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STUDIES ON SKELETAL AND DENTAL VARIATION: A VIEW ACROSS TWO CENTURIES

Don Brothwell

INTRODUCTION

It seems that every few decades there is value in reviewing research and progress in studies on earlier human populations. For the emphasis within a subject may change, with new avenues being explored or new researchers with different interests appearing on the scene. While human bioarchaeological research is broadly based, some of us have been especially involved over the years with human remains from British sites, and it would therefore seem an ideal subject to discuss here.

What follows is a summary overview of the work that has been undertaken on earlier British populations, beginning in the Pleistocene and finishing in the medieval period. This work extends back well over a century and has produced a vast literature. In the space available, an attempt will be made to highlight some of the main themes and results. It will be seen that the investigations have met problems and have raised as many questions as they have answered, but nevertheless they have also contributed to progress concerning the more general biology of past populations.

PLEISTOCENE BRITONS

Perhaps more than in most other parts of the world, claims for British Palaeolithic human fossils have had a controversial history. Investigations of cave sites began early, for instance the sites of Goat's Hole, Paviland and Kent's Cavern, Torquay, which began to be explored between 1823 and 1824.[1] While some finds turned out to be of questionable date, the so-called 'Red Lady' of Paviland is firmly Upper Palaeolithic (about 16 500 BC). By the 1870s, Mousterian artefacts and associated Neanderthal fragments had been found at Pontnewydd cave in Wales and other cave sites were also being explored.

Pleistocene sands and gravels were to contribute significantly, although again not without controversy. Red Crag sands at Foxhall, near Ipswich, produced a modern-looking mandible in 1855, sadly now lost.[2] The 90-foot Thames terrace at Galley Hill, Kent,[3] produced a skeleton in 1888 that interested palaeontologists, but which is now thought likely to be only Neolithic in date. Perhaps the most notable year for problematic finds was in 1912, producing the Halling skeleton from Brick Earth in Kent,[4] and the now infamous Piltdown skull from Sussex.[5] Neither is now seen as Pleistocene, but the Piltdown bones have at least provided a fine example of the scientific detection of a palaeontological fraud.[6]

Fortunately, the discovery of part of a 250 000-year-old human skull in a 100-foot Thames terrace at Swanscombe in 1935,[7] and recently teeth and part of a 500 000-year-old tibia at Boxgrove in Sussex[8] provides tantalizing but incomplete evidence of late *Homo erectus*, and a more advanced pre-Neanderthal form of hominid. While it is to the credit of English Heritage that considerable funds were made available to excavate areas of the Boxgrove quarry site, it raises two important issues for us all. First, United Nations-supported international law to stop quarrying at such world important hominid sites is long overdue. There is no doubt that many stone tools, much faunal material and perhaps more hominid remains have been lost at the Boxgrove site before the eventual termination of quarrying. The second issue is that, because of the removal of deep gravel deposits from critical parts of the site, the environment of some preserved potential hominid-yielding deposits has been transformed, and there is thus now great danger of accelerated weathering and decay.

It should be said that the biological significance of the Boxgrove hominid tibia is that its cortical robustness supports other evidence of a strongly built European *H. erectus* physique. On the other hand, the Swanscombe skull helps to establish significant cranial remodelling within the next 200 000 years, with increasing vault height and upper parietal bossing (a significant advance on the erectine level). The most controversial feature is perhaps the skull thickness, still viewed by some as a primitive trait, but which can surely only be used as an indicator of environmental stress.

