
<td>Intensive survey</td>
<td>0.7 sites/km²</td>
<td>Gaffney et al., 1985, fig. 8</td>
</tr>
<tr>
<td>Northamptonshire</td>
<td>Non-intensive survey</td>
<td>0.4 sites/km²</td>
<td>Taylor 1975, 113</td>
</tr>
<tr>
<td>Oxfordshire</td>
<td>Non-intensive survey</td>
<td>1.0 sites/km²</td>
<td>Mills 1982a, 63</td>
</tr>
<tr>
<td>Chalton Area</td>
<td>Intensive survey</td>
<td>0.8 sites/km²</td>
<td>Cunliffe 1973a</td>
</tr>
<tr>
<td>Elsted, Sussex</td>
<td>Intensive survey</td>
<td>0.2 sites/km²</td>
<td>Redknapp &amp; Millett 1980</td>
</tr>
<tr>
<td>Holme on Spalding Moor</td>
<td>Intensive survey</td>
<td>0.8 sites/km²</td>
<td>Halkon 1987</td>
</tr>
<tr>
<td>Tame Valley</td>
<td>Non-intensive survey</td>
<td>0.6 sites/km²</td>
<td>Smith 1977</td>
</tr>
<tr>
<td>Fenland</td>
<td>Intensive survey</td>
<td>0.3 sites/km²</td>
<td>Hallam 1970, 72</td>
</tr>
<tr>
<td>Wharram Area</td>
<td>Intensive survey</td>
<td>0.5 sites/km²</td>
<td>Hayfield 1987</td>
</tr>
<tr>
<td>West Sussex</td>
<td>Non-intensive survey</td>
<td>0.5 sites/km²</td>
<td>Pitts 1979</td>
</tr>
<tr>
<td>Coastal Plain</td>
<td>Intensive survey</td>
<td>1.7 sites/km²</td>
<td>Fowler 1972, 119</td>
</tr>
<tr>
<td>Shropshire</td>
<td>Intensive survey</td>
<td>1.5 sites/km²</td>
<td>Fowler 1972, 119 (adjusted as Gregson 1982b, 23)</td>
</tr>
<tr>
<td>M5: Somerset-</td>
<td>Intensive survey</td>
<td>(road building)</td>
<td></td>
</tr>
<tr>
<td>Gloucestershire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEAN (all surveys)</td>
<td></td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td></td>
<td>±0.5 sites/km²</td>
<td></td>
</tr>
<tr>
<td>MEAN (without SMR)</td>
<td></td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td></td>
<td>±0.5 sites/km²</td>
<td></td>
</tr>
</tbody>
</table>

(Millet 1990, 184) 198

**Burial Evidence**

Population estimates for the LPRIA, based on burial evidence have been demonstrated in the previous chapter as impractical because of mortuary practices and of the paucity of burial sites. Arnold (1984, 133) extrapolated from human burials in Roman Britain a figure of 2,000 as the average population of Britain, which as Fulford (1984, 131) says, in quoting him, is ludicrous. Conversely Jones (1984, 41) has suggested that an estimate of York's population in the Roman period may be made from the number of burials at Trentholme Drive. On the basis that a 1,000 burials have been excavated,
representing half the cemetery’s graves, and that Trentholme Drive was only a thirtieth of the city’s burial area for three centuries, and assuming an average life span of 40 years, a population of approximately 4,000 to 6,000 could be estimated. Considering that the city was the site of a legionary fortress with c5,000 soldiers, this figure is surely an underestimate. Furthermore to extend this estimate to the whole of Britain at this time would require more evidence of contemporary burial sites, which, at present is lacking.

*Population Size - Roman Britain*

There are two basic approaches to estimating population size and density from archaeological evidence. The first and more fruitful approach is from settlement data and the second is from the assessment of the richness of the environment in terms of animal and plant resources and then calculating how many people could be supported from it (Renfrew and Bahn 2000, 452). It has been proposed by Raoul Naroll, a demographer (Renfrew and Bahn, 2000, 452), from data taken from an examination of 18 modern sites that the population of a prehistoric site is equal to one tenth of the total floor area in square metres. Archaeologists have refined this figure by allowing 2.235 square metres for each of the first 6 people and then 9.3 square metres for every other person. Much would depend on the culture of the people being examined, since in normal circumstances a nuclear family would range from 4.5 to 6, while, in the event of an extended family, the household size may double or even triple (Cook 1972, 18). Estimating the population of a large area using archaeological evidence might then be done by calculating the population of each site and counting the sites for each region. Population estimates of wide areas during prehistory, however, can only be guesses to be compared with other analyses based on ecological and environmental studies.
Population Size - Settlement Data

Millett (1990, 181) reports that the problem of population size has been tackled by most historians writing about the Roman province of Britannia, and says there is no prevailing view on an acceptable estimate. This he illustrates in table 2.

Table 2. Previous population estimates for Roman Britain

<table>
<thead>
<tr>
<th>Authority</th>
<th>Method of estimation/source</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collingwood 1929</td>
<td>Towns, villages, villas and army</td>
<td>0.5 million</td>
</tr>
<tr>
<td>Wheeler 1930</td>
<td>Known sites plus food need</td>
<td>1.5 million</td>
</tr>
<tr>
<td>Collingwood &amp; Myres 1937,180</td>
<td>Settlement pattern</td>
<td>1 million</td>
</tr>
<tr>
<td>Frere 1967 (revised 1987)</td>
<td>Known sites plus food need</td>
<td>2 (3) million</td>
</tr>
<tr>
<td>Smith, C. 1977</td>
<td>Frere 1967 plus new rural density</td>
<td>5-6 million</td>
</tr>
<tr>
<td>Cunliffe 1978b</td>
<td>Frere 1967</td>
<td>2 million</td>
</tr>
<tr>
<td>Fowler 1978</td>
<td>Frere 1967 + new rural density</td>
<td>4 million</td>
</tr>
<tr>
<td>Sahvay 1981, 544</td>
<td>Extrapolation from surveys; Smith 1977</td>
<td>4-6 million</td>
</tr>
<tr>
<td>Fulford 1984, 131</td>
<td>Comparison with medieval figures</td>
<td>max. 2.8 million</td>
</tr>
</tbody>
</table>

(Millett 1990, 182)

As a postscript to the above table of Millett’s, Frier (2000, 810), it is noted, on writing about populations within the Roman Empire says –

*Finally, some thinly settled areas at the Empire’s periphery were annexed after AD 14: Britain, Nabataea and Dacia. None of these is likely to have had more than a few hundred thousand inhabitants.*

Using an optimum period during Roman occupancy, considered by Millett to be the first half of the fourth century AD, he attempts to provide a more systematic approach to the question. He does so by calculating the population of the towns, the countryside and the military. For a minimum urban society he uses the sum of the defended areas of
the known towns and multiplies it by population numbers suggested as typical in the 
pre-industrial era. A maximum density of 216 people per hectare is quoted for towns, 
and for villages 137 per hectare is used. Estimates based on how many inhabitants were 
thought to have lived in stone and wooden houses in Silchester and Neatham show a 
habitation of 100 and 283 respectively. In the absence of more reliable and detailed 
findings, he sees his range of 183,971 to 290,057 people as a working estimate (Millett 
1990, 182). As shown on page 60, in calculating the rural population he uses the 
number of people per settlement site multiplied by the available sites, that is, 92,750. 
By taking a site occupancy of 20 - 50 people, suggested from figures for the average 
nuclear or extended family, a mean population of 3.3 million can be determined. The 
Roman army stationed in Britain in the early fourth century AD has been taken to be of 
the order of 10,000 - 20,000 men (Jones 1996, 214, quotes 21,000 – 25,000) which 
with dependents of somewhere between 50,000 - 200,000, would give an average of 
125,000 for the military (Millett 1990, 185). Combined, an estimated total for the 
urban, rural and military population could be 3.67 million for fourth century Roman 
Britain. The addition of the relatively less populated areas in the rest of the British Isles 
- Scotland and Ireland – may suggest a population in excess of 4 million. 
A review of Millett’s estimate of the population of Roman Britain has criticized his 
calculations as having too many variables (Keppie 1991, 414) while another reviewer 
sees his figures as entirely reasonable (Potter 1990, 31). His estimate contrasts with 
those of earlier historians who saw the population densities of Roman Britain 
considerably less than those of neighbouring Gaul. Also, in comparison to the eastern 
and southern core, the rest of Britain was seen as being thinly populated. More recent 
evidence as discussed previously has disputed this demographic analysis by
demonstrating through aerial and field walking surveys an extensive pattern of regional settlements which lends support to Millett’s high rural population figures. However, “much of the new evidence for rural settlement is as yet ill-digested and chronologically imprecise” (Jones 1996, 14).

Even so, the settlement sites yet to be discovered and the continuity of rural settlement in the fourth century combined with the later occupancy of less favourable sites offset and strengthen the conclusion that previous estimates were too low. Millett’s estimate of the population of Roman Britain, while beset by many variables, is reasonable and in keeping with present population studies.

Population Size - Post-Roman Britain

How can we reconcile this figure of 4 million with a population in medieval England thought to be less than 3 million or one of 4 million at the end of the sixteenth century (Fulford 1984, 131). The arguments favouring an estimate higher for Roman Britain than those of earlier historians where figures of 0.5 - 3 million are quoted above, for example, uses an urban rural ratio based on Roman London. From Tacitus’ record of 70,000 dead in Boudica’s sack of London, Verulamium and Colchester, including the area within the walls (Annals XIV 33 {see p. 9}), Frere (1991, 253) calculated a population for London of about 30,000. In the Domesday survey of AD 1084 and in the time of the poll tax of AD 1377, London represented 1.5 per cent of the population of England and Wales. Using the same rationale for Roman Britain a population of two million may be approximated for the first century AD (Jones, 1979, 242). As a result of massacres, famine and disease, a figure less than this would be anticipated until there was a recovery in the later centuries.

Caesar’s conquest of Gaul and the ruthless pacification of the country by the Roman army must surely have an analogy in the conquest of Britain. The battle for Alesia, the
last significant resistance to the Romans, saw an army composed of virtually every Gaulish tribe, and said by Caesar (*BG VII, 76-77*) to comprise 8,000 cavalry and 240,000 infantry, wiped out – such was the power of Rome.

