

Is it necessary to assume an apartheid-like social structure in Early Anglo-Saxon England?

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It has recently been argued that there was an apartheid-like social structure operating in Early Anglo-Saxon England. This was proposed in order to explain the relatively high degree of similarity between Germanic-speaking areas of northwest Europe and England. Opinions vary as to whether there was a substantial Germanic invasion or only a relatively small number arrived in Britain during this period. Contrary to the assumption of limited intermarriage made in the apartheid simulation, there is evidence that significant mixing of the British and Germanic peoples occurred, and that the early law codes, such as that of King Ine of Wessex, could have deliberately encouraged such mixing. More importantly, the simulation did not take into account any northwest European immigration that arrived both before and after the Early Anglo-Saxon period. In view of the uncertainty of the places of origin of the various Germanic peoples, and their numbers and dates of arrival, the present study adopts an alternative approach to estimate the percentage of indigenous Britons in the current British population. It was found unnecessary to introduce any special social structure among the diverse Anglo-Saxon people in order to account for the estimates of northwest European intrusion into the British population.

Keywords: historical demography; inverse method; migration; Britons; Belgae; Germanic people

1. INTRODUCTION

It is now commonly accepted by archaeologists and historians that most, if not all, of the invasion groups arriving in Britain, from the Romans to the Normans, were relatively small migrations of vigorous people who used force and fear to control the considerably larger indigenous population. Although major battles and massacres took place, there was no mass extermination of the indigenous Britons as was once thought (Davies 1999; Richards 2000): the new settlers assimilated with their indigenous neighbours. The problem is to reconcile the relatively small number of Germanic people who arrived in Britain during the Early Anglo-Saxon period (AD 430–730) according to archaeological evidence with the relatively large northern European immigration (approx. 500 000 and above) implied by Weale *et al.* (2002) and Capelli *et al.* (2003). Weale *et al.* (2002) considered the possibility that the immigration of Germanic people occurred as a gradual process over many generations, including the possible input of Belgae and Roman-Frisian mercenaries; however, they concluded that the best explanation for their findings was a massive migration of Germanic men into central England, contributing 50–100% of the male population at that time. Capelli *et al.* (2003) estimated that this immigration contributed approximately 40% over the same period.

Thomas *et al.* (2006) suggested that the Early Anglo-Saxon kingdoms imposed a sexual apartheid-type system on their British subjects for up to 15 generations (approx. 400 years), causing the immigrant Germanic population to grow more rapidly than the indigenous British population. The authors presented four main arguments to support their hypothesis: two theoretical arguments based on the migration context and the relative sizes of the

two groups, and two evidential arguments based on textual and skeletal evidence. However, the underlying assumption that significant northwest European immigration only occurred during the Early Anglo-Saxon period is problematic. For instance, according to Oppenheimer's (2006) interpretation of the same genetic evidence, most of the immigration could have occurred *before* the Anglo-Saxon period.

2. THE THEORETICAL AND EVIDENTIAL ARGUMENTS

(a) *Theoretical arguments*

Thomas *et al.* (2006), following Weale *et al.* (2002), assumed that the Germanic genetic input into Britain was only significant during the Early Anglo-Saxon period, and that no significant intermarriage occurred between the British and Germanic peoples. An examination of the broader migration context requires a more detailed consideration of the historical, archaeological and linguistic evidence than provided by Thomas *et al.* (2006). Much of this evidence is subject to continual debate; however, the following brief historical reconstruction provides an alternative valid interpretation of the historical and archaeological sources for the migration context than considered by Thomas *et al.* (2006).