HOLOCENE POPULATIONS

Let me now move on to studies on more recent British populations. Under the stimulus of antiquarianism, many excavations took place in the 19th century, although some were little more than plundering and treasure hunting. Fortunately, as a result of the influence of anatomists and other medical specialists, human remains were often saved for study, especially the skull. Thomas Bateman, for example, digging between 1848 and 1858, initiated a skeletal collection that remains today in Sheffield. Others followed, and some reported on and illustrated the cranial material, and even T. H. Huxley became involved.[9] Indeed, in 1865 Drs Barnard Davis and John Thurnam produced a large volume, *Crania Britannica*, considering 260 skulls of Neolithic to medieval date, pointing out that there were osteometric changes through time.[10]

Methodology was already being considered, and new techniques of recording explored. John Grattan, for instance, developed a contouring method as an alternative or extension of conventional measurement. More rigorous mathematical treatment of osteometric data was also needed, and Karl Pearson at University College London took up this challenge. For the next 40 years, his journal *Biometrika* was to provide detailed osteometric analysis, both of specific cemeteries and reviewing geographic areas.[11,12] To embrace multiple measurements in considering biological affinities of different populations, he devised the *coefficient of racial likeness* (CRL) – useful in its time, but now replaced by D^2, canonical analysis and principal component analysis. For all its faults, the CRL confirmed and extended on the conclusions of 19th-century biologists that there were micro-evolutionary differences between earlier British populations.

Surprisingly, following the Second World War, there were very few similar studies of British material and this work was largely kept alive by Dr Jack Trevor at the University of Cambridge. There is still a neglect of osteometric studies, but a real need to determine further the degree of regional variation and the finer details of changes through time. Contrary to the views of some prehistorians, the differences in physique tentatively established between the early Neolithic and Bronze Age peoples of Britain demonstrates that there was a considerable influx of distinctive Beaker/Food Vessel people into the country (see Mays, chapter 17, in this volume). What is more puzzling and demands far more investigation is that there are also noticeable changes from Anglo-Saxon to Norman times.[13]

There is still the possibility that osteometric measurements may at times assist in dating problematic skeletal samples. Such a series was excavated from one of the Five Knolls barrows in Bedfordshire[14] and was thought to be early Saxon, but the skeletal analysis eventually showed their affinities were with medieval groups; they are probably medieval gallows victims.

Regarding non-metric traits, the potential for using them is similarly far from realised (see Tyrell, chapter 18, in this volume). They were neglected until the late 1950s, and while some fluctuate in frequency through time, and can be used multifactorially to evaluate population distances between groups, there is an urgent need to consider their aetiology in more detail. While some traits may be under simple genetic control, oral tori in particular seem to be especially enigmatic and could be environmentally determined. As so often happens, these traits have been drawn into the basic methodology of investigating skeletons, and are even used to suggest family clustering in cemeteries,[15] which makes their further study even more urgent. It is correct to call these traits 'epigenetic' as none show simple Mendelian inheritance. Rather, they are the expression of genes affecting development, but are also influenced by environmental factors.

STUDIES ON DISEASE

Although early in the 20th century British anatomists and anthropologists were contributing significantly to the study of the health status of the ancient Egyptians, there was a puzzling absence of the same kind of detailed studies on early British populations. Pathology had, of course, been noted (reviewed by Brothwell[16]), but not in a systematic and comparative way. Again, it was not until the second half of this century that a range of studies on the evidence for disease appeared and, much to my concern, have somewhat overwhelmed other skeletal and dental research. So the literature on the palaeopathology of early British populations is now vast and growing, but in fact specific lines of research are still poorly funded. For instance, investigations on the survival of microbial DNA in different burial environments demand further research.

But for all the problems, a history of some diseases in early British groups is beginning to take shape. We now have quite a wide range of evidence, from clubfoot and Down's syndrome representing congenital abnormality, to increasing evidence of malignant tumours and even surgery. There is still much to debate. The impact and, indeed, the correct identification of environmental stressors on the skeleton are an area of current British research interest. For instance, was the Bronze Age child from Wiltshire,[17] with thickened skull and areas of surface remodelling, a victim of anaemia or rickets? How complex is the aetiology of orbital cribra? How can we distinguish the major factors causing Harris lines or zones of enamel hypoplasia? Perhaps osteoporosis, cortical bone loss, can be more simply investigated, and it has recently been searched for in early Londoners and a medieval village population (both with success[18]). But frequencies are low, compared with those which can occur for orbital cribra or Harris Lines.