*Coactis equitum VIII milibus et peditum circiter CCL*

In the years that the Romans had been in Gaul tens of thousands of its young men had been killed. Proportionately, a similar destruction of the Britons’ young and virile population by the Romans must surely have occurred in the first century AD by the crushing of their resistance. A bottleneck in the population created by these disastrous events, it is suggested, gave rise to an increased reproductive cycle in the survivors, as has occurred in recent and past global conflicts, to restore and eventually increase their numbers. Interbreeding by the indigenous population with their conquerors, Romans and their followers, no doubt played its part, too. A divergence in the island’s culture and economy fostered by the new regime also had its consequences in the emergence of a robust society following the conquest. Drinkwater (1990, 211) suggests, that paradoxically, *Pax Romana* brought conditions which gave impetus to the developing craftsmanship and commercial life of Gaul. His observation can be applied equally to the neighbouring Britons.

Physically, we learn from skeletal evidence (supported by more extensive studies in central Europe) that the people of Roman Britain were not significantly different from those of medieval times in their physical characteristics or vital rates (Jones 1979, 243). This conclusion is in keeping with the limited evidence available from funerary inscriptions as to mortality levels. Variations in population size throughout the whole Roman period, it is suggested, were the result of exogenous factors such as disease and nutrition, hygiene, public authority, climate, etc (Jones 1979, 243). What factors then, if the views expressed on population densities of Britain in the period under discussion
are to be convincing, would have been responsible for the decrease in the numbers
determined for the medieval period?

An adaptation to population growth in the developing countries of the past has been to
use the increasing labour force to intensify land use and animal husbandry. In modern
times this is supplanted by the use of industrial and scientific inputs into agriculture to
expand output (Boserup 1975, 262). An increased use of land and settlement has been
described in the PRIA and Roman Britain in the foregoing chapters. In post-Roman
Britain, if the population were increasing, and lacking modern expertise, evidence of
complementary further land development would support this premise. The
deforestation for increased land development attributed to the Roman administration
continued after it had gone. Confirmation of this is seen by no significant sign of
regeneration of woodland at the expense of agricultural land being evident until the
sixth century (Esmonde Cleary 1989, 175).

*Roman Army*

The end of Roman rule in Britain, in the early fifth century, is seen as a system collapse
(e.g. Esmonde Cleary 1989, 173). The strength of the Roman army over three
centuries of occupation fluctuated, as did its socioeconomic effect. Documentary and
archaeological evidence suggests a wide span of numbers in estimates of its size.
Numbers quoted range from 45,000 to 53,000 in the second century to 28,000 to
33,000 in the early fifth century AD.

<table>
<thead>
<tr>
<th>Year</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD 120</td>
<td>45,000 to 53,000</td>
</tr>
<tr>
<td>AD 210</td>
<td>47,000 to 55,000</td>
</tr>
<tr>
<td>AD 300</td>
<td>21,000 to 25,000</td>
</tr>
<tr>
<td>AD 400</td>
<td>28,000 to 33,000</td>
</tr>
</tbody>
</table>

(Jones 1996, 214)
The strength of the units of the late fourth century army is dependent on various assumptions. An extreme view has Britain awash with troops in the fourth century while a minimalist approach sees numbers under 20,000 even as low as 15,000 from the late third to fourth centuries (Jones 1996, 214). The Notitia Dignitatum lists details of regiments in Britain but not their strength. An assessment based partly on strengths at the time of the Principate and those of the new field army legions, the Comitatenses, of about a thousand and those of the old legions, now the Limitanei, at 3,000 men suggest a notional strength of 28,000 for the frontier garrisons and 5,500 for the field army legions.

Revised estimates show, with archaeological support, that a large area of Britain, Wales and the North West was undergarrisoned, if not seriously depleted, in the later third century. The reason was that badly needed reinforcements for the continuous foreign and civil wars in other parts of the Empire were sent from Britain, which in the third century was generally peaceful. The troops removed were not replaced. The reduced garrison has been estimated in the later third century to be between 10,000 and 20,000 men and remained so throughout the fourth century, balanced by withdrawals on the one hand and reinforcements on the other (Jones 1984, 162-169). By the beginning of the fifth century, the army was now mainly frontier troops, native Britons, with the field army withdrawn to mainland Europe. The collapse of the Roman administration left the remaining garrisons unpaid and without direction. They, being largely regionalized, dissolved into the surrounding community either as rural workers, farmers, brigands or mercenaries no longer shoring up the bureaucracy, the magnates or a stable government.
Climatic Change

Changes in climate conditions affecting food production have been argued as a contributory factor in a population decline exacerbated by raiding Picts, Scots and Saxons who sought to relieve adverse conditions in their own regions by preying on a weakened and disunited community. Environmental changes, in a country with an extensive marginal agriculture interacting with man made problems, did produce a multidimensional crisis at the ending of Roman rule (Jones 1996, 241-243). The sixth century writer, Gildas, reported, famine and plagues, consequences of overpopulation and declining food supplies, in the immediate post-Roman era (Esmonde Cleary 1989, 174). At a time between the fourth and eleventh centuries, probably during the mid sixth and the late seventh centuries, a demographic catastrophe occurred that possibly halved Britain’s population (Jones, 1996 241; 1979, 232). The epidemics of the sixth century and afterwards greatly contributed to this decline. It has been noted that an increase in mortality of 200 or more deaths / 1,000 population / year would prevent population growth or reduce it for a time on the basis that historically human reproductive powers have ranged between 15 and 50 births / 1,000 population /year. Repeated mortality crises affecting a given population would require a long period for it to recover (Jones 1979, 232; Cipolla 1978, 89).

The events, which included a system collapse, invasions, famines, pestilence and other catastrophes following the end of Roman Britain, obviously contributed to a serious decline in population density from the fifth century until the Middle Ages. The expectation that population density in the Middle Ages after five hundred years or more would be greater or at least no less than the time of the Romans is reconcilable on this basis.
Chapter 5 Molecular Genetics in Population Studies

Introduction

Molecular genetics has been defined as the biology of those molecules related to genes, gene products and heredity. In other words, it is genetics as viewed at the level of molecules and, in particular, molecules that involve the structure and sequencing of the nucleic acids, which carry the genetic information. The molecule that stores genetic information is called DNA (deoxyribonucleic acid) (Clark and Russell 1997, 1-2). The molecules contain four bases or nucleotides, that is, adenosine, cytosine, guanine and thymine or ACGT. The letters, ACGT, may be likened to the alphabetic code of molecular biology. These letters make up the words (codons) which, in turn, form the sentences (sequences) and stories (genes) used to codify the various structures that form genetic complexes. Among other things, they can be used for the identification of hereditary characteristics of individuals and populations. The sequences and genes are located in the chromosomes (chapters) and all 46 of them make up the genome (the book of life). See figure 7 on page 70
THE DNA CONTAINED IN THE HUMAN GENOME

IS NATURE'S BOOK OF HUMAN LIFE.

This book of life contains
- 23 chapters (chromosomes).
- Each chapter is composed of several thousand stories (genes).
- Each story is composed only of 3 letter words (codons).
- Each 3 letter-word is selected from 4 possible letters ATGC.
- The secret of life is contained within 1 billion words.

To read the human genome is equivalent to reading 800 Bibles and would take 100 years if read at the rate of 1 word per second for 8 hours per day.


Molecular genetics provides a means of investigating the origins of the people of Britain in the period under study, but, first, it is useful to look at the genetic evolution of Europe as a whole through an analysis of their mitochondrial DNA (mtDNA). The mitochondrion is an organelle found in the cytoplasm of cells of higher organisms and its DNA is inherited, almost exclusively, from the mother. Each individual carries only one type, unlike nuclear DNA where inheritance is from mother and father.

Phylogenetic trees relating to mitochondrial DNA may then be interpreted as genealogies reflecting the maternal history of the population. This uniparental inheritance of mitochondrial DNA with no apparent sign of intermolecular recombination, a faster rate of evolution than nuclear DNA and its presence in high copy number in the cell makes it ideal for phylogenetic, population and identification studies (Vigilant et al. 1991, 1503; Zischler 1999, 118).

Peopling of Europe – Mitochondrial DNA

The origin of a population can be investigated in several different ways including the origin of genetic structure and the origin of culture.
and language” (Degos and Dausset 1974, 195).

As an example of population origins, studies on the molecular genetics of the peoples of Europe indicate, through the analysis of mitochondrial DNA regional variants, that they spread from Africa between 100,000 to 60,000 years ago to the entire Old World. They arrived in Europe some 50,000 years ago (Cavalli-Sforza et al. 1993, 639; Clark and Russell 1997, 420). This expansion is in agreement with archaeological evidence of earliest modern humans from about 100,000 years ago and the creative explosion of the Upper Palaeolithic type technology of some 50,000 years ago (Harpending et al. 1998, 1996; Klein 1989; Foley and Lahr 1997, 3-32). Archaic Homo Sapiens, the later more sophisticated form of Homo erectus, of which the Neanderthals are the best known of these archaics, occupied the more temperate zones of Europe approximately 250,000 years ago (Stringer 1993, 501-2). They were to be replaced by modern humans over several millennia about 40,000 years ago (Harpending et al. 1998, 1961). Though there was co-existence between Neanderthals and modern humans they did not interbreed to any significant extent (Richards et al. 1996, 196). Sykes (1999, 137), however, after an examination of over 2,000 European DNA sequences, found that it is probably safe to assume that there was no interbreeding with female Neanderthals. Richards et al. (1996, 185) in their phylogenetic and diversity analysis of the mitochondrial control region 1 distinguished 5 major lineage groups from sequence variations of individuals from Europe and the Middle East. Samples of blood and hair obtained from maternal grandmothers in rural districts were used for the analysis. The sample size and DNA phylogeny were increased and refined to support an interpretation of 3 separate phases of colonisation occurring in (i) the Early Upper

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1 A region on the mitochondrial genome, which is polymorphic, that is, it shows different versions of the same gene. These variations may be used to identify
Palaeolithic about 50,000 BP; (ii) the Late Upper Palaeolithic 11,000 to 14,000 BP; and (iii) the Neolithic from 8,500 BP (Sykes 1999, 131). From these different periods of colonisation it is estimated that (i) has contributed 10 per cent to the modern gene pool, the largest contribution of 70 per cent being provided by (ii) and the remaining 20 per cent by (iii).

The group (i) colonists spread over Europe from the Near East and with the advent of the last Ice-Age, 18,000 to 20,000 BP, retreated to refugia in SW France and Cantabria or to the Ukraine in the east to survive in a less life-threatening environment. Support for this hypothesis is concluded from the absence of authenticated archaeological sites in North Europe between 22,000 and 14,000 BP. As the Ice Age receded the population expanded from its refugia into areas which were now well stocked with game and sustenance. Evidence of late glacial human re-colonisation of Northern Europe is confirmed by radiocarbon dating of archaeological sites (Housley et al. 1997, 25-54).