Addressing the arguments by Thomas *et al.* (2006), and describing the wider migration context, requires the clarification of certain terms, some of which are still debated. In this paper, the term Briton refers to those people living in Britain before the Roman invasion of AD 43, and their descendants. They were not homogeneous people, but a mixture of tribes of Palaeolithic Britons, Neolithic 'Celts' and Belgae (Morris 1973; Bassett 2000). The term Saxon was a generic term used by Britons, and Continental writers of the day, to describe all Germanic

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invaders or immigrants whatever be their Continental tribal origins, whether Saxons, Angles, Jutes, Frisians, Franks or whoever (Malone 1929; Morris 1973). This meaning of Saxon, used by Gildas writing in the sixth century AD, continued in the various Celtic languages, for which the word for English nationality is derived from the word Saxon, e.g. the Gaidhlig loanword Sassenach (Saxon) is occasionally used disparagingly by Scots when referring to the English. The English language itself is referred to in Welsh as Saesneg, in Cornish as Sowsnek and in Breton as Saozneg, all derived from Saxon. The various Germanic peoples themselves referred to the Britons, and other non-Germanic-speaking people, as Wealh or Wylisc (Welsh) meaning foreigners (to the invading Germanic tribes rather than to Britain itself; Morris 1973; Wolfram 1997; Ward-Perkins 2000).

The various Germanic tribes were not genetically homogeneous: they accepted people of other ethnic backgrounds provided they adopted the tribal culture. The various Germanic tribes in Britain referred to themselves collectively as Engle or Englisc (English; Malone 1929; Morris 1973). Anglo-Saxon is a more recent term with multiple meanings, referring sometimes to either the Germanic invaders or, as used in this paper, the final mixed Britons and Germanic peoples in Britain, among other meanings (Malone 1929). It is misleading to talk of the Britons and Anglo-Saxons as two clearly different, homogenous groups: in reality, the situation was much more complex (Morris 1973; Ward-Perkins 2000). It is also a mistake to concentrate just on intermarriages between the various groups of people: the emphasis should be on interbreeding, inside or outside of marriage, such as that due to fornication, adultery, prostitution or rape. In these cases, it is unlikely that any resulting child would have taken the identity of the father, as stated by Thomas *et al.* (2006). For instance, in the later Medieval period, births outside of marriage were not uncommon and crossed social boundaries (Pattison 2007).

(i) *Pre-Roman period*

Recent genetic surveys show that the majority of present-day Britons of British descent descend from Palaeolithic hunter-gatherers who travelled north along the Atlantic coast and crossed the land bridge to Britain from southwest Europe during the later stages of the last ice age, *ca* 7500–15 000 years ago (Torrioni *et al.* 1998; Wilson *et al.* 2001; Oppenheimer 2006). DNA studies indicate that relatively small numbers of Neolithic farmers from northwest Europe settled in Britain between *ca* 5500 and 6500 years ago, possibly contributing 20–25% to the then population of Britain (Miles 2005; Oppenheimer 2006). A re-examination of radiocarbon records by Gkiasta *et al.* (2003) suggested that Neolithic culture arrived in Britain between *ca* 5000 and 6200 years ago, mainly by indigenous adoption rather than by colonization. Employing the phylogenetic network approach of evolutionary genetics to historical linguistics, Forster & Toth (2003) estimated that the Celtic language arrived in Britain *ca* 5200 ± 1500 years ago. Although the lexical-phylogenetic method has been criticized, it is supported by independent analysis by Atkinson & Gray (2006*a,b*), who used a Bayesian Markov Chain Monte Carlo approach to estimate that the Celtic language reached Britain *ca* 6100 years ago. From the overlap of these four estimated

periods, the Celtic language was probably introduced into Britain by Neolithic farmers, rather than the nineteenth century view that they only arrived during the Iron Age in the early first millennium BC. In this paper, the Palaeolithic Britons and Neolithic immigrants are collectively referred to as *indigenous* Britons.