The most neglected of the environmentally determined conditions is surely hypothyroidism. Regions of Britain are known to have been iodine-deficient in the past. We also know that iodine deficiency may cause not only cretinism in a population, but also less severe growth disturbance, so why have we not taken account of this in skeletal samples from goitrogenic areas?

Since the early days of skeletal biology, the classification and understanding of joint diseases has greatly improved, and most of the forms of arthropathy have been identified in human remains. Perhaps of special note is the fact that archaeological material has contributed significantly to establishing rheumatoid arthritis[19] as rare before post-medieval times, in the UK at least. Only in recent centuries has it reached epidemic proportions.

There are still interesting research problems concerned with joint diseases. We still neglect brucellosis arthritis, although it could display distinctive joint changes and may well have been common. And what of Schmorl's nodes? This anomaly was seen in the CT scans of the Lindow II bog body, and while the vertebral herniations are not usually clinically important, they *are* common in past populations, and can occur by later adolescence, and are surely indicators of biomechanical stress. At least, they deserve more detailed investigation.

Discriminating between different patterns of bone change caused by a number of major infectious diseases has gained the attention of researchers over the years.[20] Mycobacterial diseases, and especially leprosy,[21] had a significant impact on British medieval populations, and in fact extended well beyond the areas where leper hospitals were established. Its appearance in the south of England as far west as the Scilly Isles by later Roman-Dark Age times as well as in the far north, in the Norse community of the Orkney Islands (9th–12th century AD), suggests to me that there was not a single region of entry, but at least a kind of pincer movement, from both south and north.

The pathogens that have especially interested me are those causing treponemal diseases, including venereal syphilis. Three of the four clinical conditions produce bone changes and offer a special challenge in piecing together their micro-evolutionary history and relationships. In 1926, a site at Spitalfields Market in London produced a skull with advanced tertiary syphilis.[22] Unfortunately, it turned out to have a post-medieval date, but further discoveries have now been made, the first with a firm pre-Columbian date in York.[23] There is not space here to elaborate on the discoveries of probable treponemal disease in the UK or elsewhere, except to say that archaeology is beginning to contribute to an understanding of treponemal evolution. My own current view is that venereal syphilis is a late medieval, *newly evolved* form, probably derived from endemic syphilis in Southwest Asia. Its late appearance into Britain fits the hypothesis that the pathogen was late in adapting to populations living in colder northern European climates and societies, and had to become more aggressive and venereal in transmission.[24]

In some respects, prospects continue to improve for the study of ancient populations, whether in the UK or elsewhere, with CT scans, DNA analysis, and improved computer technology (see Brown, chapter 27, in this volume). In other respects, however, there may be growing problems. Funding is getting more difficult to find. Restrictions on X-raying living individuals, or in other respects being less able to study certain diseases in living peoples because they have become uncommon or extinct, limits studies on skeletal and dental changes. Growing restrictions on animal experimentation also make aspects of comparative pathology perhaps less promising for the future.

The cloud on the horizon, which will probably not go away, is the reburial issue. At a personal level the present author has had two British cemetery samples removed for reburial before full study, and the situation could get worse. There is therefore good cause to review where our studies have got to and which aspects deserve our special research efforts before it is too late!

REFERENCES

1 Oakley KP. The problem of man's antiquity. An historical survey. *Bulletin of The British Museum (Natural History): Geology Series* 1964; **2**: 85–155.

2 Collyer RH. The fossil human jaw from Suffolk. *Anthropology Review* 1867; **5**: 221.

3 Newton ET. On a human skull and limb bones found in the Palaeolithic terrace gravel at Galley Hill, Kent. *Quarterly Journal of the Geological Society of London* 1895; **15**: 246–263.