The flow of Mesolithic colonists throughout Europe to more bountiful environs no doubt created the genetic divergence within group (ii) and was significant in shaping the modern mitochondrial gene pool (Sykes 1999, 137).

Group (iii) the last wave of European colonisation in 8,500 BP, the Neolithic period, is attributed to the spread of agriculture from the Middle East (Sykes 1999, 138; Cavalli-Sforza et al 1994, 42). The mitochondrial phylogenetic analysis demonstrates clear Middle Eastern ancestry and the haplotype cluster has two subdivisions, which shadow the two major farming routes into Europe (Richards et al 1996, 194; Sykes 1999, 197).

As defined archaeologically and evident genetically, these routes followed the Mediterranean and the Atlantic coastlines while the other route followed the Danube to the rich riverine regions of Central Europe (Zilhao 1993,52). The hypotheses presented by Richards et al (1996) and Sykes (1999) indicate that contrary to the Ammerman and
Cavalli-Sforza (1984) 'wave of advance' model, the ancestral European genetic changes were not determined by Neolithic farmers but by earlier Mesolithic arrivals who were responsible for the genetic diversity following the last glacial period.

**Populating Britain**

The population of Britain before the arrival of agriculture, as suggested by Bodmer (1993, 56), was descended from the Late Palaeolithic hunters who occupied Northwestern Europe. Following the phylogeny described by Sykes for group (ii) the arrival of these Mesolithic people could have happened in the postglacial period, some 12,000 to 10,000 years BP. These invaders or migrants with origins adapted to a cold and dark climate were, as Bodmer says, tall, red haired and blue eyed. At the time of arrival by the descendants of the Middle Eastern farmers, these hunter-gatherers probably numbered no greater than ten to fifty thousand. This blend of hunter-gatherers and farmers increased the genetic diversity as well as the population of Britain about five and a half thousand years ago. These conclusions, as has been said, were derived from molecular genetic studies based largely on mitochondrial DNA analysis.

The higher mutation rates for mitochondrial DNA than nuclear genes means that mitochondrial DNA can be used to study the evolutionary history of closely related species or races within the same species. Most of the variability occurs within the D loop segment of the control region (Clark and Russell 1997, 419). The hypervariable parts of the control region evolve at a rate that is on average five to ten times higher compared to nuclear genomes (Zischler 1999, 118). These mutations and/or substitutions of nucleotides within the hypervariable segment of the mitochondrial DNA become useful for testing relatedness between living descendants and that of material from a suspected ancestor who is separated by several generations. The high copy number of mitochondrial DNA in a cell, most cells containing more than a 1000
copies compared with the two copies of nuclear DNA, make it particularly useful in forensic and ancient DNA studies where the DNA is degraded and difficult to extract, such as in material from archaeological burial sites. These properties are useful in the reconstruction of human population history since the analysis of molecular lineage is not compromised by recombination, and the high rate of evolution of the DNA allows the accumulation of substituted nucleotides over time periods relevant to population history (Sajantila et al 1996, 42).

From the foregoing population studies on mitochondrial DNA, it seems evident that the people of Britain, over considerable millennia, have remained relatively unchanged genetically. How can this be when Bodmer postulates that in prehistory the Middle Eastern farmers had a major impact on the small mesolithic population of blue-eyed, red-haired hunter-gatherers, in terms of expansion and genetic diversity? What of the historical record that tells us of the Roman invasions complete with a supporting cast of followers from its provinces and territories throughout Europe, the Middle East and Africa? Since the biological samples for the study were obtained from people of the twentieth century, what of the genetic contribution from later Anglo-Saxon, Viking and Norman invasions, not to mention the various refugees and immigrants from elsewhere around the globe? The answer may lie in the sex of the genetic contributor since most invaders were unlikely to have been accompanied by their spouses.

**Y-chromosome in Population Studies**

Analysis based on mitochondrial DNA ignores the contribution to the phylogeny by the male. As an illustration of the difference made using the Y-chromosome instead of mitochondrial DNA, there is the study on the population structure of Polynesia (Hurles et al 1998). This report showed that 99 per cent of mitochondrial DNA predated the European arrival, but that at least a third of Y-chromosomes were derived from an
exclusive male post contact group of sailors, traders, whalers and missionaries.

Analyses using the Y-chromosome perhaps may provide a useful comparison to mitochondrial DNA for population origins and mixtures for ancient Britons.

Another study, estimating Scandinavian and Gaelic ancestry of the male settlers of Iceland, and using the Y-chromosome di-allelic and microsatellite variation, suggests that 20-25% of the founding males had Gaelic origins while the remainder were of Norse extraction. The data were derived from comparable differences between Icelanders, Scandinavians and Gaels from Scotland and Ireland on the basis of an analysis of DNA from present day populations (Helgason et al. 2000, 697).

In a later study using mitochondrial DNA (mt DNA) lineages from the populations of the Islands of the North Atlantic, the proportions of Norse and Gaelic matrilineal ancestry were investigated. The North Atlantic Islands' populations were located in the Orkneys, the Western Isles, the Isle of Skye and Iceland. Compared with those in the rest of the British Isles, Scandinavia and other regions of Europe the magnitude of diversity of the levels of Gaelic admixture in the mt DNA pools of the Islands was assessed. Contemporary population mt DNA lineages provided the direct link to matrilineal ancestors from the Viking era and allowed an examination of the contribution by Scandinavian females to the Norse settlements of the North Atlantic Islands (Helgason et al 2001, 714-715).

Studies such as those of Helgason et al. (2000 and 2001) using molecular genetics to trace patrilineal and matrilineal descent of the population of Iceland in particular, support the archaeological and historical evidence of population movement during the Viking era from the late eighth to eleventh centuries AD. These reports show through Y-chromosome analysis that Iceland was colonized by a male warrior society in keeping with a present day population of 75% Scandinavian origin. Conversely, an
investigation based on matrilineal descent using mt DNA for the analysis shows a Scandinavian admixture of 37.5%. These molecular genetic statistics lend credence to the historical sources of a Norse expansion of Viking males establishing settlements in the British Isles, acquiring indigenous wives and/or slaves and later participating in a mass migration of people to Iceland.

There have been media reports of molecular geneticists, such as Professor David Goldstein and others, undertaking studies of the present British population, using the Y-chromosome to ascertain the contribution made to the genetic pool by past invaders and colonizers of prehistoric and historic Britain (BBC 2001). Studies such as this offer an insight into the effect of those unattached males on the indigenous population, which reflects, in the main, the matrilineal lineages determined by mt DNA analysis.

The Major Histocompatibility Complex (MHC)

The most outstanding feature of human MHC genes is an extremely high degree of allelic polymorphism. Because of the high polymorphism, allele frequency data of MHC genes for ethnic groups are quite useful for anthropological study.

In particular, cluster analyses based on allele frequencies of MHC genes are effective in elucidating genetic relationships among various ethnic groups.

(Imanishi et al 1992, 627)

The human MHC, usually referred to as the human leucocyte antigen (HLA) is a large multigenic family whose products control the immune system’s capacity to recognise foreign proteins such as in disease and organ transplantation (Wen-Hsuing Li 1997, 259). The MHC region is located on the short arm of chromosome 6 and is highly polymorphic. The HLA genes of the MHC are classified into two groups, class1 and class 2, depending on their structures and functions. Genes in each class exist as a
multigene family and several show a high degree of polymorphism in various ethnic groups (Imanishi et al. 1992, 627; Gojobori and Imanishi 1993, 67). This inherited characteristic of these multigenic families can be typed and matches made to kin and ethnic origins of human populations. Frequencies of these polymorphisms or alleles of gene groupings, called haplotypes, also may be used to construct phylogenetic trees to estimate genetic distances between individual ethnic groups as seen in figure 8, page 78 (Gojobori and Imanishi 1993, 70) and figure 9, page 79 (Piazzo and Lonjou 1997, 380).
Figure 1. The phylogenetic tree constructed by the UPGMA using allele frequencies of HLA-A and B genes, which shows evolutionary relationships among 80 ethnic groups.

Gojobori and Imanishi (1993, 71)
Genomic Matching Technique (GMT)

Polymorphic frozen blocks of the MHC, that is regions with haplotypes, like the beta block, that have remained largely unchanged throughout human history, may be profiled by the GMT. The beta block contains immunorelevant HLA-B, HLA-C and PER B-11.1 and PERB-11.2. Contained within it are polymorphic and complex
sequences which may be amplified to provide haplospecific and haplotypic responses of the whole block to match the donor organ in the case of transplants and/or family or ethnic origins (Gaudieri et al 2001, 279-280). GMT offers an analysis encompassing both patrilineal and matrilineal ancestry.

Ancient DNA

Ancient DNA has been defined by Herrmann and Hummel as:

(1) Any bulk or trace of DNA from a dead organism or parts of it, as well as extracorporeally encountered DNA of a living organism or parts of it, (1994, 2)

(2) serves as a source material in evolutionary biology, historical anthropology and forensic science. Ancient DNA provides direct access to the genetic information of past individuals or populations in contrast to those studies that use modern DNA for the reconstruction of population history. (1997, 33).

What has been discussed in the foregoing work involving mtDNA and Y-chromosome studies cannot be construed as positively confirmed knowledge of the DNA of the populations in their period of history. A response to this uncertainty may lie in extracting DNA from archaeological bones and teeth to determine ancient ethnicity as well as kinship. Studies in this direction have been done and more are underway (Handt et al 1994; Oota et al 1995; Richards et al 1995; Zierdt et al 1996; Colson et al 1997; Stone and Stoneking 1999; Kolman and Tuross 2000). This would seem to be the way in which these uncertainties may be resolved (Renfrew 1992, 471, 1992a, 289-290, 1996, 71; Bodmer 1993, 57; Pääbo 1993, 64; Pluciennik 1996, 13; Sims-Williams 1998, 524).

Investigation of DNA obtained from human remains excavated from Iron Age and Romano-British burial sites could assist in understanding population growth during this
period. Studies have been limited because of a lack of suitable material, expertise and difficulties in extracting uncontaminated degraded DNA. In the succeeding chapter I propose to look in some detail at what is involved in extracting ancient DNA from archaeological teeth, the more common survivors of the decay process.
Chapter 6 Ancient DNA: Recovery from Archaeological Teeth

Introduction

Ancient DNA (aDNA) is said to have been extracted, presumably for the first time, by a Chinese team of the Hunan Medical College in 1980, from the remains of a Chinese Princess, whose corpse had been preserved for almost 2000 years (Herrmann and Hummel 1994, 1). Later, in 1985, Paabo, a Swedish molecular biologist, extracted DNA from a 2,400-year-old Egyptian male mummy. Until then the prevailing view had been that after death DNA, under normal circumstances, would decay rapidly. Only in cases where preservation was good, such as in museum specimens, tanned skins, artificial mummies and long frozen remains in which biological integrity was of a high degree, was DNA expected to be found. The early techniques of Paabo and others required so much aDNA to be extracted from the test material that they were and are limited to well preserved specimens (Herrmann and Hummel 19994, 1). Their practical difficulties encountered in obtaining clones of aDNA were due, no doubt, to the physical and chemical damage to its molecular structure, which limited the amount of sequence information obtainable from a single specimen. Consequently, this had the effect of aDNA having a curiosity value, worthy of no further serious research effort.