The Germanic peoples originated from the proto-Germanic peoples of the Northern Bronze Age culture centred in central northern Germany and southern Scandinavia between *ca* 1700 and 450 BC (Schutz 1983). A comparative linguistic analysis based on the first sound shift indicates that Germanic languages developed as a group *ca* 500 BC (Schutz 1983; Wolfram 1997; Todd 2004). Considerable archaeological evidence in the form of burial rites, rock face carvings and goods and skeletal material found in graves, moors, former lakes, ponds and old river beds reveals that these people had continuously occupied these lands from Neolithic times, which ended in north Europe *ca* 1800 BC. There exists no evidence of further movement of people into this area although their culture became increasingly influenced from the south (Mariën 1971; Schutz 1983; Todd 2004). Archaeological evidence also reveals considerable and long-lived trade in amber, bronze, slaves and possibly furs between the Germanic peoples and southern Europe, including via Spain and Holland (Schutz 1983; Todd 2004).

From approximately the sixth century BC, Germanic people spread slowly across Europe occupying the land east of the Rhine and north of the Danube by Roman times when they came into contact with Celtic tribes who were slowly expanding north and northwest from their homeland in central Europe (Schutz 1983; Todd 2004), or in southwest Europe according to Oppenheimer (2006). Linguistic evidence, based on word borrowings, indicates close political and cultural ties between Celtic and Germanic peoples in pre-Roman times (Schutz 1983). In particular, Germanic people came in close contact with Celtic tribes in northern France and the Low Countries, where a slow intermixing of the neighbouring Celtic and Germanic peoples eventually produced hybrid people who claimed descent from Germanic people, yet had adopted much Celtic culture (Hawkes & Dunning 1930; Birchall 1965; Hawkes 1968; Mariën 1971; Schutz 1983).

These hybrid people became known as Belgae, living in the area that became the Roman Province of Belgic Gaul, a region that included present-day Belgium, and were well established in their new territory by 110 BC (Mariën 1971; Schutz 1983). The Belgae were in contact with Britain, to where some had migrated during the first and second centuries BC (Hawkes & Dunning 1930; Birchall 1965; Hawkes 1968; Morris 1982; Manley 2002; Miles 2005). There were several large Belgic tribes in southern England by the time of Julius Caesar's first incursion in 55 BC. This was supported by Oppenheimer (2006) who, employing principal components analysis, identified a close genetic similarity between modern Belgians and the southern English. The population of Britain must therefore have received a significant northwest European genetic contribution *before* the Roman invasion of AD 43.

(ii) *The Roman period*

The use of Germanic mercenaries in Roman armies was initially limited, but grew over time. The invasion

of Britain in AD 43 involved a Roman army of 40 000–48 000 men, including possibly over 10 000 Belgic Gauls and Batavians, another Germanic tribe from northwest Europe (Hassall 1970; Morris 1982; Manley 2002; Miles 2005). During the first and second centuries AD, the garrison of Britain consisted of between 45 000 and 60 000 men, with approximately 10 000 men from the Roman provinces of Belgic Gaul and Lower Germania (Holder 1982; Phang 2001). After more than a century of relative peace, the Roman army was reorganized into stationary border garrisons (Dobson & Mann 1973; de la Bédoyère 2001). The Hadrian's Wall garrison consisted of approximately 11 000 men, with a total force within three days march of approximately 20 000 men (de la Bédoyère 2001). The army of Britain was maintained largely by drafts from the Rhine provinces of Belgic Gaul, and Upper and Lower Germania (Dobson & Mann 1973; Holder 1982; de la Bédoyère 2001; Phang 2001). Germanic mercenaries even arrived from outside the Roman Empire (Dobson & Mann 1973), and by the fourth century AD had become the mainstay of the Roman army, with many becoming high-ranking officers (Holder 1982).

Until AD 197, Roman soldiers were banned from marrying, although the ban was not strictly enforced (Holder 1982; de la Bédoyère 2001; Phang 2001). Furthermore, Roman soldiers were not expected to be celibate: sex was common with female slaves and prostitutes (Phang 2001). Roman soldiers also consorted with women living near the garrison forts (de la Bédoyère 2001). Owing to the long period of service, some 20–25 years, soldiers formed close ties with their stations, marrying and raising families, and largely losing contact with their original homes (Dobson & Mann 1973; Holder 1982; de la Bédoyère 2001; Phang 2001; Manley 2002).