4 Keith A. *The Antiquity of Man*. London: Williams & Norgate, 1915.

5 Dawson C, Woodward AS. On the discovery of a Palaeolithic human skull and mandible in a flint-bearing gravel overlying the Wealdon (Hastings beds) at Piltdown, Fletching (Sussex). *Quarterly Journal of the Geological Society of London* 1913; **69**: 117–144.

6 Weiner JS, Oakley KP, Le Gros Clark WE. The solution of the Piltdown problem. *Bulletin of The British Museum (Natural History): Geology Series* 1953; **2**: 141–146.

7 Ovey CD (ed.). *The Swanscombe Skull: A Survey of Research on a Pleistocene Site.* London, Royal Anthropological Institute, 1964.

8 Roberts MB. Excavation of the lower Palaeolithic site at Amey's Earthen Pit, Boxgrove, West Sussex: a preliminary report. *Proceedings of the Prehistoric Society* 1986; **52**: 215–245.

9 Huxley TH. Notes upon the human remains from Keiss. In: S Laing, *Pre-historic Remains of Caithness.* London: Williams & Norgate, 1866: pp. 83–148.

10 Davis BJ, Thurnam J. *Crania Britannica*. London: Taylor & Francis, 1865.

11 Macdonell WR. A study of the variation and correlation of the human skull, with special reference to English crania. *Biometrika* 1904; **3**: 191–244.

12 Morant GMA. First study of the craniology of England and Scotland from Neolithic to early historic times, with special reference to the Anglo-Saxon skulls in London Museums. *Biometrika* 1926; **18**: 56–98.

13 Brothwell D, Krzanowski W. Evidence of biological differences between early British populations from Neolithic to medieval times, as revealed by eleven commonly available cranial vault measurements. *Journal of Archaeological Science* 1974; **1**: 249–260.

14 Dingwall D, Young M. The skulls from excavations at Dunstable, Bedfordshire. *Biometrika* 1933; **25**: 147–157.

15 Stead S. The human bones. In: IM Stead (ed.), *Iron Age Cemeteries in East Yorkshire*. London: English Heritage, 1991: pp. 126–139.

16 Brothwell D. The palaeopathology of early British man: an essay on the problems of diagnosis and analysis. *Journal of the Royal Anthropological Institute of Great Britain and Ireland* 1961; **91**: 318–344.

17 Brothwell D. The human remains from Avebery barrow G55, with special reference to the further evidence of a childhood deficiency disease in the Bronze Age. *Wiltshire Archaeology and Natural History Magazine* 1992; **85**: 141–144.

18 Mays SA. Age-dependent cortical bone loss in a medieval population. *International Journal of Osteoarchaeology* 1996; **6**: 144–154.

19 Rogers J, Waldron T, Dieppe P, Watt I. Anthropathies in palaeopathology: the basis of classification according to most probable cause. *Journal of Archaeological Science* 1987; **14**: 179–193.

20 Roberts C, Manchester K. *The Archaeology of Disease* (2nd edn). Stroud: Sutton, 1995.

21 Manchester K, Roberts C. The palaeopathology of leprosy in Britain: a review. *World Archaeology* 1989; **21**: 265–272.

22 Morant GM, Hoadley MF. A study of the recently excavated Spitalfields crania. *Biometrika* 1931; **23**: 191–248.

23 Dawes JD, Magilton JR. *The Cemetery of St. Helen-on-the-Walls, Aldwark*. The Archaeology of York, 12/1. York: Council for British Archaeology, 1980.

24 Brothwell DR. Microevolutionary change in the human pathogenic treponemes: an alternative hypothesis. *International Journal of Systematic Bacteriology* 1981; **31**: 82–87.

