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THE INHUMED SKELETAL MATERIAL FROM AN EARLY ANGLO-SAXON CEMETERY IN WORTHY PARK, KINGSWORTHY, HAMPSHIRE, SOUTH ENGLAND

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RESUME
R. PERROT

Ce travail est, essentiellement, consacré à la paléopathologie du cimetière ancien, anglo-saxon, de Worthy Park, Kingsworthy, situé dans le Hampshire, à quelques kilomètres de la vieille ville romaine de Venta Belgarum (aujourd'hui Winchester).

La nécropole a été utilisée entre la fin du 5ème siècle et le milieu du 6ème, par une population métissée comprenant des Francs, des Britons, des Saxons et d'autres peuples d'origine germanique, mais il semble cependant, que les premiers inhumés correspondent à de sujets n'arrivant pas directement du Continent, mais de l'Est de la Grande Bretagne, vraisemblablement du Sussex.

Démographie et anthropologie.

99 individus ont été répertoriés : 32 hommes, 40 femmes, les autres étant indéterminables. On compte 71 adultes (de 18 à plus de 50 ans) et 28 jeunes (de la naissance à 18 ans).

A Kingsworthy (comme dans la plupart des communautés anglo-saxonnes primitives) il est possible de distinguer trois classes d'individus :

Classe A : guerriers et propriétaires terriens
Classe B : fermiers
Classe C : serfs et demi-affranchis.

La stature varie selon le statut social : dans la classe A, les hommes mesurent en moyenne 176 cm contre 170 pour l'ensemble B + C (soit + 6 cm). Il en est de même pour les femmes, où la moyenne A de 162 cm tombe à 160 pour B + C. Les sujets de A mesurent donc en moyenne 4 cm de plus que ceux de B + C. Cette différence pouvant être mise sur le compte d'une nourriture plus riche pour la classe A aussi bien pendant l'enfance que plus tard.

Paléopathologie.

. **34 variations anatomiques** sont retenues, parmi lesquelles le **métopisme** qui atteint 8,9 % des crânes.

. parmi les **anomalies congénitales** est remarquable le cas d'un sujet masculin présentant une **agénésie totale du membre supérieur** (gauche)

. **l'ostéoarthritis** concerne 53,3 % des hommes et 28,5 % des femmes pour le rachis et respectivement 50 et 23,1 % pour le reste du squelette.

. **l'ostéochondritis dissecans** concerne 14 individus (à égalité dans les 2 sexes) pour le membre inférieur (pied). Un seul cas se situe au niveau de l'épiphyse proximale ulnarienne.

. **12 fractures** ont été répertoriées avec certitude, 8 autres sont douteuses. Clavicule, fémur, fibula et patelle ne sont jamais concernés. C'est l'avant-bras qui est atteint en priorité.

. les blessures par arme blanche sont inexistantes.

. quelques observations permettent d'envisager des **maladies infectieuses** : périostite (8 cas), kyste sébacé infecté du frontal (1 cas), sinusite bilatérale (6 cas).

. 3 cas de **néoplasmes** : ostéome du rebord orbitaire (1 cas), carcinome de la voûte, améloblastome de la mandibule (ces deux cas étant douteux).

. 16,7 % des individus (et 22,1 % des orbites) montrent un **cribra orbitalia.** Cette affection concerne à 60 % les jeunes, et, parmi les adultes, les femmes.

. 15,5 % des dents sont tombées post-mortem ; 6,8 % seulement le sont ante-mortem : de faible % milite en faveur d'une hygiène buccale.
Les caries concernent 3,2 % de la population, davantage les hommes que les femmes (4,2 % contre 2,9).

. un certain nombre de maladies n'a pas été trouvé à Worthy Park : **rachitisme, scorbut, lèpre, tuberculose, syphilis, poliomyélite, tumeurs malignes, goutte.**

. en dehors de possibles extractions dentaires, **aucune chirurgie n'est décelable** en particulier, aucun cas de trépanation.

. **la cause de la mort est difficile,** voire impossible, **à diagnostiquer.** Une femme semble être morte des suites d'un accouchement difficile. Un enfant est (?) décédé d'hyperostosis spongiosa.

. concernant le **nombre de naissances** d'après l'aspect anatomique du bassin, il semble possible d'établir une moyenne de 2 à 3 enfants par femme.

. pour terminer C. WELLS aborde le probléme du **développement musculaire variable selon le sujet** et conclut, après un long exposé, qu'à un type physique donné correspond une activité musculaire précise qui va accentuer les caractéristiques morphologiques de l'individu.

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1 – INTRODUCTION
by Sonia CHADWICK HAWKES

Since the long delay between excavation and publication of this Anglo-Saxon cemetery was caused almost entirely by my refusal to go to press without a proper report on the skeletons, it will be appropriate here to give some account of the sequence of events, the problems encountered and the reasons why the publication of the osteological material takes the form it now does.

After excavation in 1961 and 1962, the human bones were sent direct to the Duckworth Laboratory in Cambridge. Here they were received by Mr. Bernard Denston, who was responsible for their reconstruction, and who filled out the data sheets, retained in the laboratory, on which are recorded the definitive measurements and preliminary observations about other aspects of the skeletons. The chief author of the final report was to have been Mr D.R. Brothwell, who was at Cambridge when the first batch of skeletons arrived but who was soon after posted to the British Museum (Natural History) in London. As a result, some skeletons and parts of skeletons were transferred to London, too, with the unfortunate consequence that a few cannot now be found.

In 1963, the writer was asked to finish the report on the Winnall II cemetery, only a mile or two from Kingsworthy, and since at that time it was planned to publish the two cemeteries in the same volume, Mr. Brothwell agreed to prepare a joint report on the two skeletal series. He completed a semi-final draft of it in 1966 but, when the writer asked for alterations and additions in the light of the archaeological findings, declined to co-operate further. Seven years now elapsed, during which the Winnall cemetery was published without any full skeletal report (Meaney and Hawkes, 1970) while the Kingsworthy report was laid aside. In 1973, Mr John Musty, Chief Laboratory Officer, Dept. of the Environment, and one of his officers, Mrs. Carole Keepax, kindly attempted to produce an amended version of the 1966 report which would be acceptable both to Mr. Brothwell and the writer. In this they were only partly successful : in 1974 the writer still had no basic data about the individual skeletons and the report contained no adequate reference to a number of skeletons, notably 26 and 38, which, from the time of excavation, had seemed to be of outstanding interest. The most positive step forward at this stage was the completion, by Miss Justine Bayley, from the Department of the Environment, of a report on the hitherto neglected cremation burials.

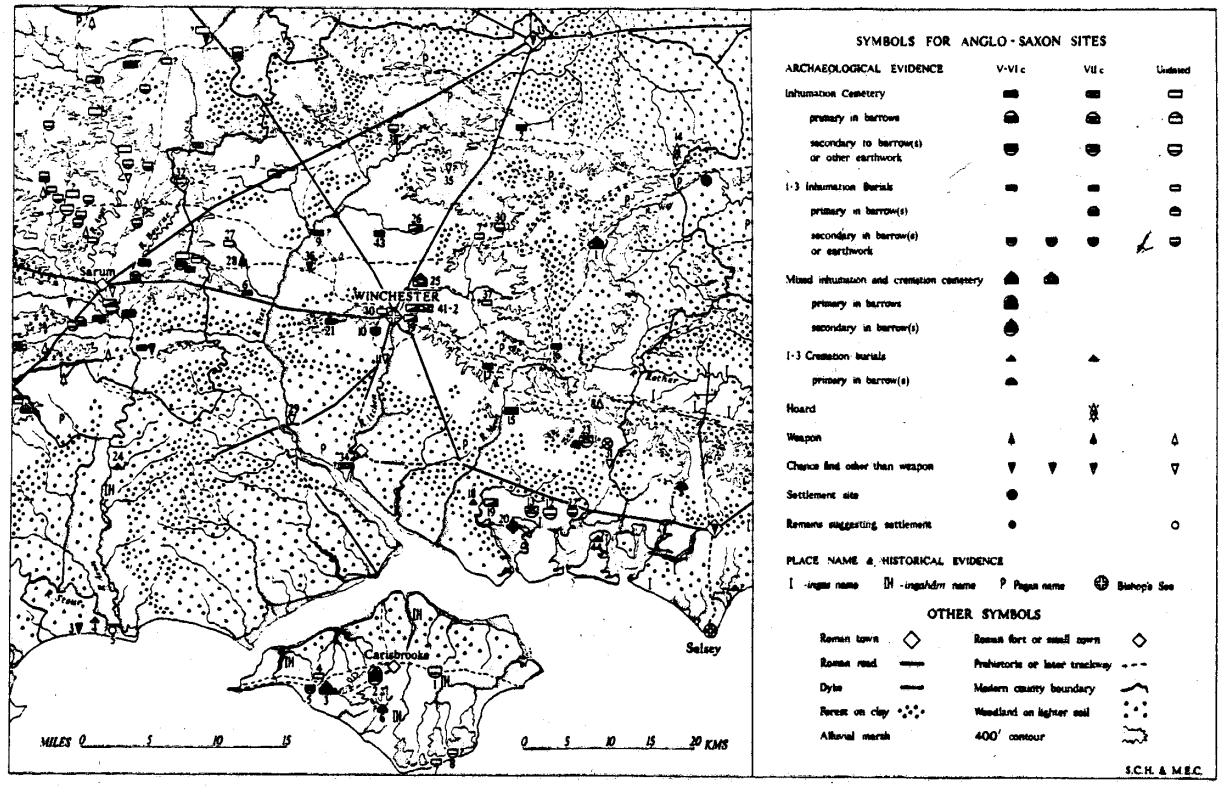
Towards the end of 1973 the whole business of the Kingsworthy skeletons entered a new and vigorous phase when the writer teamed up with Dr. Calvin wells. At first his help was confined to examining and writing up for publication articles on the problem skeletons, the child-birth case in Grave 26, the congenitally deformed man in Grave 38 and the possible case of rape in Grave 78 (Hawkes and Wells, 1975 a, 1975 b, 1976). But from these he came to be interested in the cemetery as a whole, and in 1975 he was persuaded, with the backing of the Department of the Environment, to write the report on the palaeopathology in the cemetery which is published below The task was rendered difficult for everyone concerned by the division of the skeletal material between Cambridge and London : with the help of Miss Rosemary Powers and Mr. John Musty, some was recovered from the British Museum, but some important items have still not been traced.

Nevertheless, Dr. Wells's report was substantially finished early in 1976. It was now realised that, in writing also of non-metrical traits and demography, he had exceeded expectations and that the areas of overlap and, to some extent, disagreement between him and Mr. Brothwell were too large to permit publication of both reports in the same volume. Discussion of this problem, with Mr. Brothwell's decision to publish independently, took until December 1977. Not until the summer of 1978 could the writer resume work on the final report on the cemetery, however, and then the tragic death of Dr. Wells on 31 July of that year persuaded the writer to delay things no longer. The collaboration with Calvin Wells had been a happy and rewarding experience, for which the best thanks now can only be prompt publication.