During the fourth century AD, small mobile field armies were established: largely recruited from free Germanic men from outside the Roman Empire (Dobson & Mann 1973). These soldiers were billeted with civilians in towns and cities across Roman Britain providing many opportunities for consorting with British women (Holder 1982). The greater part of the garrison army remained in Britain after the break with Rome in AD 410 (Morris 1973; Holder 1982), after which these soldiers were no longer paid or supplied by Rome (de la Bédoyère 2001). Presumably, they were employed by local British magnates to continue to defend Britain and gradually merged into the British population. From the above, these Germanic mercenaries must have made a considerable genetic input into Britain during the approximately 400 years of Roman occupation.

(iii) *Early Anglo-Saxon period*

Saxons had been raiding the coast of Britain well before Anglo-Saxon times, occasionally in concert with Irish, Picts and Franks (Miles 2005). Britain successfully defended itself for some decades after its break with Rome until approximately the mid-fifth century AD when a large coordinated assault of Irish, Picts and Saxons was anticipated; and the British then requested the help of Germanic mercenaries to defend Britain (Morris 1973). Increasing numbers of Germanic mercenaries arrived including Frisians, Danes, Saxons, Jutes, Angles and Franks. After the expected attack was averted, civil war broke out among the Britons, with both sides employing mercenaries. Intermarriage occurred between Britons and mercenaries—even the British leader

Vortigern married the daughter of Hengest, the leader of the mercenaries (Morris 1973).

Many Germanic mercenaries, however, joined by recent arrivals, began to revolt against the Britons. The majority of Britons in the occupied areas submitted without resistance, some collaborating and rising to positions of high status within their adopted tribe, creating the Anglo-Saxons. In the early sixth century AD, there were some generations of peace when British and Anglo-Saxon kingdoms coexisted, with further intermarriage. These kingdoms differed from each other in many ways, but all were mixtures of Germanic and British people. The different cultures and languages were not insurmountable obstacles to mixing, as assumed by Thomas *et al.* (2006) (Morris 1973; Ward-Perkins 2000). Fighting between the various kingdoms resumed by mid-sixth century AD, and by the eighth century the Anglo-Saxons gained complete control of England (Morris 1973). Romano-British culture had all but disappeared in Britain by the time of the revolts of the Germanic mercenaries and they had no reason to adopt it (Ward-Perkins 2000; de la Bédoyère 2001); however, the Anglo-Saxons continued to use a range of Romano-British civic forms and structures, such as field boundaries, estate structures, animal husbandry, systems of assessment and tribute collection, building methods and designs, and political units (Morris 1973; Arnold 1997; Hamerow 1997; Bassett 2000; Ward-Perkins 2000).

It is often alleged that the Celtic language contributed little to the English language; however, this may be mistaken originally due to the nineteenth century English bias to German culture and language. It now appears that Celtic influences affected the syntax, and to a lesser extent phonology, of early English rather than its vocabulary (Filppula *et al.* 2002). Even so, Breeze (2002) identified, for the first time, numerous English words derived from the Celtic language. More recently, Oppenheimer (2006) proposed the alternative view, based partly on the lexical linguistic work of Dyen and Forster and partly on other historical evidence, that the eastern Britons spoke a Germanic language before the Roman occupation and that it survived through the Roman period. Clearly, the migration context was more complex than that assumed by Thomas *et al.* (2006). In particular, the evidence suggests that British culture was not supplanted by Germanic culture, but that a gradual blending of the two gave rise to the new Anglo-Saxon culture.

The argument concerning the relative sizes of the two groups—Britons and the Germanic people who arrived during the Early Anglo-Saxon period—is conceded, and, as discussed below, estimates obtained in the present study agree with those of Thomas *et al.* (2006), namely, a 'native population in the region of two million' and 'migrating populations in the Early Middle Ages are between tens and low hundreds of thousands'.