Polymerase Chain Reaction (PCR)

In the mid 1980s, a resurgence of interest in aDNA came with the discovery of the polymerase chain reaction (PCR), a test-tube cloning technique (Saiki et al 1985; Mullis et al 1987). Technology such as the PCR enabled researchers to circumvent the earlier problems in cloning aDNA by producing molecules for sequence analysis by
direct amplification of the fragmented and frequently sparse DNA strands (see figure 10).

Figure 10.

The polymerase chain reaction produces unlimited copies of DNA in the first step, denaturation, DNA is heated, separating the two strands. In the second step, primer annealing, short segments of DNA are attached to the strands. Primers (green and red) isolate the part of the strands to be copied and analysed (blue and purple). In the third phase, extension, the enzyme polymerase produces strands matching the original two. Completion doubles the amount of DNA.

Powledge and Rose 1996, 38.

The amplification is made specific by two short DNA fragments or primers which are made to match the base sequences on either side of the sequence being studied. From a few dozen or a few hundred aDNA fragments multiple copies are produced for DNA sequence analysis (Paabo 1993, 63; Brown and Brown 1994, 719) By targeting those
genetic sequences providing the most useful information, the need for tedious and possibly fruitless screening of a clone library is avoided.

**DNA in Soft Tissues**

Until 1990 it was generally accepted that aDNA would be found only in relatively young specimens or those that had been artificially or naturally preserved (Brown and Brown 1994, 719). The soft tissues of the body through autolytic and putrefactive changes decay rapidly unless these factors are reduced by conservation in an optimal environment such as being frozen, dried, kept in a neutral wet or natural condition or artificially mummified. The aDNA in these circumstances may survive to provide some form of analysis. Bodies as old as 5,000 years providing tissues suitable for DNA analysis have been found captured in permanently frozen layers from regions of the Arctic (Nielsen et al 1994) and Alpine areas of Europe and South America (Hedges and Sykes 1992; Handt et al 1994). Ancient DNA also has been extracted from human brains deposited 7–8 thousand years ago in anaerobic water saturated peat (Hauswirth et al 1994, 107) and from gut contents of the Lindow Man (Fricker et al 1997). Various other human soft tissues, too, like skin, muscle and liver taken from mummified remains found in Egypt and North and South America have yielded aDNA which has been extracted and amplified (Pääbo 1989, 1993; Hedges and Sykes 1992; Woodward et al 1994; Handt et al 1996).

**DNA in Hard Tissues – Population Studies**

The extraction and amplification of aDNA from the far more abundant human remains of bone and teeth in the late 1980s by Hagelberg and others (1989) had great significance. It has since been shown that, although both bone and soft tissues are suitable for DNA studies, skeletal remains should be given preference as source materials when there is severe degradation. This has been supported from studies on
both tissues as bone extractions proved more successful and demonstrated less DNA degradation. (Lassen et al 1994, 154; Paabo 1993, 65).

Not only was information available from epigenetic analyses of skeletons about historic, protohistoric and prehistoric populations but also from the aDNA contained within their bones and teeth (Hagelberg et al 1989; Audic and Béraud-Colomb 1997, 857). Using aDNA extracted from these hard tissues a number of theories on population origins, movements and kinship have been confirmed. Among the studies found in the literature there are: the sharing of polymorphisms between the ancient early settlers (Hagelberg et al 1994); the origin of the modern Japanese traced to the Jomon and Ainu peoples (Horai et al 1991); the similarity of allelic frequencies between past and modern populations in an early medieval German burial site (Zierdt et al 1996, 185); and an analysis of bones from Anglo-Saxon and Romano-British cemeteries (Richards et al 1995, 295; Hedges and Sykes 1992, 280).

**DNA in Teeth and Bone – Kinship and Ancestry**

Until recently, morphological features such as epigenetic variants of the skeleton, metric or odontological markers were the only way in which kinship could be inferred from human skeletal remains. These observable features of the human organism, however, because of the unknown factors of inheritance remained largely tentative in determining kinship (Hummel and Herrmann 1996, 215). It is now possible through the application of aDNA to examine genetic variations of ancient individuals and validate findings based largely on the physical examination of the skeleton. Several studies on ancient human genetic material have been recorded such as dismissing claims that the individual Tyrolean Iceman was a fraudulently placed Egyptian mummy (Stoneking 1995, 1259). An important contribution from a study on the skeletal remains of six infants and one subadult dated from second to ninth centuries AD and excavated from a
burial site in Friesland, was the identification of their sex which is impossible to deduce from bone morphology (Colson et al. 1997, 916), although others have determined otherwise (Farwell and Molleson 1993; Schultkowski 1993; Watts 2001).

In seeking the ancestors of modern Europeans Professor Sykes and Professor Hedges sought an answer in the aDNA taken from the teeth of 30 skeletons found at neolithic farming locations in France and Germany including those taken from British palaeolithic cave sites used by prehistoric hunters. Suitable DNA was obtained only from six specimens, four neolithic and two palaeolithic, and compared with sequences from 900 modern Europeans. Their results, although limited, showed that most Europeans were descended from hunters and not farmers as two of the palaeolithic samples were of a European type whereas two of the neolithic specimens demonstrated a Middle Eastern lineage. These findings support the hypothesis that agriculture was brought to Europe from the Middle East by a few colonists and that most Europeans are descendants of hunter gatherers who ultimately took up farming (Musty 1998, 28). The same group have traced the lineage of the 9,000 year old Cheddar Man to two modern descendants, a Cheddar schoolteacher and Lord Bath’s butler (Sykes 2001, 184).

Other applications of using aDNA in determining relationships may be found in the linking of a disarticulated arm to the skeleton of a 17th century German nobleman (Gerstenberger et al. 1998). It also has been used in revealing inconsistencies with the archaeological and historical record of a traditional family burial site of the 16th and 17th centuries, when compared with the genetic reconstruction of the assignment of individual graves (Hummel et al. 1999, 1719). In a burial group buried between the end of the 17th and the beginning of the 20th centuries aDNA was extracted and analysed to demonstrate the purported relatedness of family members and to authenticate the skull of the family founder (Mazura et al. 1997, 97). In more recent history, nuclear and
mitochondrial DNA analysis has been used to establish the authenticity of the remains of the Romanov family found in a mass grave near Ekaterinburg in Russia in 1991 (Gill et al 1994, 130). A later study confirmed the identity of Tsar Nicholas II’s mortal remains by comparing his aDNA with that taken from the femur and rib of his brother, the Grand Duke, Georgij Romanov, who died in 1899, some 19 years before the murder of the Tsar (Ivanhov 1996, 417).

The foregoing examples present the utility of aDNA and give support to the optimism expressed about future studies. At the recent 5th International Ancient DNA Conference held at Manchester this optimism was not shared. Ancient DNA research presents extreme technical difficulties because of minute amounts, the degraded nature of surviving DNA and the exceptional risk of contamination (Cooper and Poinar, 2000, 1139), which must now be addressed.

**Methodological Challenges with Ancient DNA**

Problems associated with aDNA studies are various and begin with the understanding that DNA is a chemically unstable molecule that decays spontaneously, mainly through hydrolysis and oxidation, which leads to a breakdown of the DNA strand that fragments into smaller and smaller pieces (Austin et al 1997, 303). In a living organism destructive processes that break down the bonds between base and sugar residues continuously affect DNA. Fortunately organisms are able to survive the onslaught of these attacks by an inbuilt repair process. After death, the repair process ceases while many of the destructive processes continue with DNA molecules reduced to several base pairs (bp) (Handt et al 1994, 524). By contrast DNA extracted from fresh tissues yield fragments of more than 10,000 bases in length (Pääbo 1993, 60). Following the death of an organism DNA that survives the major autolytic degradation of the first few hours or days is further degraded by hydrolysis and oxidation (Richards et al 1995,
Theoretically, it has been calculated, using laboratory models, that DNA should not survive for not more than 10,000 to 100,000 years, unless special conditions exist for its preservation, such as the example of tissue from a mammoth found in permafrost, and even then it is expected to be severely fragmented and chemically modified (Lindahl 1993, 713; Höss et al 1996, 1306; Austin et al 1997, 303).

Contamination

Contamination can occur at many stages when working with aDNA. From the time of the burial of the deceased to the extraction and amplification of DNA from the remains, the presence of extraneous human, animal and microbial contaminants is a major problem for the authentication of the target sample. Contaminant DNA can be introduced during the burial process, from the environment of the grave, the intrusive effects of resurrecting the remains by archaeologists, forensic examiners and despoilers and from within the laboratory. When working with aDNA it is important to establish a methodology where contamination is reduced and an authentic product is obtained for analysis. It is essential, therefore, that aseptic conditions prevail where possible, particularly in the laboratory. The procedures for obtaining authentic ancient DNA, as proposed and followed by various workers in the field, are summarised in the succeeding paragraphs (Handt et al 1994, 626-527; Herrmann and Hummel 1994, 62-66; Audic and Béraud-Colomb 1997, 855; Austin et al 1997, 303).

Selection of Material

Subject to the availability of the material the choice should be on samples which are representative of the best site for the preservation of DNA. Bone and teeth have been found to fulfil this criterion. Bone is a material lacking in liquids and enzymes and the cells within it can be expected to suffer less from autolytic processes because of the
probability of their being better protected against diagenetic influences than other cells are within the body (Hummel and Herrmann 1994, 205). Bones and teeth, because of their hard surfaces, form a protective mantle to safeguard the organic residues within them from the chemical reactants and microbial infestation. The binding of the DNA molecules to mineral surfaces such as hydroxyapatite stabilises them (Burger et al 1999, 1727).