2 – THE SITE SUMMARIZED
by Sonia CHADWICK HAWKES

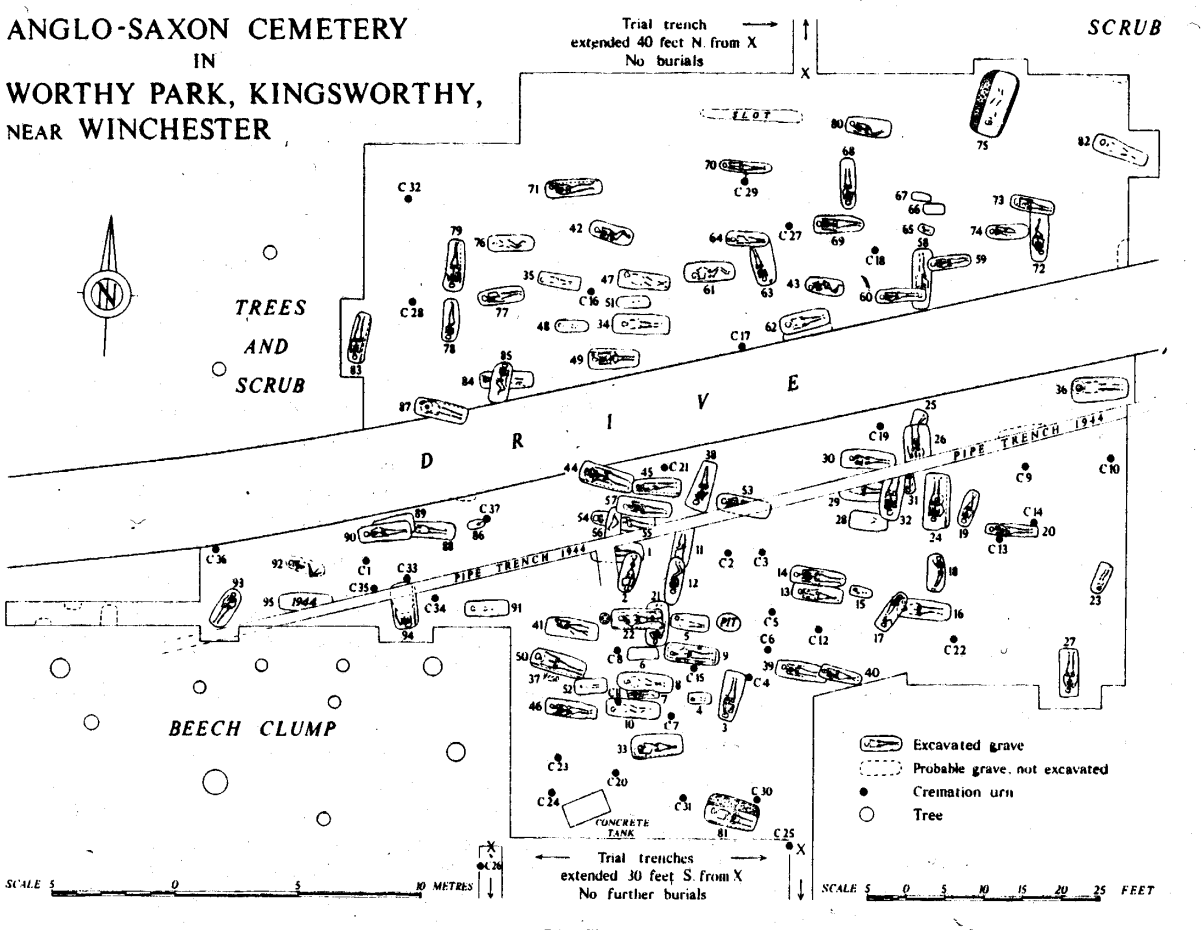
The Saxon cemetery in Worthy Park, Kingsworthy, is situated in Hampshire just three miles up the valley of the River Itchen from the old Roman town of Venta Belgarum, better known today as Winchester (Plan I). In the middle of the seventh century AD, after three centuries of near abandonment, Winchester became the capital of the emergent Saxon kingdom of Wessex. Before that, however, present archaeological evidence suggests that Germanic colonisation of the area was sparse. The cemetery at Kingsworthy (Plan II) is thus an important one. From their grave-goods, the people who first used this burial-ground arrived during the latter part of the fifth century and the latest burials on the side date from about the middle of the seventh century, by which time nearby Winchester had a Christian bishop. Our pagan cemetery was therefore in use for nearly two centuries.

The earliest burials seem to represent a small pioneering group of moderately well-to-do men and women who had come, not direct from North Germany or the Continent, but from further east along the south coast, perhaps from Sussex. Their ethnic



PLAN I — Hampshire from C 400 - 700 AD (1)

(1) The Worthy Park, Kingsworthy Cemetery is number 25, just north of Winchester



PLAN II

origins may have been mixed for there is evidence to suggest that the community included Franks and perhaps some Britons in addition to Saxons and other peoples of North German origins. Once settled their history appears to have been a troubled one. Anglo-Saxon cemeteries are normally orderly in their lay-out, but at Worthy Park the cemetery plan is chaotic, with many burials superimposed, suggesting that probably twice, in the sixth and earlier seventh centuries, there had been sufficient disruption for people to forget the whereabouts of earlier interments. Perhaps new-comers ousted the old. Certainly there was warfare, whether against Britons or other English, for the weapons show remarkable evidence of damage and makeshift repairs. After the initial phase, signs of prosperity are absent until the mid seventh century, a fact which may reflect the isolation and instability of this part of Hampshire before Winchester rose to economic and political importance under King Cenwealh (c. 648-72).

The Worthy Park cemetery first came to light in but proper excavation was not possible until 1960-61, and even then only half the site could be explored. However, skeletal remains were recovered from 34 cremation burials and 99 inhumations. The former were very fragmentary and only barely informative, but the latter proved fascinating indeed. After long delay and long vicissitudes, they found their interpreter in that great master Dr. Calvin Wells, whose death in 1978 has robbed us of one of the great exponents of our human past reconstructed from its bare bones.

At present the full report on the Worthy Park cemetery seems likely to be delayed for some further years, but there can be no reason to delay publication of the report on the human remains, which can stand by itself as a model of its kind and one of the last completed works of a scholar who remains "sans pareil" amongst students of human biology. He could bring the dead alive.

3 – THE PALAEOPATHOLOGY
by Calvin WELLS

3.1. Preamble.

This Appendix is concerned with the pathology of Worthy Park population. That this fact should need an apologia or justification may appear ridiculous in 1976. Yet experience shows that some archaeologists and physical anthropologists still tend to believe that anyone with an anthropological training and the necessary enthusiasm can say all that is needed about the fractures and arthritis, etc... which emerge from an ancient burial ground. But osteological anthropology predominantly studies the normal skeletal features of early groups - their genetic endowment in all its diversity. From the normal morphology of persons and populations it seeks to establish their relationships to establish their relationships in time and space ; their past evolution and present affinities. In contrast to this, pathology studies the reactions of individuals and communities to all the pressures and influences of their environment. It observes their response to climatic factors, to the animals and plants which share their territory, to the tools they use, the physical and mental strains imposed on them. Disease and injury are never haphazard in their incidence. They always reflect, often very precisely, what people do and what is done to them. The pathology which afflicts an individual tells us immeasurably more about him, as a person who dug and wove and fought and fell, than all the indices of his skull or limbs can ever do.

But the injuries and diseases that are found in a skeleton have often developed over months or years of ill health. During that time they have affected the sufferer in many ways, reducing his vitality, changing his temperament, restricting certain movements or patterns of behaviour, producing pain here, compensatory adjustments there, always moulding him with infinite subtlety. Only a clinician or clinical pathologist who has spent his life studying disease as a **living and on-going process** can assess the significance of its final etchings on a dead bone.

Physical or osteological anthropologists commonly have a limited perspective which leads them to see bones in a kind of mental vacuum : "a femur is a femur ; a mandible is a mandible... their indices are in no way inter-related", is a view which is by no means unknown amongst them. Indeed, to some extent it is an almost inescapable result of their training and their daily occupation. Clinicians, on the other hand, are constantly having it borne in on them from an endless variety of biological responses that all parts of the body are functionally interdependent and that changes in one area seldom fail to modify another. Moreover anthropologists, from the fact that they more often measure skeletons than dissect corpses, tend not to look beyond the isolated bone. They seem to forget or ignore the fact that all living bones are surrounded by muscles, nerves, arteries, veins, fascia, lymph ducts and skin, which are intimately and inextricably woven into a functional whole, no part of which can be diseased without repercussions in some more or less distant organ. To clinical pathologists this is the very core and essence of their thought about disease. If a woman complains of "pins and needles" in a hand they can hardly fail to think of a possible cervical rib ; if a man develops a cough they will not overlook an aneurysm or a tapeworm as a possible cause ; if an adolescent complains of breathlessness they will not omit to seek an earlier history of rheumatic fever ; if an ancient skeleton has a gangrenous toe bone they will at once look to see if it has an osteitic palate. These examples might be multiplied indefinitely. Every pathologist could suggest a hundred more ; anyone who is not medically trained will hardly be aware

that such relationships exist, still less have the ability to detect and interpret them. Yet there are a few non-medical anthropologists who deceive themselves that they are capable of recognizing disease and explaining its course and significance ; and some archaeologists generously, though misguidedly, accept this estimate of their ability.

Fortunately, an increasing number of excavators are now turning to professional palaeopathologists and, even more fortunately, the great majority of physical anthropologists have enough scientific humility to recognize their limitations and incompetence in the interpretation of disease.

It is against the background of this preamble that the following palaeopathological report is written.

3.2. Non-metrical variants.

"Non-metrical" variants may be defined, for the purposes of this study, as anatomical traits which can best be recorded on a "present or absent" basis. They may also be considered as normal characters in that their presence or absence is not clearly associated with any benefit or handicap to the individual. **Metopism**, the persistence of a mid-frontal suture into adult life, is a well known example which has been much studied and the frequency of which has been recorded for many populations. **The sutural partition of the occiput** to form an inca bone is another well known example ; so is that **perforation of the olecranon fossa of the humerus** which is commonly referred to as septal aperture. Many anatomical variants of this kind exist but few have been much studied and their frequency in most populations is unknown. As more comest to be known about them they are likely to prove rewarding for the study of ethnic relationships because it appears that most of them are genetically determined, many perhaps with quite simple patterns of inheritance. But caution is necessary because a few of these traits, e.g. gonial eversion, may be influenced by cultural or other factors. This is unlikely to apply to many of the characters investigated here.

Although they are referred to as "non-metrical" variants this is a somewhat misleading term. All are measurable in one way or another : the occurence of a foramen can be recorded but its diameter and distance from nearby landmarks can also be measured ; epipteric bones may simply be noted for their presence or their areas can be calculated. **But it seems that the most significant feature is the presence or absence of these traits and that their size is unimportant or of only minor concern.** Many of them, moreover, are difficult to measure accurately either because of their smallness (e.g. post-condylar canals) or owing to the imprecision of their boundaries and the subjectivity with which they must be assessed (e.g. supra-orbital grooves, mandibular tori and malar tuberosity). They are here recorded, therefore, on a simple present or absent basis.

Although these traits appear to be genetically determined there is little evidence that any of them are sex-linked characters so on **a priori** grounds it seems reasonable to pool the male and female results. In Table 1 this has been done but only after the values had been separately calculated. No significant differences between the men and women for any character were found at Worthy Park although they occasionally occur in other populations. At North Elmham, Norfolk, 2 (2,1 %) of 96 male humeri had a **septal aperture**, 18 (20,4 %) of 88 females had one, but the reason for this tenfold difference is unknown. It was trivial at Worthy Park, Jarrow Monastery and Monkwearmouth. At Jarrow **gonial eversion** was present in 28 (45,9 %) of 61 males and in only 13 (22,4 %) of 58 females but this feature may be partly due to functional influences. At Worthy Park the difference was much less (M 71,0 %, F 53,8 %).