(b) *Evidential arguments*

Thomas *et al.* (2006) presented two evidential arguments—a textual source, the law code of King Ine of Wessex and skeletal evidence, including grave goods—in support of their hypothesis that the Britons were forcibly segregated from the Germanic invaders, with no significant intermarriage between the two groups, during the Early Anglo-Saxon period. As stated above, the various

Anglo-Saxon kingdoms were not homogeneous groups: they showed a great variety of different customs, as different among themselves as between them and the Britons. The various Anglo-Saxon kingdoms fought among themselves as much as with the British kingdoms; indeed, Anglo-Saxon and British kingdoms formed alliances whenever it was to their mutual advantage (Ward-Perkins 2000). The smaller kingdoms combined to form larger kingdoms (Bassett 2000). There is evidence that the Britons and Anglo-Saxons in Wessex did mix and intermarry (Morris 1973; Ward-Perkins 2000).

Given this background, the law code of King Ine of Wessex may be interpreted differently from that proposed by Thomas *et al.* (2006). A more reasonable alternative interpretation is that the laws, which assigned Welsh Britons a lower economic and legal status than that of other members of the kingdom, were to encourage Britons to fully join the kingdom and not be ‘foreigners’: that is, to cease being ‘Welsh’. At the time that King Ine codified his laws, *ca* AD 690, the West Saxons had recently gained new territory from the Britons in Devon and southern Somerset, and the laws would have encouraged these newly conquered Britons to integrate quickly into the general population of the kingdom. With recurrent warfare between rival kingdoms, solidarity within a kingdom would have been crucial to its survival (Arnold 1997).

A similar strategy was employed by the Moorish Caliphate in Medieval Spain: Jews and Christians were subject to a special tax—the *jizya*, which Muslims did not pay—in an endeavour to encourage non-Muslims to convert to Islam. According to the Qur’an (1990), non-Muslims who refused to pay the tax, were required to either convert to Islam or face the death penalty. The ethnicities of the people involved were of no concern. Similarly, the distinction between Briton and Anglo-Saxon was based on cultural and linguistic choices rather than descent (Ward-Perkins 2000). In the sixth and seventh centuries AD, Britons who wanted to improve their status in Anglo-Saxon kingdoms would have had to give up being identifiably British, in both appearance and speech (Higham 1992). Britons in the western midlands voluntarily joined the Anglo-Saxon kingdom of Mercia, meaning that from the seventh century AD they would be counted as Anglo-Saxons, despite being mainly of British descent (Bassett 2000). It is notable that King Ine of Wessex claimed King Cerdic, a Briton, as an ancestor (Morris 1973; Myres 1986; Ward-Perkins 2000). In summary, such law codes do not necessarily support the interpretation that they were to establish an apartheid-like system against the Britons, as argued by Thomas *et al.* (2006): indeed, their aim may have been the exact opposite, to encourage integration.

The skeletal evidence in support of the argument that the Anglo-Saxons and Britons were reproductively separate, is, as conceded by Thomas *et al.* (2006), circumstantial, being based on the study of Härke (1990) who proposed a stature differential between men buried with and without weapons in Early Anglo-Saxon England: those with weapons were Germanic immigrants and their descendants, whereas those without were predominantly Britons. This argument was supplemented by the less reliable evidence of a greater number of grave goods found in the graves of those buried with weapons than those without, being taken to indicate the economic advantage

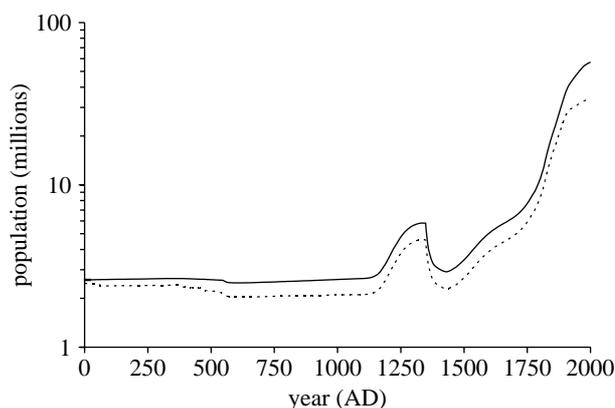


Figure 1. The solid curve represents the original total population P for Britain over the last two millennia (based on Pattison 2003). The dotted curve represents the modified population P_C for the descendants of the indigenous British population (excluding 25% of the British Belgae).