Teeth form a natural barrier to contamination by exogenous DNA and appear to provide DNA lacking in most of the inhibitors to enzymatic amplification of aDNA (Woodward et al 1994, 244). They are known also to survive most post-mortem circumstances such as decomposition, immersion in water, burial and fires reaching temperatures of 1,100°C (Sweet and Hildebrand 1998, 1199). Although teeth have been found to contain smaller amounts of DNA they have proved to be preferable sources for aDNA extraction and amplification. Ancient DNA extracted from bone is found to contain a considerable amount of DNA derived from soil living bacteria and fungi that invade and take up residence in the outbranched Haversian canals of the bone (Zierdt et al 1996, 193). Microbiological action, although ubiquitous, is likely to diminish through lack of resources in bone and allow better preservation of aDNA than in the soft tissues (Hedges and Sykes 1992, 272). The aDNA within the hard, relatively impervious tooth is encapsulated and better protected against such invaders (Thueson, 1995, 139). This natural barrier provided for the tooth against exogenous microorganisms and contaminants make it an ideal source for obtaining aDNA for analysis (Woodward et al 1994, 244).

The choice of material for aDNA extraction should be supplemented by evidence of good cellular and biomolecular preservation determined by histology (Richards et al
and amino acid racemization and pyrolysis (Poinar et al 1996, 864; 1999, 8427).

**Microscopy**

Conventional light microscopy and ultrastructural studies on archaeological tissues and materials can be useful in determining the level of preservation and contamination by micro-organisms within them. It is particularly helpful in selecting specimens for the extraction of aDNA where a choice exists. DNA in teeth and bone is found in the cellular elements such as in the dental pulp, cementocytes and odontoblasts and in the osteocytes, osteoblasts and osteoclasts of bone. Evidence of their survival can auger well for a positive result while contaminating micro-organisms revealed by microscopy forewarn of possible limitations on the extraction of target aDNA for analysis (Herrmann and Hummel 1994, 5, 1997, 304; Richards et al 1995, 292; Austin et al 1997, 304). The following illustrations provide examples of ancient bone as seen by microscopy. (see figures 11 and 12, pages 91 and 92).
Figure 11.

FIGURE 1. Microradiograph of a cross-section of a mammoth femur from the Neanderthal site Salzgitter, Lower Saxony, Germany. Although some 60,000 years old, the microstructure is still perfectly preserved due to wet and anaerobic conditions in glacial gravels and sands. Magnification bar in μm.

Herrmann and Hummel 1994, 5.
Microorganisms provide the majority of contaminating DNA under decomposition of any source material. Thus the ratio of aDNA to contaminating DNA may be very low as in this example. Numerous boring canals by invading bacteria and fungi have destroyed the original texture of a human femur from the Romano-British cemetery at Poundbury, England, leaving only a small island of well-preserved tissue, enclosing an osteocyte marked by 1. Magnification bar in μm.

Herrmann and Hummel 1994, 10.

Amino Acid Racemization

Most amino acids in proteins exist in the form of two optical isomers, the D and L enantiomers. When isolated from active metabolic processes the L amino acids undergo racemization to form D amino acids. The process is similar to that of DNA depurination and may be used as an indicator of DNA degradation in ancient specimens. Poinar and others (1996, 854) used the D/L ratio of the amino acid,
aspartate, to assess the content of endogenous DNA in archaeological specimens. They found that, if the ratio of aspartic acid exceeds 0.08, ancient DNA sequences could not be retrieved. The method can be used to eliminate unnecessary analyses on specimens unlikely to provide useful results or be used to confirm contamination by exogenous DNA arising in the polymerase chain reaction, assuming that none were in the original samples.

*Procedures to Minimise Contamination*

The study of aDNA is made difficult by the many sources of contamination arising from the handling of the remains (Colson *et al* 1997, 911). Exogenous DNA may be introduced into the host particularly through the interaction of humans from the time of death to the extraction of the aDNA in the laboratory. Extraneous DNA from sources other than humans can generally be excluded phylogenetically. Unfortunately modern DNA outcompetes the more degraded aDNA when amplified by the PCR, but the former's longer and less fragmented frequencies point to its foreign origins.

Contamination may be overcome by the introduction of a minimisation programme to the various stages of the methodology to safeguard authenticity of the result (Höss 1995, 119; Handt *et al* 1996, 368; Audic and Béraud-Colomb 1997, 855; Austin *et al* 1997, 304; Burger *et al* 1999, 1724).

*Procedures (Austin *et al* 1997, 304)*

1. Selection of specimen by aseptic technique using gloves and face mask to prevent contamination from the investigator.

2. Choice of specimens should be determined by the state of its preservation such as being in a cold, sterile and/or anaerobic environment. Where this is unobtainable an internal, as against an external, source which is less likely to have been exposed to
exogenous contaminants, for example, a tooth or a section of bone should be chosen (Cooper 1994, 150; Burger et al 1999, 1722).

3. The specimen should be carefully prepared for extraction of its aDNA by sterilizing its surface to remove possible biological contaminants. This may be done by irradiating with ultra violet or treating the surface with a dilute solution of sodium hydrosulphite or bleach, taking care to avoid denaturation of the endogenous aDNA. Surface contaminants also can be removed mechanically, in the case of a tooth or bone, by scraping with a sterile scalpel blade, rubbing with emery paper or sandblasting to remove a millimetre or so of its surface. A combination of both chemical and physical treatments may be necessary in some circumstances (Hagelberg 1994, 197; Zierdt et al 1996, 187; Sweet and Hildebrand 1998, 1199).

4. Where possible, work on aDNA should be carried out in a laboratory dedicated to these procedures and away from analyses on modern DNA of like species. In addition, equipment and reagents should be exclusive to the laboratory. If this is not possible work on aDNA should precede that of extant DNA.

5. Sterile laboratory conditions must prevail and this includes the wearing of full protective clothing by laboratory workers. Regular treatment of bench surfaces, equipment and reagents by ultraviolet irradiation and where possible by bleach is a necessary pre and post operative procedure (Pääbo 1993, 64; Handt et al 1994, 527; Stoneking 1995, 1259).

6. During the extraction and PCR amplification of aDNA and DNA it is necessary to set up multiple negative controls to detect the presence of contaminants. These negative controls include parallel samples without the extract. The test sample can be interspersed with one of another taxon to monitor for cross-contamination during

**Authentication**

1. Putative aDNA sequences must be reproducibly obtained from different extractions of the same sample and from different samples of the same and other tissues. Independent replication in two separate laboratories is the ultimate test of aDNA authenticity (Pääbo 1989, 1943; Handt et al 1994, 528, 1994a, 1777; Ivanov et al 1996, 417).

2. Phylogenetic sense of aDNA sequences must be made, that is, they should be compatible with the organism it supposedly represents (Handt et al 1994, 526-527; Richards et al 1995, 298).

3. An inverse relationship between amplification efficiency and sequence length is one of the characteristics expected of aDNA when compared with extant DNA. There is also a low copy number of target sequences in the extract that adds to the authenticity of the analysis (Handt et al 1994, 524; Cooper and Poinar 2000, 1139).

**Conclusion**

In this chapter the history, choice of materials and pitfalls in the analysis of aDNA have been presented. A case study of archaeological teeth obtained from an AD fourth to fifth century cemetery at Bradley Hill, Somerset, England will be presented in the next chapter in which methodological challenges are demonstrated.
Chapter 7 Archaeological Teeth— A case study in aDNA analysis

Introduction

In order to provide a practical adjunct to this study of the people of Iron Age and Roman Britain, an attempt was made to obtain some teeth from remains found in cemeteries of the period. The curators of several museums in Britain were approached with a view to acquiring suitable specimens. An appeal also was posted through the on-line archaeological database seeking the support of workers in the field. Unfortunately, although there were expressions of interest, no teeth were forthcoming. Of particular interest was the acquisition of teeth from Trentholme Drive Roman cemetery at York. Professor Warwick in the Wenham Report (Wenham 1968, 157) concluded that the Trentholme people were mostly near to, but not identical with, the so-called Romano-British type (above, chapter 2). This may be true for the inhumations since most legionaries of the third and fourth centuries AD were supposedly British. Legionaries of the earlier centuries were more likely to be foreign. A comparison of aDNA sequences extracted from female teeth, presumably native Britons, with those from earlier cremations would be useful in determining whether ethnic differences were detectable. Although the earlier burials were cremations, aDNA has been extracted from such material. Indeed, it has been suggested that the cremation process provides some protection for bone and tooth DNA by removing nutrients supportive of microbial survival (Brown et al 1995, 186).

The Curator of the Natural History Museum in London where the Trentholme Drive skeletal material is deposited expressed reluctance to provide the samples requested. The experience of museum curators, I was advised, concerning the recovery of aDNA from
British material, in general and museum specimens in particular, has been disappointing. As a consequence, museum curators are now most reluctant to allow sampling and destruction of specimens in their care, unless the case for analysis is very strong. As an alternative to Trenholme Drive the small Romano–British cemetery at Bradley Hill offered an opportunity to carry out aDNA analyses on a small local population.

**Bradley Hill Cemetery**

The site of the Romano-British low status farmstead and cemetery, occupied from c350-c420 AD, at Bradley Hill, Somerton, Somerset, was extensively excavated from 1968-1970 and in 1972 by R. Leech (1981). Bradley Hill is situated about 8.8 km north west of the former Roman town of Lindinius or Lindinae (modern Ilchester). It is in an area having, in the Roman period, a diversity of settlement with an exceptional concentration of wealthy Roman villas and a predominantly rural population occupying farmsteads, villa estates and villages. The cemetery which is on the site appears to be the burial place of 55 of the inhabitants from the farmstead.

Although published relatively recently (1981), many palaeopathologists would caution against analyses of the type offered. Few are now confident of the ability to age adult remains at all closely. Indeed, it would be instructive to have this material re-examined and re-published. However, at the time of publication it offered a very detailed and immensely interesting analysis of a sizeable and seemingly closed community. The findings are as follows.

- The 55 burials associated with the farmstead comprise 10 adult males, 10 adult females, one female child and 34 infants.
• Examination of the remains revealed that 67 per cent of those born died before the age of four. After the age of four it was probable that the child would survive to adulthood.

• Only one of the Bradley Hill children died between four and about the age of 19.

• The 10 adult males, on average, lived 11 years longer than the 10 females.

• The youngest male died at about 20 years, the oldest at about 75 years.

• 30 per cent of the males died before the age of 35, but 60 per cent lived beyond the average life expectancy of 42.2 years.

• The youngest female died at about the age of 19, the oldest at about 45.

• 70 per cent of the women died before the age of 35, 80 per cent by the age of 40 and all by the age of 50.

• The average life expectancy of a woman at 20 was only 39.9 years.

• It was estimated that for each generation of the population, the average family consisted of two adults, the male living to 42.2 years and the female to 30.9 years, and six children, four of which died at birth or in infancy and two lived to be adults.

As has been said in Chapter 2, assessing age at death by anthropometric means can with any certainty determine only whether the remains are young, adult or old. The use of more sophisticated analyses by experts in odontology, however, give rise to claims of more certainty in life span assessments.