Table 1 (p.) shows the pool male, female and unsexed frequencies for 35 non-metrical traits from Worthy Park. In Table 1 bis (p.), they are compared with the equivalent rates from Jarrow, Monkwearmouth and Caerwent not only because these,

TABLE 1 — Frequency of non-metrical variants (M + F pooled + unsexed)

VARIANT	n	+	%
Metopism	56	5	8,9
Bregma bone	43	2	4,7
Coronal wormian	79	1	1,3
Sagittal wormian	38	0	0,0
Lambdoid wormian	70	30	47,1
Asterionic ossicle	65	7	10,7
Epipteric ossicle	58	3	5,2
Inca bone	46	0	0,0
Supra-orbital notch	93	61	65,6
Double supra-orbital foramen	89	39	48,1
Supra-orbital grooves	81	39	48,1
Double infra-orbital foramen	28	0	0,0
Paramastoid process	26	6	23,0
Foramen of Huschke	83	5	6,0
Double or hourglass occipital condyle	50	1	2,0
Pre-condylar tubercles	55	3	5,2
Postcondylar canal	23	6	26,1
Double hypoglossal canal	51	10	19,6
Sagittal sinus turns left	44	3	11,4
Pterygoid spurs	4	2	50,0
Blurred sub-nasal margin	61	8	13,1
Sub-nasal fossiculae	58	2	3,4
Malar tuberosity	68	22	32,4
Malar marginal tubercle	59	9	15,3
Zygomaxillary tubercle	54	8	14,8
Gonial eversion	86	54	62,8
Multiple mental foramen	91	1	1,1
Infero-lateral mental tubercle	97	21	21,6
Atlas bridge	52	4	7,7
Ossified dens	26	1	3,8
Acetabular crease	69	28	40,6
Septal aperture of humerus	94	7	7,4
Femoral third trochanter	85	6	7,1
Vastus notch	56	6	10,7

TABLE 1 bis — Comparison of frequency of non-metrical variants in three Anglo-Saxon groups

VARIANT	JARROW			MONKWRMTH.			CAERWENT		
	n	+	%	n	+	%	n	+	%
Metopism	96	4	4,2	32	0	0,0	32	1	3,1
Bregma bone	45	0	0,0	27	0	0,0	8	1	12,5
Coronal wormian	66	2	3,0	37	0	0,0	6	4	66,7
Sagittal wormian	45	0	0,0	23	1	4,3	8	0	0,0
Lambdoid wormian	73	15	20,5	23	83	4,8	6	4	66,7
Asterionic ossicle	38	4	10,5	–	–	–	–	–	–
Epipteric ossicle	41	0	0,0	36	0	0,0	–	–	–
Inca bone	56	2	3,6	24	1	4,2	8	0	0,0
Supra-orbital notch	111	60	54,1	56	37	66,1	49	28	57,1
Double supra-orbital foramen	96	21	21,9	56	11	19,6	47	6	12,8
Supra-orbital grooves	90	56	62,2	43	21	48,4	26	15	57,7
Double infra-orbital foramen	63	8	12,7	–	–	–	17	3	17,6
Paramastoid process	28	10	35,7	21	2	10,0	–	–	–
Foramen of Huschlke	154	15	9,7	–	–	–	66	1	1,5
Double or hour-glass occipital condyle	76	1	1,3	–	–	–	–	–	–
Precondylar tubercles	100	4	4,0	24	0	0,0	12	0	0,0
Post-condylar canal	55	30	54,5	25	4	16,0	–	–	–
Double hypoglossal canal	110	15	13,6	23	3	13,0	11	3	27,3
Sagittal sinus turns left	80	6	7,5	30	9	30,0	38	4	10,5
Pterygoid spurs	14	10	71,4	–	–	–	–	–	–
Blurred sub-nasal margin	109	14	12,8	34	4	11,7	28	2	7,1
Sub-nasal fossiculae	104	3	2,9	–	–	–	28	0	0,0
Malar tuberosity	83	16	19,3	25	1	4,0	37	5	13,5
Malar marginal tubercle	52	12	23,1	21	1	4,7	34	3	8,8
Zygomaxillary tubercle	80	4	5,0	21	2	9,5	27	4	14,8
Gonial eversion	119	41	34,5	45	14	31,1	62	29	46,8
Multiple mental foramen	161	4	2,5	52	1	1,9	77	3	3,9
Infero-lateral mental tubercle	120	22	18,3	32	3	9,4	58	17	29,3
Atlas bridge	103	10	9,7	39	4	10.2	36	5	13,9
Ossified dens	50	6	12,0	–	–	–	–	–	–
Acetabular crease	95	20	21,1	41	12	29,5	35	17	48,6
Septal aperture of humerus	174	15	8,6	55	5	9,1	81	9	11,1
Femoral third trochanter	145	43	29,7	42	10	23,8	43	13	30,2
Vastus notch	85	10	11,8	22	0	0,0	32	2	6,2

too, were largely Anglo-Saxon groups but also because the results were in each case assessed by me using identical criteria.

No dramatic differences are found between these populations but a few minor divergences may be noted. **Bregma bone** occurs at Worthy Park but not at the other sites. The 8,9 % frequency of **metopism** is a commonly found value : at Monkwearmouth its absence from 32 skulls can be considered unusual. The frequency of individuals with **Lamboid wormian bones** (47,1 %) is considerably higher than in the other populations and a further feature, not shown in Table 1, is that about 40 % of persons with these ossicles had 4 or more of them. The frequency of **post-condylar canal** is low compared with North Elmham whereas doubling of the hypoglossal canal is somewhat higher than at any of the other sites. Monkwearmouth was distinctive in having a 30 % incidence of the **sagittal sinus turning left** instead of right. The Worthy Park 11,4 % rate for this feature is more usual but this was supplemented by 3 cases in which the sinus bifurcated. Although **malar tuberosity** is one of the most subjective of variants its 32,4 % at Worthy Park gives it a frequency significantly in excess of the other three groups. This probably gave them a somewhat "high cheeked" or slightly rugged facial appearance which in the case of some of the women, perhaps, may have been a distinct addition to their charms. But against this must be set the rather high incidence of **gonial eversion** (62,8 %) and **infero-lateral mental tubercles** (21,6 %)which no doubt often produced an angular or "lantern jawed" effect. The only post-cranial feature which need be mentioned is the rather high incidence of **acetabular crease** (40,6 %).

It is unfortunate that the lack of statistics from other Early Saxon sites prevents these non-metrical variants from being used to assess the genetic relationships between the Worthy Park people and other populations. They are included here for their intrinsic interest, for comparison with the three somewhat later groups recorded in Table 1 and in the hope that they may serve as reference material for future studies on other groups.

3.3. Congenital Defects.

Apart from those conditions which are discussed under **Non-metrical variants** many other anomalies may be found, some of them undoubtedly genetic in origin, others of uncertain status but perhaps due to adverse intra-uterine factors or to developmental errors during gestation. Most of the deviants discussed here are probably genetically caused and it is convenient to refer to them all as "Congenital" but to bear in mind the uncertainty inherent in this description.

A common difficulty is that the assessment of the extent to which a feature is developed, or even its presence, depends on subjective judgments which differ greatly from one observer to another. **Torus mandibularis** is a striking example of this. Large masses of bone projecting from the mandible, as were found in an 8 th-9 th century group from Iona (Wells 1974 a), are no problem. But the lingual surface of the alveolus is often slightly sinuous or thickened where the bone flows over and between the roots of teeth. Trivial elevations of this kind are almost certainly not tori in the genetic sense. They are, in effect, functional buttressing of the alveolus to withstand the pressure of powerful mastication. Yet no two anthropologists are likely to be in total agreement over a long series of jaws and often they will differ widely in their assessment. In spite of a number of jaws with sinuous and physiological thickening of the alveoli it seems likely that only 2 skulls, 12(F) and 57(M), have a true mandibular torus and in neither can the feature be described as much more than incipient. Burials 49(M) and 57(M), have a true mandibular torus and in neither can the feature be described as much more than incipient. Burials 49(M) and 84(M) have a **torus auditivus** of the R. ear but in both persons it was small, in 84 hardly more than a doubtful **elevation of the meatal wall.**

Burial 73(M) has the unusual feature of **two congenital holes in the blade of his L. scapula** : one measures 6 x 9 mm, the other 8 x 10 mm.

Most of the other congenital anomalies are **vertebral.** Burials 14(M), 17B (1)(M) and 18 (1) (F) have various degrees of **sacral spina bifida** : in Burial 14 this was complete. Burial 13(M) had sacralization of the L5 vertebra and 26(1)(F) had a detached neural arch of L4.

The incidence of these anomalies is low and several which might have been expected were not found. Anomalous articulations between the L5 vertebra and the sacrum are common in many populations. They usually take the form of additional articular facets the transverse processes and the sacral alae. Only minor deviations of these bones were found at Worthy Park. Sacra with six segments, instead of the normal five, were not present. Neither **cervical ribs** nor **supernumerary vertebrae** were found. **Sternal perforation, epicondylar process of the humerus** and many other common variations were likewise absent although it is probable that the poor state of many of these burials made it impossible to identify such variants as did occur.

The one outstanding congenital defect at Worthy Park was found in Burial 38. This was a man, aged about 28-30 with an exceptionally well preserved skeleton which was meticulously excavated by Mrs Sonia Hawkes herself. The R. arm was bent up in a natural position across the front of the thorax with the bones of the hand and fingers lying, in their normal articular relationship, in front of the cervical vertebrae. All the bones of the L. arm, forearm and hand, and also the L. clavicle and scapula, were missing. No disturbance of the grave or skeleton, ancient or modern, had taken place and it was immediately apparent that this man had suffered from **congenital absence of his L. forequarter.** Today we are familiar with such deformities as a result of the notorious thalidomide episode. But congenital absence of the limbs was well known in pre-thalidomide days and the defect took many forms. Balard (1938) described an interesting group in which at least seven members of a family were severely affected over four generations. Two of these persons seem to have had L. arm amelia almost identical to this man from Worthy Park. In these cases it is usual to find other abnormalities, either additional minor genetic deviations or compensatory adjustments to the major deformity. Burial 38 is no exception. Numerous abnormalities occur in his spinal column, ribs and pelvis, etc.. The case has been reported elsewhere (Hawkes and Wells, 1976) with much additional detail and discussion.

In view of the occasional familial occurrence of absent limbs and of the other congenital anomalies noted here, the cemetery was scrutinized for further examples which might suggest close inbreeding, family burial plots or other evidence of near relationship amongst groups of these persons. No such evidence was found.

The absence of cleft palate and other developmental defects which are known to be due to adverse influences affecting the growth of the foetus in utero may hint that certain virus diseases, such as rubella, were not present in the Worthy Park population.

3.4. Osteoarthritis.

The commonest detectable disease to affect the Worthy Park people was **osteoarthritis** : 16 (53,3 %) of the 30 adult men and 15 (38,5 %) of the 39 adult women had the disease. Fifteen (50,0 %) of the men and 9 (23,1 %) women had non-vertebral lesions. This finding is typical of many early populations. Because much uncertainty exists amongst non-medical readers it is perhaps worth saying something about this complicated disease. Firstly, it is a quite different condition from rheumatoid arthritis which is largely due to

auto-immune reactions, affects women more than men, may begin in adolescence or even in childhood, attacks multiple small joints and is primarily localized in the periarticular tissues. In contrast, osteoarthritis is a disease of which the causation is still largely obscure. It is clear that injury plays a great part, especially repeated minor injuries, which is a way of saying that it often reflects the "wear and tear" of joints. It is more common in men than women, is seldom found under the age of 25, is often restricted to one or two large joints and is primarily localized to the articular cartilage and its underlying bone. Its capacity to reflect the strains and injuries to which joints have been subjected makes it an extremely useful guide to what an individual did or had done to him. Its usefulness in this respect is compounded by the fact that osteo-arthritis is a very common disease in many or most populations and is amenable to statistical comparison between groups. Archaeologists and anthropologists occasionally express boredom with osteoarthritis : they find a tedium in the fact that dozens of "common or garden" arthritic lesions emerge from a burial ground but rarely a case of gout (Wells, 1973 a), osteoid osteoma (Wells, 1965 a) or osteogenesis imperfecta (Wells, 1965 b). This yearning for the exotic rather than the humdrum shows a grave misunderstanding of the relative values of these diseases for the reconstruction of past patterns of living, in men and animals, at least as far back as the dinosaurs. The very banality of arthritis is what makes it useful to an archaeologist. A single case of Paget's disease in a cemetery (Wells and Woodhouse, 1975) reveals little except that a single case of Paget's disease was present in the cemetery. A hundred arthritic joints in each of two burial grounds with spinal, shoulder, wrist, hip and foot frequencies of 38 %, 7 %, 3 %, 29 % and 18 % in one, 16 %, 36 %, 28 %, 2 % and 13 % in the other reveal a whole complex of different activities in the two communities. It is the task of the palaeopathologist not merely to identify lesions of this kind but to interpret them so that the non-clinical reader may understand the origin, effect and probable end result of each apparently trivial erosion or deposition of bone. Although the site of election for osteoarthritis varies greatly it can affect any joint in the body except the synarthroses.