of the Germanic immigrants and their descendants over the British. However, as acknowledged by Thomas *et al.* (2006), this argument is possibly circular, as grave goods such as weapons are the main identifier of a grave as being that of either a Germanic or British person: indeed, Arnold (1997) warned against these simplistic interpretations of grave goods. Härke (1990) assumed that weapon burial in the period of interest was an exclusive Germanic rite; however, it is possible that Britons, who had adopted Anglo-Saxon culture, would also have adopted Germanic burial rites.

Given the confusion and uncertainty regarding the origins and numbers of arrivals of the various immigrant groups to Britain, it was considered in this study to be more fruitful to attempt an examination of the population growth of the indigenous Britons and their descendants over the past two millennia. Then the difference between the indigenous core and the total population should represent the immigrant peoples and their descendants, most of who originated from northwest Europe.

3. MATERIAL AND METHODS

The total population data for Britain used in the present study are based on that of Pattison (2003), although with a smaller population between AD 350 and 1100 that represents the population decline following the peak in the Roman period, the occurrence of plague *ca* AD 550/1, and by a slow recovery to the Roman period peak value by the eleventh century AD, as suggested by Morris (1973). The average trend in the population of Britain over the past 2000 years is shown as a solid curve in figure 1: the data are reasonably accurate for the period after AD 1801 when regular census surveys commenced. For the period prior to AD 1801, the total population curve represents the best available average trend compiled using data from numerous sources (see Pattison 2003).

To estimate the amount of migration to Britain, the total population curve shown in figure 1 was modified to give the curve for descendants of the pre-Roman indigenous sub-population of Britain (dotted curve in figure 1). The indigenous component P_C of the total population of Britain P was estimated using an inverse method similar to the back-projection method employed by Wrigley & Schofield (1989), as developed by Lee (1974). That is, for each generation in turn, starting from *ca* AD 1 (before the Roman invasion

of Britain) and working forward in time, the indigenous sub-population P_{CN-1} in generation $N-1$ was calculated from the indigenous sub-population P_{CN} in generation N using versions of the equation,

$$P_{CN-1} = (P_{CN} + NI - NM),$$

where NI , the natural increase, is given by (crude births–crude deaths), and NM , the net migration, is given by (emigration–immigration). Reasonable estimates of NI for England and Wales are available only after AD 1540, based on parish records of baptisms, marriages and burials: estimates after AD 1837 are more reliable again, based on civil registrations of births, deaths and marriages (after AD 1855 for Scotland). Reasonable estimates of NM for Britain are available from AD 1820, when records of migration commenced. Estimates for periods earlier than those mentioned above are somewhat less reliable (see [Pattison \(2007\)](#) for further details).

As the first step in the calculations, the pre-Roman indigenous population was estimated by subtracting from the total population an estimate of the number of Britons of Belgic descent who arrived from northwest Europe between *ca* 150 BC and AD 1. Britain had an estimated total population of 2.6 million in AD 1, of which 2.0 million were in present-day England ([Pattison 2003](#)). This estimate is in agreement with that assumed by [Thomas *et al.* \(2006\)](#). From [Hawkes & Dunning \(1930\)](#), a maximum of approximately 20% of the area of England was occupied by the British Belgae at that time. To take into account the slightly higher population density usual in southern England compared with the rest of Britain, the population of the Belgic territory was taken as 25% of the population of England, i.e. 0.5 million. It was then assumed that 25% of this sub-population was Belgic and thus from northwest Europe: consequently, the percentage of Britons of recent northwest European descent for the whole of Britain in AD 1 was taken as 5%. Next, all known British historical events that affected the population size, including the deaths of indigenes in battles, due to the raids, invasions and occupations of the Romans, Irish, Anglo-Saxons, Vikings and Normans, as well as deaths in civil wars, overseas military expeditions and due to major plague out-breaks, were estimated and taken into account in the calculations where appropriate. Migration was generally small before AD 1540; however, there were three large migrations of Britons to Brittany during the Late Roman and Early Anglo-Saxon periods, AD pre-600, and the return of a large group of their descendants during and after the Norman conquest of AD 1066. The calculations were extended up to AD 2001.