Detailed examination of the bones revealed an unusually high number of cranial and skeletal anomalies common to many individuals and probably best explained as family
traits. The evidence suggests that the community was inbred to a considerable extent.

Two skeletons (F146 and F148) which did not display these anomalies were considered as probable incoming males.

Since the original study on the human material from Bradley Hill by Everton and Leech a generation ago, there has been remarkable progress in the use of DNA technology for kinship and population analyses based on archaeological skeletal remains. Were tooth samples available from the incoming males, a study of their aDNA with those of the putative inbred remains could provide supportive evidence about their possible progenitor role as well as giving some clue to their origins.

An approach was made to the Curator of the Somerset County Museum Service to obtain tooth samples, which included those from the incoming males. The Museum was willing to provide the samples with the proviso that the integrity of the teeth was maintained and they were returned after analyses. Sixteen specimens of the Bradley Hill teeth were received including two from the incoming males. The treatment of the teeth and the analyses made are described below.

*Extraction of aDNA from Bradley Hill Teeth*

The methodology adopted was as follows:

Recently extracted teeth from the Dental Hospital and dental surgeries were used first before attempting to extract aDNA from the archaeological samples in order to establish an appropriate methodology. The test teeth were stored at 4°C or 20°C until used to obtain samples of pulp or cavity material for the extraction of aDNA.
Modern teeth were pre-treated by soaking them in 3% hydrogen peroxide followed by 90% ethanol and then sterile distilled water for three minutes in each solution before air drying and storing in a sterile capped specimen container (Ginther et al 1992, 127). It was found (Schwartz et al 1991, 980) that teeth placed in hydrogen peroxide lacked native high molecular weight (HMW) DNA. The pre-treatment of teeth, therefore, was brought into line with the more common use of 5 % bleach for 5 minutes followed by an equal length of time in 70% ethanol with a final rinse in sterile distilled water. The teeth were exposed to UV irradiation for 20 minutes on each side before being drilled with a 1.5 mm drill to create a pilot hole into which a 1 mm drill was introduced to collect samples for analysis.

**Chelex as Method of Choice - Extraction Protocol.**

1. All steps were carried out in a laminar flow sterile cabinet.

2. All materials used were sterilized by autoclaving or by UV irradiation.

3. Using a dental drill and a 1.5 mm bit, the surface around the enamel dentine junction was eroded and a pilot hole drilled.

4. The drillings were removed with a cotton bud dipped in 5 % bleach and with a 1mm bit the hole was extended into the dental pulp, cooling the bit on dry ice every 5 – 10 seconds. The drilled residue was collected on a clean small plastic weighing tray and transferred to a previously weighed sterile 1.5 ml Eppendorf tube.

5. The tube was then re-weighed and the amount of tooth powder calculated.

6. In the laminar flow cabinet 15 ml of a sterile solution of 5 % aqueous Chelex 100 was kept in motion in a small beaker using a magnetic stirrer.
7. 500 µl of the Chelex was added to the powdered tooth residue.

8. Two negative controls, one containing 500 µl of Chelex, and the other 500 µl of Chelex in which the drill had been rotated after sterilizing and washing in 95 % ethanol and sterile distilled water.

9. A positive control was prepared using 3 µl of whole blood which had been added to 1 ml of sterile distilled water, left at room temperature for 15 to 30 minutes, centrifuged for 3 minutes at 10,000 to 15,000 x g, and the supernatant carefully removed and discarded. 5 % Chelex to a final volume of 200 µl was added and DNA extracted as in the following procedures (Walsh et al 1991, 509).

10. The test sample and the controls were vortexed for 1 minute and placed in a heat block at 56°C for 15 minutes.

11. Samples were vortexed for a further minute and then incubated for 10 minutes at 95°C, vortexed for a minute and centrifuged at 1400 rpms for 3 minutes. 400 µl of supernatant (a lesser amount for the positive control) were removed and transferred to a fresh sterile tube for storage at 4°C or -20°C until required for analysis.

Chelex 100

Chelex 100 was the method of choice to extract aDNA over the standard DNA extraction procedures. It contains fewer steps, that is, it requires fewer tube changes, the procedure is simple and rapid, and involves no inorganic solvents (Walsh et al 1991, 506; Akane et al 1993, 699; Woodward et al 1994, 246; Faerman et al 1995, 132). Some technical difficulties have been overcome with DNA typing by automated extraction methods.
which minimize the risk of modern DNA carry over (Hummel and Herrmann 1994, 210; Zierdt et al 1996, 192). Since the extraction of aDNA would be done manually Chelex extraction of DNA was adopted

"- - - Chelex 100 is as efficient or more efficient than using proteinase K and phenol chloroform extraction" (Walsh et al 1991, 506), and

" In our hands, direct DNA purification by Chelex from minute samples of bone/teeth powder gave the best results" (Faerman et al 1995, 327).

The above recommendations lend support to the choice of Chelex as an extraction agent.

Chelating resins such as Chelex 100 have the capacity to form complexes with metals and this can be of advantage in DNA preparation. Cell disruption and protein denaturation by boiling free DNA molecules as well as inactivating proteases, but have the disadvantage that DNA may be degraded by the catalytic action of metal ions. The addition of chelating ions such as Chelex 100 before boiling, it is suggested, prevents DNA degradation (Ellegren 1994, 212). The resin must be pipetted while in suspension. This can be achieved by pipetting with a large bore pipette tip (1000μl) from a stirring suspension, for example, 15 ml of 5% aqueous Chelex agitated in a small beaker with a magnetic stirrer and stir bar (Walsh et al 1991, 508; Ellegren 1994, 212). The choice of this procedure was further dictated by the limitations imposed in obtaining a sample of tooth powder and yet maintaining the integrity of the tooth.
DNA Analysis of Bradley Hill Teeth

In order to preserve the integrity of the archaeological teeth from the Bradley Hill cemetery it was necessary to consider methods of extracting aDNA in a manner that would cause minimal damage to the specimens. Among the methods of doing this are:

1) bisecting the tooth at the junction between the enamel and the dentine and extirpating the pulp cavity (Smith et al 1993, 1197; Sweet and Hildebrand 1998, 1199) (see figure 13, page 104),

2) vertically splitting the tooth and removing the pulp (Drancourt et al 1998, 12637) or

3) drilling a pilot hole in the region between the crown and the roots followed by a smaller hole to remove powdered tooth (Woodward et al 1994, 244; Faerman et al 1998, 862).

Although bisecting the tooth horizontally or vertically to remove dental pulp and dentine for aDNA analysis and then cementing both halves to restore the tooth has been done, I was not confident, in this instance, of doing it successfully. As I wished to keep faith with the museum curator and had expectations of obtaining other archaeological teeth for further studies, I chose to use the protocol of Woodward et al (1994) as the more conservative approach.
Figure 13 Extirpating tooth pulp cavity for DNA analysis
PCR amplification and Mitochondrial Sequencing of aDNA

DNA is found within both the mitochondria and the nucleus of the cell. Although there is only one copy of genomic DNA per cell, there are 600 to 1000 more copies of Mitochondrial DNA (mtDNA). Although nuclear DNA is inherited from both parents, and genetically more diverse than maternally inherited mtDNA, mtDNA has a higher rate of mutation and thus, the sequence will gradually change from generation to generation. Mitochondrial sequencing can thus be used to reveal the relatedness between two individuals. In the present study, nuclear DNA was targeted in the amplification of the Major Histocompatibility Complex, Beta Block by GMT (Tay et al, 1995, 381) and Human Growth Hormone. The GMT method identifies a polymorphism that can be used to distinguish between individuals. HGH PCR is a nested method that involves two rounds of amplification. This method was employed as nested PCR can usually produce results from smaller than optimal quantities of DNA (Bein et al, 1992). MtDNA was also amplified for sequencing (Calafell et al, 1996, 37). In some cases the original Chelex method of extraction (see page 100) was modified through the addition of proteinase K or guanidinethiocyanate, as indicated (Kulski et al, 1998; Hoss and Paabo, 1994).

Following Chelex extraction DNA could not be quantitated by spectrophotometry. DNA was added directly to the PCR reaction, except in cases where micro concentration was used, as indicated.

Mitochondrial Sequencing (Calafell et al, 1996, 37)

The following PCR protocol was used from Calafell et al, 1996.
FWD Primer (MT M13F): 5'-TGTAACGACCGCCAGT-3'

REV Primer (MT M13R): 5'-CAGAAACAGCTATGACC-3'

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Volume (μL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 X PCR buffer</td>
<td>1</td>
</tr>
<tr>
<td>4 x 5mM dNTPs</td>
<td>0.25</td>
</tr>
<tr>
<td>25mM MgCl₂</td>
<td>0.6</td>
</tr>
<tr>
<td>Primer 1</td>
<td>0.2</td>
</tr>
<tr>
<td>Primer 2</td>
<td>0.2</td>
</tr>
<tr>
<td>Taq Polymerase (Amp Gold)</td>
<td>0.1</td>
</tr>
<tr>
<td>DD water</td>
<td>1.65</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4</td>
</tr>
</tbody>
</table>

4μL of Master Mix is added to 6μL of DNA

The following PCR cycle is used,

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Step</th>
<th>Temp °C</th>
<th>Time</th>
<th>No. Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>94</td>
<td>10-15M</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>94</td>
<td>45s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>66</td>
<td>40s</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>72</td>
<td>40s</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>1</td>
<td>72</td>
<td>5M</td>
<td>1</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>4</td>
<td>1s</td>
<td>1</td>
</tr>
</tbody>
</table>

PCR products were then checked on a 1.5% agarose gel, sequencing followed, when positive results were obtained (Calafell et al, 1996).

**GMT PCR**

The following protocol was used from Tay et al, 1995 and Gaudieri at al, 2001.

FWD Primer (CLHGE3)
5' ACA AGC CCC CAG AAT TCT GCT T 3'

REV Primer (CLHGE4)
5' GAC TAT CCA GAA GCT ACA GCT ACT C 3'
10μL of Master Mix is added to 10μL of DNA.

The following PCR conditions are used.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Step</th>
<th>Temp °C</th>
<th>Time</th>
<th>No. Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>95</td>
<td>2M</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>94</td>
<td>10s</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>55</td>
<td>10s</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>3</td>
<td>72</td>
<td>30s</td>
<td>35</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>72</td>
<td>2M</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>4</td>
<td>1s</td>
<td>1</td>
</tr>
</tbody>
</table>

**HGH PCR**

The following nested PCR Protocol was used from Bein et al, 1992. For the first round of PCR the following primers were used.