The arthritic process exhibits several different changes, two of which may be mentioned here because it is often convenient to refer to them separately. One is the outgrowth of flanges or excresences of bone around the affected joint - often called "lipping" which are usually referred to as osteophytes or osteophytosis. The other is the condition known as eburnation. In many arthritic joints the synovial membrane and the joint cartilage wear away so that the articulating bones rub directly against each other eventually becoming dense and as polished as a billiard ball - a state sometimes appositely called "ivory" eburnation. Owing to the particular details of the anatomy of the spinal column it is worth making a distinction between osteophytosis affecting the margins of the vertebral bodies, with or without fusion of adjacent segments of the column, and a true osteoarthritis which affects the posterior intervetebral joints. Many anthropologists blur the distinction between these two lesions by subsuming both under the general term arthritis.

One more fact is worth emphasizing as a generalization for the non-osteologist. Bone, despite its strength and rigidity, is an extremely plastic tissue, in contrast to the recalcitrance of nerve tissue or the almost total lack of reparation shown by muscle. Nerves, arteries, veins, muscles and extrinsic stresses readily mold bone and leave their imprint upon it and it is the combination of this plasticity with its great recuperative powers that makes bone such a sensitive indicator of what has befallen it and enables a professional palaeopathologist to be an invaluable ally for the archaeologist.

The poor condition of most of the Worthy Park skeletons is especially apparent in their spinal columns. assessing their pathology. Of the 69 sexable adults the 30 males ought to yield 1441 hemi-segments of vertebra (counting the superior and inferior halves and the 1st sacral segment separately) , the 39 females should yield 1863 hemi-segments. In fact, far fewer survive to be used with confidence, the precise number depending on whether osteoarthritis of the posterior joints or osteophytosis of the body margins is being considered but seldom amounting to much more than a third of what would have been present if all had survived. Table 2 records the adult frequency of osteoarthritis, osteophytosis and Schmorl's nodes.

It shows that arthritic lesions were three times more common in the men than in the women ; osteophytotic lesions about fifty percent more frequent. However, **Table 2**, does not show the average difference in severity as opposed to frequency, between the sexes. This can be established by grading the osteophytotic lesions on a simple five point scale . 0 : absence of osteophytosis - 1 : the lipping projects less than 3 mm - 2 : the lipping projects from 3-6 mm 3 : the lipping projects 6 mm or more but without synostosis of adjacent bones - 4 : adjacent bones are synostosed.

Assessed in this way the 91 female hemi-vertebrae score 126 points - an average of 1,4 : the 129 male hemi-vertebrae score 259 - an average of 2,0. This represents a substantially more severe degree among the men. This is further shown by the fact that simple osteophytotic synostosis of adjacent vertebrae is nowhere present in the female spines but occurs between a minimum of 16 vertebrae in at least 4 males. The distribution of spinal osteophytosis varies only slightly between the sexes. Table 3 shows the location of lesions in men and women separately.

TABLE 2 – Vertebral pathology (Total incidence)

SITE	SEX	LESION								
		Osteoarthritis			Osteophytosis			Schmorl's nodes		
		+	n	%	+	n	%	+	n	%
Worthy Park	M	37	604	6,1	129	498	27,9	19	611	3,1
	F	12	612	2,0	91	481	18,9	6	539	1,1
North	M	64	873	7,3	262	952	27,5	65	1001	6,5
	F	45	1031	4,4	191	973	19,6	16	1032	1,6

TABLE 3 – Location of vertebral osteoarthritis, osteophytosis and Schmorl's nodes

LESION	SEX	Cervical		Thoracic		Lumbar	
		n	%	n	%	n	%
Osteoarthritis	M	21	56,8	2	5,2	14	37,8
	F	4	33,3	0	0,0	8	67,8
Osteophytosis	M	17	13,2	71	55,0	41	31,8
	F	11	12,1	43	47,3	37	40,6
Schmorl's nodes	M	0	0,0	19	100,0	0	0,0
	F	0	0,0	4	66,7	2	33,3

The available material is too scanty to make it worth while to record the incidence of arthritis or osteophytosis on each individual hemi-vertebral segment. In the thoracic region there is a general tendency for lesions to occur mostly below the level of T6, especially the more severe ones.

Although these two types of vertebral lesions can conveniently be described separately it is sensible to interpret them as though they were a qimple entity since both are largely responses to physical strain. But there is another condition which may be included with them and considered at the same time. In childhood the intervertebral discs are tough fibrous capsules containing a gelatinous or semi-fluid core, the whole structure being surrounded by a thin elastic membrane. If, especially in adolescence, strenuous work is undertaken which involves compression of the inter-vertebral discs - lifting heavy objects, for example - the fibrous capsule of the disc - may rupture and its gelatinous core be extruded. This, still contained within its surrounding elastic envelope, presses against the under surface of the vertebra above, the upper surface of the one below, or against both. The bone, plastic as always, yields to this pressure and a small pit or cavity develops in the body of the affected vertebra, perhaps at a place where vestigial remnants of the notochord have left a focus of weakness. These lesions are known as Schmorl's nodes. Table 2 shows their frequency in the Worthy Park adults and, for comparison, at North Elmham. At Worthy Park they are three times more common in the men than in the women, a sexual difference which is almost always found. Table 3 shows the location of Schmorl's nodes. In the men they occurred only in the thoracic region, which is unusual because they are often also found in lumbar vertebrae, as at North Elmham where 30 % of the Schmorl's nodes were at that level. In the Worthy Park women a third of them occurred in lumbar vertebrae. The highest Schmorl's node in both sexes was at the level of T6.

Compared with many early populations, especially Anglo-saxons, the Worthy Park people are not conspicuous for the amount or severity of their vertebral lesions. They appear to have suffered from rather less spinal trauma than the populations from Jarrow, North Elmham and other sites but despite this moderate lightness the number and distribution of their lesions represent the accumulated effects of much strain and stress. The schmorl's nodes suggest that young adolescents or even pre-adolescents were made to carry heavy loads before their muscles could efficiently do so. Burial 71 (M), a juvenile excluded from Tables 2 and 3, had a node in the L1 vertebra.

It is said that lower thoracic lesions, such as are predominant here, are more likely to result from an even symmetrical downthrust than from loads carried on one shoulder and which produce lateral bending of the spine. This may make us wonder whether these people carried weighty objects evenly poised on two sides of a yoke or perhaps balanced on their heads. When heavy loads are carried on the head the initial strain and thrust is through the cervical region where it is likely to produce osteoarthritis or osteophytosis rather than Schmorl's nodes. The moderately high incidences of cervical lesions here, especially the trau-

matized necks of male Burials 57 and 73, gives slight additional support to the possibility that these persons carried weights on their heads. Beyond this it seems unwise to look for specific causes for the majority of these spinal lesions ; the essential nature of osteoarthritis and osteophytosis is that they tend to reflect the accumulated stresses endured over many years of strenuous activity.

Before leaving these vertebral lesions it should be noted that arthritis may also develop on the vertebral body, in the thoracic region, at the costal facets for articulation with the ribs and at the similar facets on the transverse processes. In 3 males 4 of these costo-vertebral facets on the bodies and 3 on transverse processes had well marked osteoarthritis ; in 3 females four transverse facets were affected.

The sacro-iliac joints are partly affected by the same stresses which impinge on the vertebral column. Functionally they owe their strength very largely to the ligaments which surround and support them and if these are stretched or torn the re-alignment of the joint may progress to osteoarthritis. At Worthy Park 4 men have arthritic changes at 5 of their sacro-iliac joints and one woman has one joint affected.

Apart from these vertebral lesions, which account for about a third of the osteoarthritis at Worthy Park, there is a wide range of other post-cranial arthritis. It shows some interesting differences between the sexes and also when compared with what is found in other populations.

Among the men the commonest site for it was the hip joint. Two men had the disease in one hip, 7 had it bilaterally - a total of 16 affected joints. By contrast, it was present in only 5 hips of 3 women. Both bones of the articulation, the acetabulum and the femoral head, were affected in 7 hips, 6 of these being males.

A striking contrast exists between the hips and the knees at Worthy Park. Clear evidence of arthritic knees was found only in Burials 44 and 64 (2) each of whom had it in the condyles of both femora. The disease is usually more frequent in ancient hips than knees but it is uncommon to find a disparity such as we have here. Descending to the foot, a marked sexual difference is found : no woman had the disease but at least 4 men had a minimum of 10 arthritic bones between them, probably more. In all, 51,7 % of the male non-vertebral arthritis was located in their lower limbs, as compared with 29,1 % in the women.

In modern populations arthritis of the shoulder joint is not very common but early groups often have a high proportion of their lesions there. At Worthy Park 8 men have 13 arthritic shoulders, 2 women have 3 between them. In all but one man and one woman a single bone of each joint was affected, most often the glenoid surface of the scapula. Lesions of the elbow, which may involve any or all of the articulating bones, were of similar frequency in both sexes but a most remarkable difference was found in the wrist and hand. Here 4 men had 7 affected bones. 5 women had 10 lesions. This difference implies that 41,7 % of the women's arthritis but only 11,7 % of the men's was located in the wrist or hand.

The final articulation which needs to be mentioned is the jaw. Only one arthritic lesion was recognized here, in Burial 30 (F), who had slight flattening of the L. mandibular condyle.

Table 4 sums up the distribution and frequency of these non-vertebral lesions.

When the overall pattern of these arthritic lesions is studied there are various aspects which deserve comment. In the first place it can be said that the total amount of this disease was moderately high at Worthy Park. Of the 69 adults, 31 (44,9 %) had the disease : 16 (53,3 %) of 30 men and 15 (38,5 %) of 30 women. When only non-vertebral lesions are considered they are found in 9 (23,1 %) of the women and 15 (50 %) of the men. On the other hand, the average extent of these lesions is mild, some can be described as hardly more than incipient and the severe manifestations which had developed well marked eburnation are detectable in only 4 of the skeletons (2M, 2F).