As in the study of [Thomas *et al.* \(2006\)](#), the modelling here is necessarily only an approximation. Estimates only are possible for many of the historical events included in the modelling—actual values will never be known; however, the lack of perfect data should not mean that a start cannot be made with the modelling. The modelling is relatively easy to handle when the data and algorithms are entered in a spreadsheet enabling the data to be readily adjusted when new or more accurate data become available, or to experiment to see how making changes to particular data affect the resulting indigenous population curve. For many of the events listed above, order of magnitude estimates were adequate. An averaging effect also occurs, in which unintentional overestimates for some events are partly compensated by unintentional underestimates for other temporally nearby events. A copy of the spreadsheet is available from the author upon request.

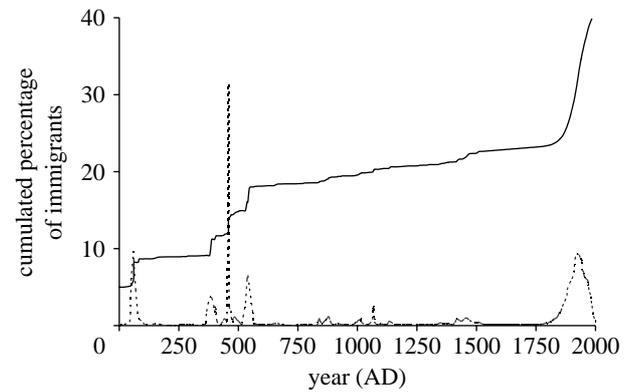


Figure 2. The solid curve represents the cumulated percentage of immigrants and their descendants in Britain over the past two millennia. The dotted curve represents the three-point smoothed percentage rate of growth of the immigrants and their descendants per year (the curve has been magnified by a factor of 50).

4. RESULTS AND DISCUSSION

It is clear from [figure 1](#) that the main decrease in the indigenous component of the total British population started by *ca* AD 1900 when large-scale migrations to Britain commenced. The estimated percentages of people of pre-Roman indigenous descent in Britain are 60% in 2001 and 64% in 1950. These values are not unreasonable compared with the geographically weighted average value of 59% for all Britain calculated from the Y-chromosome results in [Capelli *et al.* \(2003\)](#). Only the study of [Capelli *et al.* \(2003\)](#) is of interest here, as it was a more extensive survey of Britain than that of [Weale *et al.* \(2002\)](#). Effectively, [Capelli *et al.* \(2003\)](#) measured the Y-chromosome make-up of Britain *ca* 1950, before the large African/Asian influx of the 1950s and 1960s. These results agree well considering the assumptions made in determining the indigenous sub-population curve, particularly the conservative value of 5% used for the percentage of people in Britain of Belgic descent before the Roman conquest. If this percentage value is increased, then the result for the percentage of indigenous genetic contribution in Britain would be in even better agreement with that of [Capelli *et al.* \(2003\)](#).

The difference between the two curves in [figure 1](#) represents the number of immigrants to Britain and their descendants, the majority of who, before 1950, came from the Continent, with many being of northwest European origin. The accumulated percentage of the total population, of these immigrants and their descendants is shown as a solid curve in [figure 2](#). Also shown, as a dotted curve, is the three-point smoothed percentage annual rate of growth in the number of these immigrants and their descendants (these values have been multiplied by a factor of 50 to aid readability). The largest peak is 0.63%/year in *ca* AD 459, although this was short-lived. The estimated net percentage of immigrants and their descendants, as obtained by the method employed in this study, for the entire Early Anglo-Saxon period (AD 430–730) is approximately 6.2%. This value compares with [Oppenheimer's \(2006\)](#) estimates of 5.5% for England and 3.8% for all of the British Isles. The corresponding estimated number of immigrants arriving during this period is approximately 175 000, which includes the Irish immigrants that settled in western Britain, such as the Dal Riada Scots in Kintyre.