FWD Primer 5’ CAG TGC CTT CCC AAC CAT TCC CTT A 3’

REV Primer 5’ ATC CAC TCA CGG ATT TCT GTT GTG T 3’
DNA from the 16 Bradley Hill teeth, 4 samples obtained from a mid 19th century gravesite in Ontario, and modern control samples were used. The results of DNA analysis are summarised in table 3. Modern controls produced positive results for HGH, GMT and mtDNA analysis. The four teeth from the Ontario gravesite failed to produce any results when mtDNA sequencing was conducted. Furthermore, a negative result was also obtained for Mitochondrial and GMT PCR of the Bradley Hill teeth.

Table 3.

<table>
<thead>
<tr>
<th>No. Teeth</th>
<th>Origin</th>
<th>Extraction</th>
<th>Primer</th>
<th>Result</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Modern</td>
<td>Chelex</td>
<td>HGH</td>
<td>+</td>
<td>Nested PCR (1)</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>+ Prot K (7)</td>
<td>&quot;</td>
<td>-</td>
<td>&quot;</td>
</tr>
<tr>
<td>3</td>
<td>&quot;</td>
<td>GMT (2)</td>
<td>&quot;</td>
<td>+</td>
<td>&quot;</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>mtDNA (3)</td>
<td>&quot;</td>
<td>+</td>
<td>Pulp</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>Chelex</td>
<td>&quot;</td>
<td>+/-</td>
<td>Horizontal Section</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>+ GuSCN (5)</td>
<td>&quot;</td>
<td>+</td>
<td>&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Ontario 19th Century</td>
<td>Chelex</td>
<td>&quot;</td>
<td>-</td>
<td>Nested PCR (1)</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>-</td>
<td>Pulp cavity</td>
</tr>
<tr>
<td>1</td>
<td>&quot;</td>
<td>+ Prot K (4)</td>
<td>&quot;</td>
<td>-</td>
<td>&quot;</td>
</tr>
<tr>
<td>16</td>
<td>Bradley Hill, aDNA</td>
<td>Chelex</td>
<td>&quot;</td>
<td>-</td>
<td>Micro concentrated</td>
</tr>
<tr>
<td>6</td>
<td>&quot;</td>
<td>GMT (6)</td>
<td>&quot;</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

(1) Bein et al, 1992
(2) Tay et al, 1995
(3) Calafell et al, 1996
(4) Kulaki et al, 1998
Quantity of Sample for Extraction

The limitation on the amount of tooth material obtainable, imposed by the need to maintain the integrity of the tooth sample, resulted in an average of 10-12 mg, an amount considerably less than the 100-1000 mg used by other investigators (Fisher et al 1993, 62; Hagelberg 1994, 197; Brown et al 1995, 182; Burger et al 1999, 1723). It should be noted, however, that minute samples of less than a milligram of tooth powder have been successfully used for aDNA using the Chelex method of extraction (Faerman et al 1995, 330). This would appear to be the exception rather than the rule when extracting aDNA from teeth and bone.

Inhibition of the PCR

Fulvic and humic acids and other contaminants found in the soils, wherein the human remains are found, form compounds with the limited amounts of aDNA present to inhibit enzymatic amplification in the PCR (Richards et al 1993, 25; Handt et al 1994, 527; Tuross 1994, 530; Hanni et al 1995, 651; Hummel and Schultes 2000, 8). The presence of an inhibitor in ancient extracts renders them, in most cases, impossible to analyse (Handt et al 1994, 527; Hanni et al 1995, 652) unless the inhibitor can be removed by dilution or another extraction technique. It has been shown that the reproducibility of aDNA preservation and amplification success varies with the conserving environment (Burger et al 1997, 1725; Herrmann and Hummel 1997, 43). Tests to detect the presence of inhibitory agents by titrating Bradley Hill tooth extracts (98/2421c) against cultured cell DNA extractions (R85/1518B {8.1 AH}) showed no inhibition (see figure 14, page 110).
Degradation of aDNA

As has been said previously in chapter 6 DNA is degraded by hydrolytic and oxidative changes. DNA because of its hydrophilicity remains hydrated even in dry climates and hydrolytic damage will occur. All studies have shown that the molecules are reduced in size and that they are seriously affected by oxidative changes (Handt et al 1994, 524). In addition some conditions, such as in a frozen or anaerobic burial site, may increase the chances of DNA survival. Post-mortem sequence defects, which may have arisen as the result of burial conditions (eg. depurinations, transitions) as well as the absence of sufficient target DNA, will negate a PCR analysis. Dot Blot quantitation analysis of the DNA content of the Bradley Hill teeth shows no product at 39 picograms per µl or greater. Studies are emerging that many widely applied aDNA extraction techniques do
not fulfil the requirement of providing maximum DNA yields in quality and quantity, particularly in autosomal STR and mitochondrial DNA analysis. It is thought that these protocols miss considerable amounts of DNA bound up within a specimen and do not provide the yield that could be achieved (Schmerer et al 1999, 1712; Hummel and Schultes 2000, 5-6).

Even after concentrating the extraction by Centricon filtration and increasing the number of amplification cycles of the PCR (Rameckers et al 1997) the ancient samples failed to amplify indicating that the aliquots showed more than average DNA degradation and/or the amplification sub-normal for yet to be determined reasons. Fragment lengths which may be detected by automated DNA sequencing are absent in the electropherograms, figure 15, page 112, after 35 and 55 cycles for a Bradley Hill tooth, unlike the positive control from cultured cells. GMT primers were used for all analyses. A comparison is seen in figure 16, page 113, where the electropherogram of an analysis of aDNA obtained from 3,000 year old skeletal remains found in a Bronze Age burial site (courtesy of Dr Gaudieri) shows identifiable DNA sequences. Ancient DNA was extracted following the procedure used (Baron et al 1996) by her collaborators at the Institute for Anthropology, Gottingen, Germany.
Figure 15. Electropherograms showing DNA profiles of a Bradley Hill tooth 2423Q) and a negative control amplified over 35 and 55 cycles compared with cultured cells.
Conclusion

From the results of extracting the Bradley Hill teeth it is concluded that aDNA was not present in determinable quantities. Inhibitory compounds, as discussed in the foregoing paragraphs, were not detected. A study wherein there is no caveat on the quantity of tooth material that may be extracted for target aDNA could be more rewarding.
Chapter 8  The Conclusion

Introduction

As we saw in Chapter 1 there is a diversity of opinion about the level of sophistication in farming, trade and culture of the people of Iron-Age Britain. Early classical historians would have us believe that only in areas close to continental Europe where there was social contact through conquest, trade and migration was there any form of centralised proto-urban society. Those at the periphery of these locations were in the eyes of Caesar, Strabo and others either hunter-gatherers or primitive agriculturalists. Archaeological studies, however, disprove these commentaries and we find evidence of cultivated lands, nucleated settlements and pottery (Megaw and Simpson 1979, Renfrew 1987, Millett 1992, Jones 1996). These studies indicate a more technically and socially advanced society, supportive of a viable and populous community in the PRIA and are at odds with the sparse literary reports of contemporary writers. The contention that the people of southern Britain were the only socially developed inhabitants of the country bordered by essentially underdeveloped primitives cannot be upheld by developments in archaeology (Megaw and Simpson 1979, Hingley 1992, Millett 1992). The evidence about the people of PRIA and Roman Britain, their demographic features and what ailed them has been studied through written reports (many of them second hand), epigraphic data and anthropometric analysis of the mainly skeletal remains found in various burial sites scattered throughout the country. Knowledge of the physical appearance, life expectancy and morbidity of the people from the evidence available is limited particularly from the PRIA period. This may be explained by the absence of literate indigenous communicants and informed contemporary observers from other cultures in surviving written or epigraphic testimonies. The Romans brought
literacy to the Britons but the survival of creditable word pictures, demographic features and ways of life of the people during their occupancy, though better than the earlier period, is still limited. Physical and fragmentary evidence derived from archaeology and anthropology would appear to offer a more direct means of providing an identikit of these early Britons. DNA lineages derived from genetic analysis of modern Britons have been used to extrapolate and define the origin of their putative ancestors. DNA obtained from the skeletal remains of ancient burial sites can confirm the ancestral information provided by the extrapolation of the descendants’ DNA and support and advance what is presently believed about our ancestry from palaeopathological, archaeological, anthropological and literary sources (Drancourt 1998, Cavalli-Sforza 2000, Sykes 2001).

The number of people living in PRIA Britain hypothesized from historical and archaeological analyses, particularly in the discovery through aerial and ground surveys of extensive regional settlements, is much more than has been previously estimated. Population estimates based on settled areas with their propensity for food production combined with evidence of the favourable climatic conditions have led to their re-thinking. Calculations based on these revised findings add substance to a hypothesis of a PRIA population in the order of 2 million. A doubling of the population in the Roman period may be justified from the evidence of further increased land use, improved technology, centralized government with internal peace and stability and assimilation of Roman and provincial military and other settlers. The decline in optimal population expansion may be seen and inferred following the end of the Roman occupation. Although not immediate, the collapse of a formerly orderly society was followed by anarchy, famine and pestilence with nature adding its share to the woes beginning perhaps in the third or fourth centuries. The population went into decline, not
recovering its former numerical strength, until the sixteenth century on what may be
deduced from the fragmentary evidence of early medieval writers like Gildas.
The people of PRIA and Roman Britain as seen from literary and archaeological
sources have much in common with their continental neighbours in northwest Europe.
These Iron Age people who occupied an area from the Shetlands in the west to the river
Elbe in the east and from the North Sea to the Alps and Spain in the south were known
to the Greeks and Romans as Celts or Gauls. The origin of the name arising from what
the Greeks called Keltoi or outsiders, that is, people on the other side of the Alps. Apart
from their culture and language the Celts do not appear to have a common ethnicity,
although described by writers in the classical period as being taller and fairer than the
Romans. The people of Britain conversely are not called Celts by the Romans but are
said to have a similar language to them.

_Celts or Iron Age People_

The dissemination of Iron Age cultures and language among the inhabitants of
northwestern Europe and Britain has been linked to trade and migration. Trade with
more technically advanced buyers of raw materials such as metals, hides, wool, salt,
among others, were exchanged for refined and luxury goods such as fine pottery,
Drinking vessels, metal work, wine, olives, figs, etc. These items were used to foster
networks of exchange in technical skills and alliances as well as underwriting elite
dominance.

Overpopulation among the Iron Age people or Celts and a breakdown of the West
Hallstatt social structure are believed by ancient historians like Livy to be responsible
for their mass migration across Europe from the sixth to the third centuries BC
(Cunliffe 1997, 69).
Is quod eius ex populis abundabat, Bituriges Avernos Senones Haeduos Ambarros Carnutes Aulercos excivit. Profectus ingentibus peditium equitumque copiis in Tricastinos venit.