The number of arthritic foot lesions in males, compa-

TABLE 4 – Distribution and frequency of non-vertebral osteoarthritis

JOINT	M (60 lesions)			F (24 lesions)		
	+	%	Persons	+	%	Persons
Jaw	0	0,0	0	1	4,2	1
Shoulder	13	21,7	8	3	12,5	2
Elbow	4	6,7	2	2	8,3	1
Wrist/Hand	7	11,7	4	10	41,7	5
Sacro-iliac	5	8,3	4	1	4,2	1
Hip	16	26,7	9	5	20,8	3
Knee	2	3,2	1	2	8,3	1
Ankle/Foot	13	21,7	4	0	0,0	0

red with their absence in the women, must indicate that the men were more exposed to trauma in these joints. This is unlikely to have been merely because men walked more than women : simple walking over moderately good ground or well trodden paths is not especially traumatic: It is much more likely to have been due to vigorous use of the feet when kicking spades into tough soil. Violent jarring of this kind is precisely the sort of injury which, cumulatively, produces osteoarthritis. The inference from this is that the Worthy Park men did the heavy digging and spade work whilst the women used their feet for lighter tasks and were perhaps responsible for the hoeing, weeding and gleaning, or acted as goose-girls and shepherdesses. This suggestion receives further support from the fact that 30 % of the men but only 7,7 % of the women have arthritic hips. These again are characteristic of long repeated severe jarring movements of the joint.

That 8 (26,7 %) of the men had arthritic shoulders clearly indicates that these joints, too, were exposed to much stress. Digging hard soils with blunted mattocks may have contributed to this but occupations such as axeing timber, forging iron and sterring clumsy plows are common causes of the condition and probably accounted for much of it in these men. The 3 (7,7 %) women with shoulder lesions may have acquired them from extensive hoeing of the seed beds and the jolting effect which this could have transmitted up their arms. Whether these lighter agricultural tasks are sufficient to explain the relatively high number of wrist and hand lesions found in the women is uncertain. It is probable that some other more specific tasks contributed to its occurence here. If so, we could envisage such chores as wringing out clothes and heavy drapes after washing them (if Anglo-Saxon housewifery extended to such niceties) or plaiting withies and osiers to make baskets, chicken coops or sheep folds. Basket work of this kind imposes much strain on wrists and fingers. However, one of the arthritic wrists (Burial 42) is likely to have been secondary to a probable Colle's fracture which this woman seems to have sustained. The osteoarthritis in the male wrists could easily be explained as due to wrenches when plowing ; that in their fingers, as the result of injuries when building houses and barns or even as the consequence of miscirected hammer blows.

At 4 (13,3 %) of the men had osteoarthritis of the sacro-iliac joint is a further indication of the extensive strains to which they were exposed. Humping heavy loads can undoubtedly initiate or aggravate this lesion but jolting or twisting the joint as in sterring a heavy plow through clay-clotted soil or when restraining restive animals might also account for it. So could falls on the back whilst house building or by being thrown from a horse. No certainty can be achieved but these are some of the possibilities and where certitude eludes us it is better to indicate some of the ways in which these lesions might have been produced rather than pass over them in unhelpful silence.

It is interesting that only one person, Burial 30 (F), showed any evidence of osteoarthritis of the jaw. The average degree of dental attrition at Worthy Park was only moderately high by the standards of the time (see below). Heavy attrition is often due to a severely abrasive diet but may equally be caused by the need to chew tough meat. When due to toughness of the diet great strain is thrown on the tempero-mandibular joints, which may become severely arthritic (Wells, 1974 b). The fact that only one of these jaws was affected in this way suggests that their food was gritty rather than tough, abrasive from coarse flour or intrusive sand grains which eroded their teeth without damaging their mandibular condyles.

The distribution of arthritic lesions was far from even in these people. Among the men Burials 40, 57 and 73 were severely affected and also had various non-arthritic lesions. Of the women, Burials 20 stands out as having been much afflicted. The general impression created by these five persons is that they were the over-worked drudges of the community, probably the victims of assault, who suffered from chronic ill health, with a wide-scatter of pathological lesions : in short, they may have been the exploited slaves of the group. This is a report on the pathology of the Worthy Park people, not their morphology and genetic affinities, but it is tempting to wonder whether some part of this population had different racial roots from the majority - whether, in fact, the five persons discussed above were survivors from the old British stock. This question seems especially compelling in the cas of Burials 40, 57 and 73.

3.5. Osteochondritis.

A much neglected condition in early burials is osteochondritis dissecans. It is very common and its incidence and anatomical distribution can undoubtedly add to our understanding of how different populations behaved. Apart from sporadic references to these lesions the only general study of them is a brief article by Wells (1974 c). The cause of osteochondritis dissecans is still not fully understood but there seems little doubt that it is primarily due to trauma and stresses of the affected joints. It is a common disease at orthopaedic clinics today, almost always beging during the teenage period and is usually localized to the medial femoral condyle. It is characterized by an avascular necrosis of the articular cartilage and underlying bone, which sloughs away to produce a "foreign body" or "joint mouse" in the cavity of the joint, and leaves a pit seldom more than 10 x 15 mm across and 5 mm deep - often much smaller. In early skeletons they are commonly found in a much wider range of joints than is usual in clinical practice now. Fourteen persons at Worthy Park had these lesions and Table 5 (p.) summarizes their distribution.

TABLE 5 – Distribution of osteochondritis dissecans at Worthy Park

Inh (M)	SITE OF LESION
1	R. acetabulum
25 (a)	i. Base L. 1st metatarsal
	ii. Base L. hallucial proximal phalange
	iii. Base R. hallucial proximal phalange
36	R. talus : posterior calcaneal articular surface
40	i. L. tibia : distal articular surface
	ii. R. talus : trochlear surface
46	Base L. hallucial proximal phalange
73	Base R. hallucial proximal phalange
81	R. femur : lateral condyle
Inh (F)	
2	i. Base L. 1st metatarsal
	ii. Base L. hallucial proximal phalange
18 (2)	R. calcaneus : posterior articular surface
20	i. R. patella : medial articular facet
	ii. Base R. 1st metatarsal
21	Base halucial proximal phalange
26	Base L. 1st metatarsal
42	R. ulna : sigmoid fossa
62	Base L. hallucial proximal phalange

Seven men have 10 and 7 women have 9 osteochondritic lesions which involve a variety of joints but all of which, except one, are in the lower limbs. The exception is Burial 42 (F) in which the R. ulna is affected at the elbow. The lesions vary in size from small pits only 3-4 mm in diameter up to cavities 8-9 mm across e.g. Burials 20 (F) and 40 (M). Occasionally,as in Burial 1 (M), partial or complete healing has occurred - that is, the osteochondritic cavity has been filled with regenerated bone.

The most frequently affected site is the base of the proximal phalange of the great toe (7 lesions) ; the next is the base of the first metatarsal (4 lesions). The remaining 8 lesions are scattered over 8 different joints and range from the calcaneus up to the acetabulum. In modern clinical material untreated osteochondritis dissecans often eventually leads to the development of osteoarthritis. At Worthy Park only one such association was found : in the acetabulum of Burial 1 (M) and there is no proof that this was cause and effect.

The amount of arthritis and the kinds of fractures or other lesions present in Burials 20, 40 and 73 have suggested that these persons may have belonged to an exploited, over-worked serf class. If so, it is interesting to find that all three of them also have osteochondritic lesions and that in 20 and 40 these lesions are multiple.

When vigorously using the legs for carrying heavy burdens, digging or plowing, the main counter thrust is chiefly transmitted through the big toe, the 1st metatarsal, the inferior and superior joints of the talus, the distal articular surface of the tibia and thence up to the femoral condyles and acetabulum. It is precisely along this route that almost all the Worthy Park lesions are located. This gives further support to the view that these people led strenuous lives in which the demands of agriculture or house-building, etc.. imposed heavy stresses on their lower limbs while they were still young - probably in their early teens. But whereas the men had more arthritis in their feet than the women, the proportion is reversed with osteochondritis : two-thirds of the females'lesions are so placed. The solitary arm lesion, in the R. ulna of Burial 42 (F), may have been due to direct injury from the probable Colle's fracture she had sustained.

3.6. Fractures.

If osteoarthritis can be said to reflect wear and tear of joints due to repeated minor injury, fractures are usually a response to one sudden episode of major violence. We are, perhaps used to think of fractures as easily recognizable by the surplus callus which surrounds their repair or by the deformity and angulation which result from incompetent setting. But every clinician knows that many fractures are extremely difficult to detect, even with the help of X-rays and every pathologist has seen many proven fractures which have repaired so efficiently as to leave little or no evidence of their occurrence. This applies, for example, to incomplete breaks in long bone shafts, especially when they occur in young people, and to various other fractures notably those involving small bones of the hands and feet, such as the carpal scaphoid.

It often happens that the palaeopathologist, lacking as always the history of the case, is unable to be sure whether a bone has been broken or not. Worthy Park presents several such uncertainties and problems.

At least 12 bones (7M, 5F) had been broken antemortem in these people. A further 8 (4M, 4F) show what are probably fractures but owing to their excellent repair or to some other cause a modicum of doubt remains.

Burial 79 (M) has a firmly healed Colles's fracture of the R. radius. It has repaired in fairly good position without much angulation and would have given rise to only slight disability. Burial 68 (F) has well healed Colles's fractures of both radii and also a fracture of the styloid process of the R. ulna which no doubt occurred at the same time - an event which is extremely common (The L. ulna styloid process has not survived for inspection). Burial 42 (F) has a slight irregularity at the distal end of the R. radius which is one of the problem cases here. It is likely to be due to a Colles's fracture which had virtually no initial displacement other than a slight impaction of the two fragments. This is not uncommon in clinical practice may give little pain or disability at the time occurrence and is not easy to distinguish without a radiograph. In contrast to the slight uncertainty of this case, Burial 3 (F) has an obvious fracture of her L. radius. It is, however, about 40 mm proximal to the wrist

joint which is somewhat further from the joint than most Colles's fractures are found. This, too, is well healed without excessive deformity. In marked contrast to the efficient repair of all these fractures is Burial 14 (M). This man had a mid-shaft fracture of his R. ulna and R. radius. The bones have healed strongly with a mass of callus but their position is bad owing to the amount of angulation of their shafts. The distal fragment of the ulna deviates about 30^{o} from the rest of the bone ; the distal half of the radius deviates about 40^{o}. Angulation to this extent must have been very disabling. It implies a realignment of those muscles of the forearm which control the wrist movements and especially the finger flexors which enable them to grip and hods objects. The gross displacement of these bones is likely to have been accompanied, also, by tearing of the interosseou membrane which connects them to each other and adjacent to which are various blood vessels and nerves. If any large nerve of the forearm was much injured severe residual disability would be almost inevitable and, in the case of this man, there is archaeological evidence that that did, indeed, happen. At excavation the fingers of the R. hand were found in a closely clenched position and this probably represents the fully flexed condition which had become their permanent state during life as a result of neurological damage due to the fracture. The precise injury is likely to have been a tear of the posterior interosseous nerve, which is the deep branch of the radial nerve in the forearm. This gives branches to the Extensor digitorum communis, the Extensor carpi ulnaris, the Extensores pollicis longus and brevis and to other muscles of the forearm and hand. They would become paralysed and unable to extend the fingers which would then close into a flexed or clutching posture as a result of the unopposed action of the flexor muscles supplied by the median and ulnar nerves.

Two other forearm fractures remain to be noted. Burial 20 (F) had a fracture of the shaft of her R. ulna and Burial 70 (M) had a mid-shaft fracture of his L. ulna. In both persons the break has healed well with little deformity and the residual disability would probably have been trivial. Two other possible upper limb fractures are present. Burial 94 (M) has an irregular appearance around the "surgical neck" of the R. humerus. It is difficult to determine the precise nature of this. A first impression is that it is probably the result of a fracture which had healed, in excellent position, with negligible deformity. Another possibility would be that the unusual appearance is due to remodelling of the bone from strong muscle action. This man had well developed muscle markings and enormous deltoid tuberosities which must imply that he was accustomed to lift extremely heavy weighs or in some other way to make exceptional demands on his deltoid muscles and the other components of his shoulder girdle. This is yet another case where X-raying the bone gives little assistance : no clear evidence for or against a fracture is revealed by the radiographs. It remains likely that this man had a partial break of his R. humerus, just distal to the head of the bone, at an early age - perhaps in his late childhood or early teens ; that the initial displacement of the two fragments was very slight ; that it healed in almost perfect position ; and that subsequent remodelling of the bone removed most of the evidence of the injury. Finally, Burial 57 (M) has a well marked deformity of the proximal part of a metacarpal shaft which is probably the result of a firmly healed fracture.