Section I

Juvenile health, growth and development

The study of immature human skeletal remains has arguably been a rather neglected area of osteoarchaeology. In part this reflects the often incomplete and fragmentary nature of such material, but it is also a manifestation of what has until recently been a broader neglect of the study of childhood in the past. However, as the chapters in this section illustrate, osteological studies of juvenile remains have the potential to make important contributions to the study of the archaeology of childhood, particularly in terms of growth, health and mortality. They also provide sensitive indicators of the general health of the population from which they came.

Determination of age at death is, of course, the foundation of most osteological analyses of immature remains, and Louise Scheuer and Sue Black begin this section with a discussion of methods for age determination in immature remains, and the processes of skeletal development and maturation upon which they are based. Louise Humphrey discusses the value of growth studies of archaeological material. Although growth rates are important indicators of the well-being of a population, results need to be interpreted with caution. Using a case study approach, she demonstrates the value of using a combination of different methodologies when comparing growth rates between populations. The health of juveniles is discussed by Mary Lewis, who considers the role of pathologies indicative of dental disease, specific and non-specific infections and metabolic disease in understanding children's lives in the past. The importance of assessing trauma is discussed, particularly in relation to such practices as child abuse or child labour. Such issues extend in importance beyond their obvious palaeopathological significance to indicate cultural values and practices. All authors in this section discuss the importance of recognizing the limitations of immature skeletal samples for making inferences about the past populations.

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DEVELOPMENT AND AGEING OF THE JUVENILE SKELETON

Louise Scheuer and Sue Black

INTRODUCTION

Death rates and life expectancies as revealed by a demographic profile are often used as a reflection of the health and well-being of a population. When attempting to reconstruct the lifestyle of past peoples, who are represented only by their skeletal remains, there are particular problems which are absent from the study of living populations.

It is rare for the sex and ages at death of the individuals that comprise a skeletal assemblage to be known and normally one of the principal tasks in the analysis of skeletal remains is to establish these two basic biological parameters. Another unknown factor is how far the remains constitute a representative sample of the population of which they formed a part. This has the potential to bias the age at death profile of the original population. The determination of sex, age at death and representativeness of the immature component of a skeletal assemblage requires a somewhat different approach from that in the adult and this chapter aims to examine some of the factors that affect their analysis in juveniles.

TERMINOLOGY

The terminology applied to different periods of an individual lifespan varies both in different countries, and as used by clinicians, evolutionary biologists and skeletal biologists and this can lead to confusion. Accepted definitions of the periods from the beginning of life at fertilization through the childhood years are shown in Table 1.

After this time usage begins to vary. *Puberty* is generally taken to be a physiological term describing the beginning of secondary sexual change, usually ranging from 10 to 14 years in girls and 12–16 years in boys. *Adolescence* is used by some authors interchangeably with puberty but by others to describe the behavioural and psychological changes that accompany it. Some paediatricians describe adolescence as the period from 13 to 19 years of age.[1]

Table 1 – Periods from fertilization through childhood.

Embryo	First 2 months of intra-uterine life
Foetus	Third month to birth
Perinate	Around the time of birth
Neonate	Birth to the end of the first month
Infant	Birth to the end of the first year
Early childhood	To the end of the fifth year
Late childhood	About 6 years to puberty

Two schemes commonly used by skeletal biologists vary in the terminology applied to the period between the end of childhood (14–15 years) and adult life which they defined as the time of closure of the spheno-occipital synchondrosis. Acsádi and Nemeskéri[2] call the period *juvenile* and Ferembach *et al.*,[3] for the Workshop of European Anthropologists, call the same period *adolescence*. However, the age ranges of between 17 and 25 years for the closure of the spheno-occipital synchondrosis that are quoted in most standard anatomical texts are almost certainly too late.[4–6] Recourse to the original literature describing the results of inspection of dry skulls, cadavers, histological and radiological investigations report this as occurring much earlier, on average between 11 and 15 years.[7–13] On this definition the whole of the juvenile or adolescent age range as defined by the two schemes would be eliminated.