This amounts to an average arrival rate of approximately 580 immigrants/year over the whole Early Anglo-Saxon period. The number of arrivals is within the range now commonly assumed for the elite replacement theory, and within the range mentioned by Thomas *et al.* (2006) for the Early Medieval period. The estimate of 175 000 immigrants into a population of approximately 2.6 million for Britain is lower than that of Härke (1990), who estimated an invasion of approximately 250 000 into a population of approximately 1–2 million for England based on burials, and considerably lower than the genetics-based estimates of Weale *et al.* (2002) and Capelli *et al.* (2003).

For comparison, the estimated net percentage of immigrants and their descendants, obtained for the whole Roman period (AD 43–410) is approximately 6.8%, a figure comparable with that of the Early Anglo-Saxon period and clearly should not be ignored. The corresponding estimated number of immigrants that arrived during this period is approximately 175 000, representing an average arrival rate of approximately 480 immigrants/year over the whole Roman period. These arrivals were not just Roman soldiers, but also camp followers, bureaucrats, merchants, craftsmen, etc., and their descendants, from all over the Roman Empire. As discussed above, these included many Germanic people, especially during the Late Roman period. Similarly, the estimated net percentage of immigrants and their descendants, obtained for the whole Viking period (AD 793–1066) is approximately 2.3%. This value is lower than the 5% estimated by Oppenheimer (2006). The corresponding estimated number of immigrants during this period is 47 000, representing an average arrival rate of approximately 170 immigrants/year over the whole Viking period. This relatively low arrival number is not a complete surprise because, to the three groups of immigrants discussed above, the Vikings were the only group to be unsuccessful in their attempt to conquer all England. It took the full Danish army under Canute to conquer England in AD 1016, after which the army returned to Denmark.

Considering the rough estimates used in the modelling, it is noteworthy that the results for the three periods examined above are reasonable, being of the expected order of magnitude. In addition, people of northwest European descent continued to arrive in Britain after the Viking period. For instance, the Normans were predominantly Franco-Gauls with some Scandinavian blood. A large component of the Norman army of AD 1066 consisted of Flemings, a Belgic people, who, as mentioned by Thomas *et al.* (2006), accompanied the Normans in the later takeover of southwest Wales. During the Middle Ages, Flemish merchants also migrated to towns in both Scotland and England, contributing to the growth of British cities. German merchants of the Hanseatic League settled in Britain from the thirteenth to sixteenth centuries, and many other groups of people arrived in Britain from northwest Europe, including Dutch and French Huguenots in the sixteenth and seventeenth centuries, German refugees from the Reformation in the sixteenth century and the Thirty Years' War in the seventeenth century, Dutch for the drainage of Hatfield Chase in south Yorkshire and the Cambridge Fens in the seventeenth century, Germans during the Georgian eighteenth century, and many more in the nineteenth and

twentieth centuries. By AD 1914, according to Panayi (1995), Germans formed the largest non-English element in the English population after the Irish. The genetic make-up of the various immigrant groups that arrived in Britain is complex and may never be fully resolved.

The steady low-level immigration over the past two or more millennia from northwest Europe has had a cumulative effect that is clearly greater than that predicted in the simulation model employed by Thomas *et al.* (2006). It is possible that apartheid-type systems may have existed in some Early Anglo-Saxon kingdoms for short periods; however, the above analysis demonstrates that the DNA results of Capelli *et al.* (2003) can be explained without the need to invoke a prolonged apartheid-like social structure in all Early Anglo-Saxon kingdoms. In the words of William of Ockham: 'entia non sunt multiplicanda praeter necessitatem'.

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