Burial 57 also has a well healed fracture of a middle rib and Burial 49 (M) has a closely similar break, also of the body of a middle L. rib.

Lower limb fractures are uncommon at Worthy Park. Burial 76 (M) is a very defective skeleton but a fragment of the L. tibia shows what is almost certainly a well healed fracture of its shaft, with only minimal deformity. Burial 20 (F), already noted for her broken ulna, has slight deformity of the base of her R. 4th metatarsal and this is likely to be a soundly healed fracture. It is associated with some slight periostitis of this and the R. 5th metatarsal Burial 73 (M) has an unusual condition of the head of the R. 5th metatarsal. Two "sinuses" go through the bone and produce a severe deformity which involves the metatarsophalangeal joint. The base of its articulating phalange is deformed and arthritic and there is a moderately high possibility that these lesions were due to a fracture of both bones of the joint, which may have been a compound fracture or become secondarily infected, thus giving the present appearance which clearly indicates massive disorganization of the metatarso-phalangeal joint and its periarticular structures.

Burial 70 (M) already noted above, had a second fracture which involved the body of his R. scapula. It was a severe injury but healed well. The principal lesion is below the scapular spine close to, and encroaching on, the lateral border of the bone. Part of the body immediately above the fracture has been displaced anteriorly and there is now a small antemortem lacuna in the bone. The lateral border has been left thickened and irregular.

The only other lesion which need be discussed here is in Burial 2 (F). Her L2 and L3 vertebrae are fused. The body of L3 has almost collapsed and the asymmetry of the bones has produced a slight lateral curvature concave to the left and with much kyphosis or forward bending of the spine. Radiography shows gross narrowing of the intervertebral disc space and secondary slerosis of these bones. It is not due to tuberculosis and is unlikely to be the result of any infective process. The lesion is almost certainly due to a fracture of the L2 vertebra which has collapsed into L3.

It is unfortunate that the skull of Burial 38 (M) has been mislaid during the twelve year interval between

its despatch by the excavator to the Duckworth Laboratory and the arrival of the rest of its skeleton with the present writer. Mr. Bernard Denston tells us that it appeared to have fractures of the R. mandibular condyle, of the L. parietal and of the face - possibly due to sword cuts.

Table 6 sums up these fractures, probable fractures (shown by a query "?") and possible fractures (shown by two queries "??").

Because little is known about the fracture rate of bones in Anglo-Saxon and other early populations it is important to record not only the presence of fractures but also to note their absence. A record was kept, therefore, of all long bones whether fractured or not. Table 7 shows the results obtained.

Some attempt must now be made to assess the significance of these fractures. In general, broken bones may be due to accidental mishaps or to deliberate assault. Worthy Park offers examples that are likely to fall into both categories. One of the commonest fractures to result from deliberate aggression is a mid-shaft break of the ulna. This is typically incurred while trying to ward off a cudgel blow to the head and is often called a "parry" fracture. Because most agressors are right handed parry fractures tend to be more common on the left. Burial 70 (M) has a convincing example of this kind of injury. He was a man with widespread arthritis and it is tempting to think that he was of low or slave status, an overworked drudge who was sometimes beaten by his master or his social superiors. This suggestion is greatly reinforced by the evidence of his severely fractured R. shoulder blade. The scapula is an extremely mobile bone and is hardly ever broken except as a result of direct injury. Typically this may occur when blows from a heavy club are rained down on the back and because the assailant is likely to be right handed, it is usually the victim's R. scapula which is smashed, as here. Burial 20 (F) also has an ulnar fracture, but of her R. forearm, and it is likely that in trying to guard her head against a beating she received the blow on her ulna instead. Sometimes a club aimed at the head is dodged instead of being warded off. When this evasive action is too slow or too incomplete the head may be missed but the blow falls on the collar bone and breaks it instead. No clavicular fracture which might have been caused in this way is identifiable at Worthy Park. The mid-shaft fractures of the R. ulna and radius of Burial 14 (M) are so grossly deformed as to make it unlikely that they were simple parry fractures. It is more probable that they were due to some such cause as an accidental fall, perhaps from a low height, with the man's full weight displacing the broken ends of the bones as he collapsed upon them.

The 4 Colles's fractures of Burials 79 (M), 42 (F)

TABLE 6 — Summary of Worthy Park fractures

M Burial	Fracture	F. Burial	Fracture
14	Mid-shaft R. ulna and R. Radius	2	Body of L2 and ? L3 vertebra
38	??	3	Colles's fracture L. radius
49	Body of a middle L. rib ? Shaft L. ulna ; R. scapula	20	Shaft of R. ulna ? Base of R. 4 th metatarsal
70	Mid-shaft L. ulna ; R. scapula	42	? Colles's fracture R. radius
73	? R. 5th metatarsal ; ?? proximal phalange R. 5th toe	68	Colles's fractures L. and R. radii Styloid process R. ulna
79	Colles's fracture	76	Shaft of L. tibia
94	? "Surgical neck" R. humerus		

TABLE 7 — Frequency of long bone fractures

BONE	M			M			Population		
	n	#	%	n	#	%	n	#	%
Clavicle	35	0	0,0	39	0	0,0	74	0	0,0
Humerus	44	?1	?2,3	50	0	0,0	94	?1	?1,1
Ulna	36	2	5,6	47	2	4,3	83	4	4,8
Radius	38	2	5,3	47	?3	?8,5	85	?6	?7,1
Femur	51	0	0,0	54	0	0,0	105	0	0,0
Tibia	47	0	0,0	54	?1	?1,9	101	?1	?1,0
Fibula	33	0	0,0	32	0	0,0	65	0	0,0
Patella	31	0	0,0	26	0	0,0	57	0	0,0
Metacarpal	104	?1	?1,0	131	0	0,0	253	?1	?0,4
Metatarsal	111	?1	?0,9	144	?1	?0,7	255	?2	?0,8
Phalange	364	?1	?0,3	360	0	0,0	724	?1	?0,1
TOTAL	894	?8	?0,9	984	?8	?0,8	1878	16	?0,8

and 68 (F) are quite typical of an accidental tumble in which the victim, trying to break the force of his fall, lands on an outstretched hand palm down... though the question always remains : did he trip or was he pushed ? The radial fracture of Burial 3 (F) is somewhat ambiguous. It is more proximal than the usual position of a Colles's fracture and might have been due to a deliberate clout although the probability is that this, too, was accidentally caused.

Equally ambiguous are the fractured ribs of Burials 49 (M) and 57 (M). These injuries commonly result from falling on to a hard projecting surface such as a table edge or a tree stump but they are also often due to a heavy punch to the chest from a fist or elbow. There is nothing to help us decide in Burial 49 whose grave goods proclaim him to have been a warrior of some status. But for Burial 57 it is worth noting that he was probably of low status ; he was much afflicted with osteoarthritis no doubt from excessive, long continued strain ; he also has what seems to be a fractured metacarpal shaft which, itself, could have been due to a deliberate rap on the hand ; and, finally, that he has a small lesion of his frontal bone which looks as though it could have been the result of a wound. These considerations may incline us to think that his broken rib was at least as likely to have been caused by a beating as by a casual mishap.

The two probable metatarsal fractures, Burials 73 (M) (with its phalange) and 20 (F) are the kind of injury which is often due to accidentally dropping a heavy weight on the foot, to being run over by a wagon wheel or trampled by a restive ox. The probable fractured humerus of Burial 94 (M) and the tibial shaft of 76 (F) are much more likely to have been caused accidentally than deliberately. Awkward landing after a stumble could have accounted for each. The fractured vertabra of Burial 2 (F) was likely to have been due to some severe but accidental crushing injury to the spine, unless it resulted from pathological osteoporosis. To suppose otherwise we should need to envisage an attack of appalling brutality... though the story of Burial 78 (F) does not put such conduct beyond the bounds of credence.

The total impression caused by these fractures is that these persons led active and fairly vigorous lives in which occasional accidents led to broken bones. Also, that acts of aggression sometimes took place, especially downwards across the social barriers, with such typical sequelae as parry fractures, broken shoulder blades or dented skulls. In this context it is notable that Burial 57 has the further distinction of being the only member of the community whose two mandibular central incisors were lost during life - a loss which not infrequently follows a hard punch in the mouth. But the amount of trauma which can most plausibly be attributed to deliberate violence is not high when compared with some other sites (except in the case of Burial 38 (M) and it is notable that such telltale evidence of aggression as many broken noses or jaws is wholly lacking at Worthy Park.

Another interesting feature is the absence of Pott's fracture of the fibula. This is often produced as a result of stumbling and twisting the ankle on rough ground when walking over craggy plow furrows or recently deforested land. It is a very common lesion in Anglo-Saxons : among the 85 Late Saxon burials of Red Castle, Thetford, 14 % of the fibulae had been broken. Even at Jarrow Monastery, where the community had an overall incidence of fractures similar to that of Worthy Park, 3 (3,7 %) of 80 fibulae had Pott's fractures in a total fracture rate of 23 (0,98 %) of 2332 identifiable limb bones, compared with the Worthy Park total of 16 (0,8 %) of 1878 limb bones. Its absence from this site makes one wonder whether these early Germanic Settlers in the Winchester region had been established on the same plots of land long enough to have levelled them efficiently or whether they had taken over land farmed by the Romano-British population before them. Certainly they would seem to have had smooth fields and gardens which offered few hazards to the persons who cultivated them.

3.7. Exostoses.

Exostoses, that is abnormal projections from a bone, are almost always due to injury. Exceptions to this include such anatomical variants as the atavistic epitrochlear process of the humerus. In this section we are not concerned with formations of that kind. In a sense, the osteophytotic excrescences of arthritis are exostoses but for convenience of nomenclature the term is more usually applied to irregular growths of bone, commonly arising from the shafts of long bones or from some other situation not directly associated with a joint. They vary in size and shape from tiny, smooth spicules only a few millimetres long to large craggy masses 15 cm or more in length.

At Worthy Park at least 7 persons have exostoses.

Burial 38 (M) has a well marked exostoses on the R. talus. This is the man with congenital absence of the L. forequarter. He had a number of compensatory changes in his spinal column, pelvis and elsewhere and it is probable that the exostosis on his talus was a response to what must have been a lifetime of asymmetrical walking and working. Burial 49 (M) has 2 exostoses. One, c. 27 x 11 x 6 mm, arises from the posterior surface of his R. femur. It was probably due to a tear of the insertion of the Glutaeus maximus is an extensor of the hip joint the most powerful action of which is to straighten the trunk from a bending position and the injury might have been sustained whilst he was trying to draw himself up to a standing posture with a very heavy weight on his shoulders. It has been known to result from lifting a heavy concrete post. His second exostosis is on the posterior surface of his R. tibia. It measures c. 17 x 6,5 x 4,5 mm,and is at the place where his Popliteus

is inserted. This muscle flexes the knee joint and rotates the tibia inwards : a tear at its insertion might be the result of a violent attempt to flex the knee to prevent a fall when the lower leg was astride some object such as a tree branch or a horse. There is no evidence to show whether these two lesions occurred during the course of a single or of separate episodes.

Parenthetically, it should, perhaps, be explained here how exostoses arise. The commonest way is as a result of intense muscle effort which tears some of the fibres where its tendon or aponeurosis is attached to the bone. Bleeding takes place at the site of the tear and a haematoma of variable size is formed. After a few hours or days the blood clots, subsequently shrinking and hardening. It then becomes "organized", that is, osteoblasts convert the clot into bone and may even extend beyond it in a process of myositis ossificans.