In the UK and North America the terms *immature* and *sub*- or *non-adult* are sometimes used to describe any age that is not truly adult. Also in more recent publications the term *juvenile* is increasingly used in their place.[14–21] Here *juvenile* describes the whole age range from early embryonic to adult life. The terms in Table 1 are used for the earlier part of the range and *puberty* and *adolescence* are used interchangeably to describe the time of secondary sexual change. *Young adult* is applied to the period between the cessation of growth in height, signalled by fusion of the long bone epiphyses, to the final fusion of the late-fusing epiphyses such as those of the vertebral column, clavicle, iliac crest and jugular growth plate.

SAMPLING

It is unlikely that the number of skeletons in an assemblage will approximate to the total number of the population who lived and died in the vicinity of the burial place. Burial in a particular place is affected by a variety of factors including social and economic conditions and religious beliefs. After burial, subsequent skeletonization and preservation of bones are in turn affected by physical conditions and these may include temperature, type of soil, coffin design and disturbance by humans and predators. Even when an excavation is carefully planned, it is not always possible to recover all of the material in a good enough condition to contribute useful information towards sexing and ageing of individual skeletons. As a result, the age profile of the initial population will always remain uncertain. Some of the factors affecting sampling and their effects on recovery and reconstruction are discussed in more detail elsewhere.[22–24]

REPRESENTATIVENESS

It is a common observation that the number of juveniles is often lower than might be expected for a particular time and place and this can seriously bias the age profile drawn from any analysis of the assemblage.[25–28] Occasionally this supposition can be corroborated by documentary evidence. For example, it is clear from examination of the burial registers that the proportions of adults to children interred in the crypt of St Bride's Church, Fleet Street, London and the St Bride's cemetery are quite different. Therefore, any conclusions concerning the numbers of child deaths in the parish drawn from the age at death profile of the crypt collection alone would be invalid.[28] One known reason for the low number of juveniles is the custom of selectively excluding infants and young children from the main adult burial site for cultural, religious or economic reasons.[14,16,25,28] It has also been argued that the reason for low numbers of juveniles, especially infants, is due to the special physicochemical properties of their relatively fragile bones leading to poor preservation.[29–32] However, Sundick[33] believed that the principal reasons for low retrieval rate were deficiencies of skill on the part of the excavators and failure to recognize small, unfused parts of the immature skeleton rather than the nature of the material. Certainly detailed knowledge of the anatomy of the developing skeleton will lead to better awareness of the expected number of different elements and so improve recovery of juveniles.

Several methods have recently been tested in attempts to make use of juvenile material, which was previously thought to be too damaged to include in an analysis and so compensate in some way for small numbers of immature remains. Measurements of fragments of long bones, rather than total length, from Anglo-Saxon remains have been used successfully in a growth study[15], and a similar method increased sample size in an analysis of prehistoric Ontario skeletons by > 100%. Experience with two very different samples led to the recommendation of a population-specific model.[34] Another standardized method for analysing growth used any long bone that represented a single individual. This was included on a single plot to maximize information from all material vailable.[31]

GROWTH, SEXING AND AGEING

Growth consists of two factors: an increase in size and the attainment of consecutive levels of maturity but these two aspects do not necessarily advance in synchrony. For example, a boy of 6 years may be several centimetres taller than his friend of the same age. Similarly, two girls, both aged 14 years, can be at different stages of skeletal and sexual maturity.

Many factors affect the growth of the skeleton, and there is a great range of variability between different populations, between the sexes and between individuals of the same population. Part of this variation is genetically based but in many populations children subjected to adverse environmental pressures, chiefly those of undernutrition and exposure to disease, exhibit a slower rate of growth than their optimum potential.[35,36] Rates of increase in size and increase in maturity differ between the sexes and this is evident even before birth.[37,38] There are also differences in the timing of ossification of bones,[39] of bone mineral density,[40] peak bone mass[41] and mineralization and emergence of teeth.[42–46] As puberty approaches, differential hormone secretion increases sexual dimorphism. The