"Taking out with him the surplus population of his tribes, the Bituriges, Avernii, Senones, Haedui, Ambarri, Carnutes, and Aulerci, he marched with vast numbers of infantry and cavalry into the country of the Tricastini".

(Livy, V. 34.5)

There is literary and archaeological support for migrations of Celtic speaking people from northwestern Europe eastwards and southwards to the Middle Danube, the Black Sea, Asia Minor and Iberia. This movement was halted and overrun by Roman, Dacian, Sarmatian and Germanic pressures from all points of the compass around 200 BC (see figure 6, page 57). The evidence for a large-scale movement of people to Britain from the Continent is debateable. Cunliffe (1997, 273) suggests that communities in the western periphery up to the Atlantic coast and beyond escaped these predatory movements because of long standing networks of reciprocal exchange with the elite dominant zone. Organising the movement of large numbers of people to cross the English Channel would be much more difficult, I believe, than travelling by a land route. Moving east and south would be, I suggest, the preferred option as history itself records. Further, there is little or no archaeological proof to support any invasion or movement of people to Britain at this time in the numbers described for contemporary migrations on the Continent.

The acquisition of Celtic as a common language can be understood by the development of a *lingua franca* through trade and exchange as described in Chapter 4 and its eventual development into a common language with various dialects being located geographically through varying degrees of isolation of the speakers. The evidence for
the spread of the Hallstatt and La Tène cultures in Britain by migration is insufficient
and the claim refuted on existing archaeological findings. Trade, demand and the innate
skills of native craftsmen are the likely answers to the apparent ubiquitous language
and culture of Iron Age Europe appearing in Britain. Britain’s superficial
Romanization, in comparison to mainland Europe, is responsible, perhaps, for the
continuation of Celtic as a language long after it disappeared from the Continent.

*Molecular Genetics*

Molecular genetics offers a way of investigating the origins of the people of the PRIA
and Roman Britain. From the maternal perspective on the modern population of Europe
through mitochondrial DNA (mtDNA) analysis, Richards et al (1996) and Sykes (1999
and 2001) have postulated the time of arrival and likely origins of their ancestors from
genetic frequencies. In their investigation they identified seven clusters or lineages into
which 95 per cent of modern Europeans may be grouped. The age of the clusters has
been estimated to be between 45,000 and 10,000 years. Individual ages of the different
lineages have been calculated through the medium of the molecular clock whereby a
single mitochondrial DNA mutation is said to occur every 10,000 years. Consequently
by looking at the number of mutations in the mitochondrial control region of each
lineage or cluster it is possible to work out the time it took each cluster to reach its
present stage of complexity. Averaging the number of mutations found in the seven
disparate lineages of present day native Europeans, it was calculated that the older the
cluster the more changes had occurred over the millennia. Conversely, younger
clusters, not having the same time span, would not have accumulated as many changes,
and the DNA sequences within them would be closer (Sykes 2001, 196).

In the paternal perspective, Y-chromosome analysis of European radiation has lagged
behind mitochondrial DNA studies because of a lack of informative and easy to type
markers. The limitations of Y-chromosomal population studies in accurately determining dates of dispersal have been another factor. These limitations are being overcome as additional single-nucleotide polymorphisms (SNPS) are identified and more accurate locus specific microsatellite mutation rates are determined. Even so emerging similarities in the geographic patterns of autosomal, mtDNA and Y-chromosomal variation are pronounced and there appears to be congruence in the results of all three systems in determining the peopling of Europe (Lell and Wallace 2000, 1379).

From the results of the foregoing population studies in the context of the present work, it is likely that the palaeolithic hunter-gatherers spread throughout the Continent after entering it via the Middle East and perhaps from North Africa some 50,000 years ago. It seems unlikely that the initial migrants spread to northernmost Europe or Britain, unless they had adapted to the prevailing extreme climatic conditions or in an interval in one of the glaciation periods. Retreating from an adverse environment survivors may have sought refuge in Southern Britain or further south in Europe. The end of the last glaciation period around 12 thousand years ago or earlier may have seen some intrepid souls find their way to Britain across ice bridges as may be construed from lineages extrapolated from present day inhabitants. Analysis of aDNA extracted from a tooth of the “Cheddar Man”, who is said to have lived 7,000 years before the arrival of farming in Britain, that is 12,000 years ago is indicative of this migration (Sykes 2001, 196).

From the mitochondrial DNA analysis of the human gene pool of Europe the major cluster or lineage dispersed throughout the continent at the conclusion of the last glacial period. Some 10 to 12,000 years ago, based on the same analysis, another cluster emerged as part of the agricultural revolution from the Middle East (Richards et al 1996; Sykes 1999, 2001). In the fifth millennium this later group of farmers, from archaeological evidence based on Linearbandkeramik (LBK) pottery, domestication of
animals and agriculture, brought their culture from the Plains of Hungary to Central Europe. Strontium isotope ratio analysis of human skeletal remains found in two early neolithic cemeteries circa 5500 BC at Flomborn and Swetzingen in the Rhine Valley gives support to this hypothesis (Price et al 2001, 593-596). The LBK cultural movement along the Danube Valley into Central Europe, like the pottery of the Impressed and Cardial Ware culture found along the Mediterranean and Atlantic coastlines, provides a linkage in the suggested divergence of agropastoralism throughout Europe (Renfrew 1987) in concordance with present genetic studies. On the basis of geographical and climatic conditions, the populating of Britain would have occurred later than Central Europe.

**Arrival of Agriculture**

The arrival of agriculture in the British Isles whether by colonization or indigenous adoption is important in determining the origin of their peoples and their number. Population numbers until the introduction of agriculture, which is said to have arrived about 6,000 years ago (Cavalli-Sforza et al 1994) would be low. If the genetic mix in Britain is assumed to be not dissimilar to that of the reported European mitochondrial genetic pool, then only 20 per cent will have descended from neolithic agriculturalists of the Middle East. They need not have come, however, directly from there but by descent from traders and colonizers who made their way to Britain along the Danube Valley or Mediterranean and Atlantic littoral.

Agriculture evolved in widely dispersed parts of the world, from China to the Americas, and obviously was not disseminated by colonizers from the Middle East so that indigenous adoption is not an unlikely scenario. An exchange of technologies, no doubt, expedited its development with a minimal exchange of genes. That there was some exchange of genes whether by colonization or residential movement through
intermarriage is evident from phylogenetic studies of the population. Agriculture changed the productivity of the land permitting population densities 50 times that of a hunter-gatherer society within a millennium of change (Cavalli-Sforza et al 1994, 107), so that a population of two million would not be inconsistent during the PRIA.

*Molecular Genetic Studies on the Ancient People of Britain*

The future holds promise that molecular genetic studies on surviving skeletal remains, particularly teeth, of the people of PRIA and Roman Britain will clarify and complement archaeological findings based on present and yet to be unearthed burial sites. The population history of the era from molecular genetic analyses of putative descendants needs to be corroborated with those who lived at that time. This can be achieved by better extraction of aDNA from hard tissues, the avoidance of contamination (particularly modern DNA) and reproducible results. Methods for determining the viability of aDNA in archaeological specimens are available and it is anticipated that they will improve to save futile analyses on unproductive material and foster greater use of the technology.

Analyses focusing on the maternal and paternal European lineages such as the mtDNA and the Y-chromosome have shown varying histories (Goldstein 2001). Evidence of genetic diversity in Europe based on mtDNA and nuclear loci is controversial in that the latter is seen as interpreting a crucial role for the Neolithic demographic transition (Simoni et al 2000, 262; Barbujani and Bertorelle 2001, 24).

The use of the Genomic Matching Technique (GMT) is based upon matching polymorphic sequences within the MHC. The MHC consists of a number of frozen blocks, which are passed through each generation and provide a signature, which is itself derived from the amplification of duplications and the complex and reproducible interaction of duplicated and polymorphic sequences for the typing of aDNA samples.
The use of this technology offers a system that is frozen and predictable, where recombination and mutation are suppressed and sex effects have not been demonstrated. Many of the present controversies, I believe, may be overcome through its use.

*The Population of the Period*

The population of PRIA Britain, as concluded in the thesis, was significantly greater than previous historians have revealed. Archaeological studies show that there is conclusive evidence of agricultural use of the land and at a level capable of supporting the suggested figure of 2 million. The increase in numbers under Roman rule, after a decline in the conquest period, gained impetus from the resultant pacification and stimulation of productivity and technology to meet the demands of imposed and local needs. The post-Roman population, through a variety of reversals including system collapse, new invaders, climate deterioration and pestilence, went into decline not to recover until the Middle Ages.

*Future Developments in the Study of the People of the PRIA and Roman Britain*

- Studies on human history can be supported and enhanced by the analysis of aDNA, but so far have been limited by technical problems arising from contamination and reproducibility (Pääbo 1999, 126; Cooper and Poinar 2000,113). As an indication of the interest in this field of study the Max Planck Institute of Evolutionary Anthropology opened in early 1998 and will be moving into a new $30 million facility in 2002. Geneticist Svante Pääbo has built a state-of-the-art aDNA laboratory from his share of a $7.8 million Institute budget. It confirms that extracting aDNA is challenging and requires painstaking use of PCR in a laboratory shielded from modern DNA (Pennis 2001,1246).
• Archaeological teeth provide a reservoir of DNA preserved, in the main, from the ravages of time and the environment. Such a source of aDNA, when complemented by improved extraction methodology, should overcome existing problems with its analysis.

• Improved molecular genetic analyses of aDNA will contribute additional and supportive evidence to present archaeological research on the origin and ethnicity of the ancient population and perhaps problems of/questions/debate on demic diffusion and innate development. Interestingly, with DNA testing becoming relatively commonplace in the last few years, costs, particularly of some reagents are declining rapidly as more use is made of the technology in medicine, agriculture and forensic science. The spin-off will make its application more readily available to archaeological, anthropological, and historical research

• Some controversy exists over results in European population studies obtained from mitochondrial, Y-chromosome and nuclear DNA. Analyses using genetic markers such as the MHC GMT offer a possible better identification of kinship and ethnicity, and perhaps separate migrants from the indigenous population of the LPRIA and Roman Britain. For example present analyses based on mitochondrial diversity in the European human gene pool show a great similarity in the population (Simoni et al 2000, 263).

• As more PRIA/Romano-British/Anglo-Saxon burial sites are uncovered, such as those in the Winchester area, advances in molecular genetic analysis should provide the archaeologist and historian with supportive genetic evidence to assist in resolving the origin and ethnicity of the people of PRIA and Roman Britain who lie there.
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