Burial 73 (M) has an exostosis from the lateral epicondylar ridge of his R. humerus. It is c. 30 mm long, 14 wide and rises 15 mm from the bone. It is situated at the place where the lateral head of the Triceps brachii and the Extensor carpi radialis longus arise. The first of these is the most powerful extensor muscle of the elbow joint, the second extends the wrist. This exostosis could have been due to falling forward and vigorously trying to break the fall by pushing against the ground at the moment of impact. It might also be the result of some such episode as forcibly pushing a bucking horse or bullock in an attempt to ward it off or shove it into a stall. (Exostoses of this kind are not necessarily due to a single major injury they may result from the cumulative effect of several or even many, minor episodes). The presence of this lesion is yet another small piece of evidence which hints at a low social status for this man.

Burial 44 (M) has a small exostosis on the neck of his L. femur. He has extensive osteoarthritis with craggy lipping and deformity of the head of this bone and the exostosis may be a secondary effect of this, due to interference with the capsule of the hip joint. He also has a small exostosis or irregularity of the R. humerus at the deltoid tuberosity (where the deltoid muscle is inserted). He was a very powerful man and this lesion was probably due to tearing some fibres of the deltoid tendon whilst lifting a heavy object and perhaps when making a rotary movement of the shoulder joint. Burial 79 (M) has a similar exostosis at the insertion of the L. deltoid muscle. All this man's arm muscles were weakly developed and he was evidently unaccustomed to heavy labour. It is likely that he sustained a tear of a few fibres whilst trying to perform some lifting action beyond his strength. The area of insertion of the deltoid muscle is especially vulnerable to injury on account of the violent strains to which arms may be subjected. One more example of this kind was present at Worthy Park. Burial 40 (M) has a large exostosis at the distal part of the L. deltoid insertion. It measures c. 25 x 13 mm and rises 10 mm from the surface of the bone.

All these lesions are in males and they clearly indicate that it was the men who undertook those tasks which were likely to produce sudden violent jerks, twists and tears of muscles or tendons whilst the women plodded on with less spasmodic tasks which, by their cumulative wear and tear, eventually produced osteoarthritis.

The only female at Worthy Park to have an exostosis of the sort we are considering here is Burial 78. This is the teenage girl who has been fully described elsewhere by Hawkes and Wells (1975). On her R. femur she has a prominent ridge, c. 60 mm long, arising from the proximal end of the linea aspera. It projects 15 mm from the bone and has a slightly irregular free edge which is directed medially. At its distal end there is slight lateral thickening of the bone. This part of the femur is where the Pectineus and Adductor brevis muscles are inserted, two strong muscles the function of which is to bring the thighs together. This girl's exostosis was almost certainly due to tearing these muscles away from their attachment to the bone. In the supple limbs of a young teen-ager this would be an extremely rare mishap **unless** she were vigorously contracting the muscles by trying tightly to close her thighs. It is a lesion which is known to occur when a woman seeks to resist the forcible separation of her thighs during the hurly-burly of a brutal rape. Because this injury would be very unlikely to occur, in a person of this age, except when resisting the forcible thrusting apart of her thighs, we have offered this case as an example of Anglo-Saxon rape. The diagnosis receives slight additional support from a small, 21 x 10 mm, pitted lesion in the distal end of the L. femur, which may possibly have been due to a penetrating wound at the time of her violation. An additional circumstance which is thought to give further support to this suggestion is the prone position in which she was buried - a posture which was very exceptional at Worthy Park, as in other Anglo-Saxon cemeteries.

3.8. Weapon wounds.

That aggressive attacks of some violence occasionally took place among the Worthy Park people is strongly suggested by a number of probable parry fractures and the smashed scapula of Burial 70.

But unlike many Anglo-Saxon sites, such as Thorpe St. Catherine, Norfolk (Wells, 1964 a, pl. 20) evidence of injury by weapons is very slender here. The possible wound on the femur of Burial 78 has already been mentioned and left open to doubt. The only other likely case is Burial 57 (M) the miserable little man with a load of pathology, who has a small linear depression, about 24 x 4 mm, on the R. half of his frontal bone close to the metopic suture. Slight post-

inhumation erosion blurs the details of this lesion but there is a fairly high probability that it was due to a shallow wound inflicted during life by a sharp weapon. But it does not suggest the high drama of a sword slash : more likely a sleazy brawl with carver, cleaver or garden hoe. If this was a wound it presumably healed rapidly and cleanly because no signs of surrounding periostitis or infection are present. The possible sword cuts in the now missing skull of the deformed man in Grave 38 have been described above.

3.9. Infections.

The recognition of infection in ancient bones is often difficult. Flamboyant examples of osteomyelitis, with fistulous openings into the marrow cavity, are easy enough but these are uncommon in Anglo-Saxon skeletons. More typical is a slight roughness or "graining" of the bones - especially of the leg - which at times is difficult to distinguish from the effects of soil erosion and other post-inhumation artifacts. Moreover, even when there is no doubt at all that a bone is affected by periostitis it is unwise to assume that this was necessarily due to infection : lesions of this kind may sometimes be caused by non-infective inflammatory reactions.

At Worthy Park at least 8 persons (6 M - 2 F) have lesions of the leg which appear to have been due to non specific infections such as are commonly caused by staphylococci. The affected bones wary in their severity but fall into a clear pattern of distribution and appearance. A mild example is shown by Burial 17 (1) (M) with slight roughness of the proximal half of the medial surface of the L. tibia. In 50 (M) the proximal third of the L. tibia is similarly affected. More severe is 40 (M) with well marked osteitic thickening of both fibulae. And still more severe is 71 (M) in whom there is roughness, fine pitting and swelling over much of the shaft of the L. tibia, L. fibula and also slight osteitic swelling of 2 L. metatarsals. Burial 81 (M) has a thickened R. tibial shaft. Burial 38 (M) has extensive periostitis which extends over c. 65 mm of the L. tibia and 80 mm of the R. tibia, in both cases of the medial (i.e. subcutaneous) surface of the second quarter distally of the bone. In the women's skeletons, 18 (1) has slight periosteitic roughening of the proximal half of the anterior border of the L. tibia. Burial 42 (F) has periostitis of both fibulae, slight "graining" of the L. tibia and extensive osteitis of the R. bitia with fusiform swelling in the distal part of its shaft.

When the reaction is as severe as in this last case, and also in 49 and 71, it can more properly be called osteomyelitis. This implies that the lesion invaded the marrow cavity, often as a blood borne infection, as the well as affecting the cortex and periosteal regions. In cases such as 18 (1) where the periosteitic reaction is narrowly limited to such a vulnerable area as the front of the shin, it is tempting to think that it may have been traumatic in origin, perhaps caused by a blow or kick on the bone which may or may not have become infected. In other cases deep extension of a varicose ulcer can undoubtedly cause tibial osteitis as in a Roman-British skeleton illustrated by Wells (1973 b). But there remains much doubt as to the principal cause of these periosteitic legs which were very common in Anglo-Saxons and though not especially so at Worthy Park are, nevertheless, present in about 7 - 8 % of surviving tibiae. It is possible that this was some kind of syndrome which no longer exists. Even today there is a curious disease, St. Helenian fever, which is associated with inflammation of the leg bones but is limited to certain families on the island of St. Helena. We may be looking at some quite specific lesion of this kind.

Burial 3 (F) had a slight thickening of her L. femur in the distal half of the linea aspera. This resembles a periostitis but it is uncertain what might have caused it. The affected bone is rougher on the medial than the lateral side of the line. It is clearly a somewhat different type of lesion from those found in the tibiae and it might be no more than a non-infective response to the trauma of a torn muscle. The Vastus medialis, a muscle which extends the knee joint and draws the patella medially and upwards, originates from that area of the bone.

Burials 20 (F) and 57 (M) occur repeatedly in this catalogue of pathology : both are distinguished by the variety and extent of the lesions they exhibit. Each appears to have had some infection. Burial 57 had extensive osteitis, probably a low-grade osteomyelitis, of the proximal phalange of the middle finger of his R. hand. The cause of this lesion, which must have been crippling in its active stage, is uncertain. It may have been due to some penetrating wound of the finger which gave rise to cellulitis of the surrounding tissues or to the spontaneous development of a whitlow which extended deeply to involve the bone. Burial 20 had a slight periostitis of the L. 3rd, 4th, and 5th and the R. 4th and 5th metatarsals. This is rather like what is found in the early stages of leprosy, in which case one could expect to find the foot lesions associated with roughness of the palate and resorption of the inferior nasal spine. In fact, this woman's palate does have a mildly irregular and pitted appearance but this is probably within normal limits and without more conclusive evidence it would be injudicious to diagnose leprosy in this case. Incidentally, this woman may have had an old fracture of the base of her R.4th metatarsal but even if this had been in any way causally associated with the periostitis in her R. foot, it would be unlikely to have had any relevance to her left.

Another ambiguous case is that of Burial 79 (M) who has a very slight roughness and depression on the R. side of the frontal bone. This might have been the result of trauma during life, with or without infection of the deep tissues of the scalp, or it could have been due to that common lesion an infected wen or seba-

ceous cyst. The change in the bone is so slight that the possibility, even, of a post-inhumation erosive process is difficult to exclude.

The only other infection which can be identified with certainty in these persons (apart from dental disease which is discussed below) is sinusitis of the maxillary antrum. Burials 41 (M) and 79 (M) had some roughening of the floor of the R. antrum of Highmore, in Burial 70 (M) it was present on the L., and in 58 (F), 61 (F) and 83 (M) it was bilateral. The condition was recognizable only because some part of the antral wall had been destroyed by post-mortem damage and a view of the interior of the sinus could be obtained. It is reasonable to suppose that other unidentified examples may exist in skulls with intact antra. To produce these changes in the bone the sinusitis would probably have had to become chronic, with a thickened antral mucous membrane and the cavity more or less permanently full of pus. Such a condition could be conveyed to many persons as a result of droplet infection being passed on from one to another as they huddled closely together around their fires in the damp chill of a winter's night. It is likely, too, that the smoke laden atmosphere would have aggravated the condition and hastened its spread. We need no great imagination to picture the coughing and spluttering produced by the smoke and the snorting, hawking, snuffling and spitting consequent on a sinus full of pus. The air must have been putrid with the stench of halitosis.

3.10 Neoplasms.

Neoplasms include the benign and malignant (i.e. cancerous) growths. Cancers are rather uncommon in early populations though less so than was formerly believed and no clear evidence of one was found at Worthy Park, though Burial 41 (M) remains a possibility. The commonest form of new growth in ancient skeletons is the benign **osteoma**, which is often found on the skull and is sometimes referred to as a "button" or "ivory" osteoma on account of its smooth and highly polished appearance. A tumour of this type occurred in Burial 36 (M). It was a small osteoma, c. 7 x 4 mm, 13 mm above the medial part of the R. orbital margin. It hardly rose above the level of the surrounding bone and would have been quite harmless. This was the only innocent neoplasm recognised.

Malignant tumours were not found but a cranial lesion in Burial 41 (M) might have been due to deep penetration of a rodent ulcer, i.e. a basal cell carcinoma. Burial 61 (F) had a swelling of the left side of the mandible for which the diagnosis of ameloblastoma had to be considered.

Both these cases are described below in the **Miscellaneous** section (§ 3.13, p.).

3.11. Cribra orbitalia.

The presence or absence of cribra orbitalia can be identified in 95 orbits from 54 persons. Of these 44 are adults, 10 juveniles. Every adult and 2 juveniles are sexable ; 46 in all. The total frequency of cribra is 21 (22,1 %) of 95 orbits or 9 (16,7 %) of 54 persons. The distribution of the lesion is very uneven. It is absent in 21 males, present in 3 (13,0 %) of 23 females and present in 6 (60,0 %) of 10 juveniles. This relatively high rate in young people is commonly found in early cemeteries though it is still uncertain whether this is because cribra was usually a self-limiting condition or because it was part of a lethal syndrome which killed them before they attained adulthood. It is also notewirthy that in most populations the severest lesions are found in juveniles not adults . this, too, applies to Worthy Park where the most advanced disease occurs in Burials 4 (2 years) and 31 (5 - 6 years). The difference in incidence between the men and the women may be related to nutritional differences. There is much evidence to suggest that cribra orbitalia is partly due to **iron deficiency anaemia** and if so its presence in women rather than men may suggest that in childhood the girls were given less meat and other blood forming foods than their brothers, thus encouraging the development of this lesion which may have been aggravated later when the onset of menstruation led to further depletion of their haemoglobin and organic iron reserves.

It is significant that of the affected juveniles at Worthy Park the only two which are sexable are both girls.

However, even in females the incidence of this condition was not especially high and it would be unwise to assume that there was more than a moderate difference in the nutritional status of boys and girls.

Where cribra was found it was always bilateral if both orbits were available for inspection.

3.12. Dental disease.

Ignoring a few small and unsexable fragments 89 adult jaws can be identified in the Worthy Park material : 18 (M) maxillae, 21 (M) mandibles, 23 (F) maxillae, 27 (F) mandibles. In these 89 jaws 1424 tooth positions ought to be present but 168 of them have suffered post-inhumation damage and only 1256 are now identifiable. In these 1256 positions there are 29 (2,3 %) unerupted teeth, 25 of which are third molars. Of the 1227 erupted teeth 83 (6,8 % were lost during life and 190 (15,5 %) have been lost postmortem. This leaves 954 teeth now present in the jaws.

The 6,8 % antemortem loss is a fairly low one. It can be compared with a loss of 7,9 % at Jarrow Monastery, 11,1 % at North Elmham and 15,9 % at Red Castle, Thetford and suggests a better level of oral health at the Hampshire site. The causes of tooth loss during life are complex and not fully understood : advanced caries is often important but healthy teeth, also,

may be shed as a result of periodontal disease of various kinds. Table 8 shows the pattern of antemortem loss at Worthy Park.

TABLE 8 – Distribution of antemortem tooth loss

SEX	JAW	Erupted Places	Lost a - m	%
M	(Max	242	14	5,8
	(Mand	316	19	6,0
F	(Max	299	29	9,6
	(Mand	370	21	5,7
M + F	(Max	541	43	7,9
	(Mand	686	40	5,8
M	Max + Mand	558	33	5,9
F	Max + Mand	669	50	7,5
M + F	Max + Mand	1227	83	6,8

The total loss was slightly higher in women than in men but no great significance can be attached to this in view of the smallness of the sample.

The 954 in situ sexed adult teeth included 36 (3,8 %) which were carious : 22 (4,9 %) 0f 451 in males and 14 (2,8 %) of 503 in females. This is a moderately low rate but it needs slight correction because 74 loose male teeth (none carious) and 47 loose female teeth (2 carious) must be added to the total. This gives : M 22 (4,2 %) carious in 525 teeth and F 16 (2,9 %) carious in 550. A further correction is the addition of 142 erupted permanent teeth in juvenile jaws, none of which are carious. The final caries rate for all surviving permanent teeth is, therefore, 38 (3,2 %) of 1217.

Table 9 gives some perspective to this figure by a comparison with a few other series.

In adults the commonest tooth to become carious in many populations is the mandibular first molar. Here, it is the female maxillary second molar with a caries rate of 7 (13,5 %) in 52 teeth but in view of the very small sample available it would be improper to lay much stress on this or to enumerate the decay rate of each tooth separately. It suffices to say that the overall male and female molar rate is 25 (7,3 %) of 342 teeth ; premolar 7 (2,7 %) of 264 ; canine 0 (0,0 %) of 134 and incisor 4 (1,9 %) of 214.

From the deciduous dentition 83 teeth survive of which 2 (2,4 %) are carious, a L. on the upper jaw and a R. on the lower.

The site of origin of the caries cavity cannot be determined in 3 of the adult cases. In the remaining 33 it appears that 4 (12,1 %) began cervically ; 7 (21,2 %) occlusally and 22 (66,7 %) interstitially. This is very different from the predominance of occlusal cavities in modern jaws but is typical of early populations. It is very close, for example, to what was found at Jarrow (9,7 % - 19,4 % and 70,9 %) and at North Elmham.

Periodontal abscess cavities were not very common at Worthy Park : eleven persons had 22 between them. They were all small and sometimes difficult to distinguish from the normal resorption of the alveolus which follows loss of a tooth. Only 5 of these abscesses can definitely be associated with a carious tooth so it is likely that several of the others were du to spicules of bone or husks of grain becoming lodged between the tooth and the gum, eventually leading to infection of the alveolus. These 22 abscesses represent a frequency of 1,8 % in the 1227 erupted teeth, compared with 1,1 % at Jarrow and 2,5 % at Monkwearmouth. It is perhaps worth recording that Burials 40, 57 and 73, who were noted above as having been unhealthy persons much afflicted with arthritis and probably of low social class, again figure prominently here having more than 30 % of the periodontal lesions between them.

Of the 29 unerupted teeth 25 (86,2 %) were third molars : this is 17,1 % unerupted in the 146 identifiable third molar positions. There was a difference between the sexes : in males 6 (8,9 %) of 67 were absent, in females 19 (24,1 %) of 79 were absent. These "unerupted" moolars should, more properly, be called "suppressed" because radiography shows that they had not formed in the jaw. At Jarrow Monastery 31,4 % of third molars were suppressed, at North

TABLE 9 – Adult dental caries frequency

POPULATION	DATE	AUTHORS	CARIES %
Worthy Park	Early Saxon		3,2 (M 4,2 - F 2,9)
Jarrow Monastery	Late Saxon	Wells (1969)	2,8 (M 1,9 - F 3,8)
Monkwearmouth	Late Saxon	Wells (1969)	0,4
North Elmham	Late Saxon	Wells (1980)	6,4
Red Castle, Thetford	Late Saxon	Wells (1967)	1,5
England	Early Saxon	Hardwick (1960)	8,1
England	R-B	Emery (1963)	11,4
York	R-B	Cooke et al. (1958)	4,6
Belgium (Ciply)	Frankish	Brabant (1963)	12,5
Belgium (Renaix)	11th cent.	Brabant et al. (1960)	8,1
Denmark	12th - 16th cent	Isager (1938)	2,5
Lund, Sweden	1000-1520	Mellquist (1939)	4,9
Norwich	1700-1858	Wells (1968)	18,9
Britain (Pooled)	I.A.	Wells (1975 a)	10,3

Elmham 16,4 % and at Monkwearmouth only 2,0 %. The difference between these populations are likely to be genetic in origin.

One maxillary incisor (Burial 21), 2 mandibular canines (Burial 69) and 1 maxillary first premolar (Burial 40) had formed but failed to erupt.

Dental attrition was universal in these jaws but the small sample available makes it inappropriate to record elaborate degrees of erosion for each tooth. Instead, for simplicity of description the general pattern of the jaw is used and is codified on a simple five point scale : 0 = no attrition - 1 = the enamel and cusps are worn down with no more than one or two uncoalesced exposures of dentines - 2 = separate areas of exposed dentine have coalesced, most of the occlusal enamel is eroded but with no more than an occasional slight concavity of the occlusal surface ; 3 = extensive concavity of the occlusal surface is present, with considerable reduction of crown height, but with these changes often compensated by proliferation of secondary dentine - 4 = extensive destruction of the crowns of the teeth, opening the pulp cavity and often with the roots left separately exposed.

For brevity the five degrees may be referred to as absent, slight, moderate, severe and gross.

At Worthy Park 50 sexed adults scored a total of 134 degrees of attrition, an average of 2,7, with negligible difference between men and women. Although this is heavy attrition by modern standards it is not so by archaic ones. It is almost identical to that found at Jarrow (2,6) or Monkwearmouth and well below the value recorded at North Elmham (3,1). Juveniles averaged 2,0 per person on deciduous teeth, individual jaws ranging from less than 1 to more than 3. This is moderately high level for the first dentition. At Jarrow it was only 1,3, with more than 20 % of the children scoring less than 1,0 and only 12,5 % scoring 3. At Worthy Park only 10 % scored less than 1,0, 30 % scored at least 3.

Deposits of calculus or tartar are present on many of these jaws and may be widespread but in most persons they are quite light. They tend to be more or less evenly scattered over the teeth rather than being most evident opposite the orifices of the salivary ducts, as in modern jaws. Tartar is difficult to assess because of the subjective nature with which it must be judged but, in general, there seems to be little difference here between the sexes in its severity or incidence. That it began early in life is shown by its sporadic occurrence on deciduous teeth.

Hypoplastic defects of the enamel are present in at least 26 (54,2 %) persons from Worthy Park. This is a much higher incidence than was found at Jarrow or Monkwearmouth, at both of which sites about 20 % of adults were affected, but it is close to the North Elmham figure where about half the jaws had some degree of enamel hypoplasia. In contrast to the occurrence of calculus, there is a clear difference between the sex incidence of hypoplasia at Worthy Park : 16 (64 %) of 25 women had this condition but only 10 (43,4 %) of men. Enamel hypoplasia is due to some adverse influence such as disease or malnutrition which affects the development of the tooth in early childhood. In modern dentitions the most commonly affected teeth are the central incisors, lateral incisors and first molars in descending order of frequency. At Worthy Park a higher incidence was found on the canines, premolars and second molars. This difference indicates that, whereas modern hypoplastic defects are chieflydue to diseases which attack the child during its first 18 months of life, those at Worthy Park were the result of morbid conditions largely affecting the children during the 2 -4 year period.

A few miscellaneous anomalies should be mentioned. In general, the shape and position of teeth at Worthy Park were good, with few orthodontic defects but a few were found. Among the men Burial 13 had a small diastema between 11 and 21 ; and 57 had diastemata between 13 - 12 and 22 - 33 ; 17B (1) had marked overbite (the normal pattern here was edge to edge occlusion or only very slight overbite) , Burial 69 had unerupted mandibular canines, presumably with retention of the deciduous canines. Among the females Burials 2 and 42 had considerable overcrowding of the anterior mandibular teeth. In Burial 60 the incisors and 15 were much rotated in the alveolus ; and 74 had the rotated through almost 90°. In 21 the 22 is a simple pegshape, 12 is unerupted and 13 has moved close to 11 to take its place, leaving a gap in the alveolus between it and the normally placed socket of 15. Burials 8 and 58 have tooth roots deformed by severe radiculitis. Among children 17 B (2) has prominent Carabelli cusps on 16 and 26 ; 59 has extensive rotation of the permanent maxillary incisors and the 15.

A peculiar mandibular swelling in Burial 61 (F) is discussed in the **Miscellaneous** section (§ 3.13, p.).

The total dental evidence at Worthy Park permits several inferences to be made. The overall level of oral health as shown by the amount of antemortem tooth loss and the caries rate was fairly good by Anglo-Saxon and other early standards. This suggests a moderately good diet and the possibility that the modest frequency of caries may have been partly due to the protection afforded by an intake of fluorine. This element might have come from their water supply although it is probable that they usually drank from shallow surface sources containing little natural fluorine*. Perhaps they were able to eat sea fish often enough to obtain a high amount of this trace element.

The moderate degree of dental attrition does not indicate an especially tough diet and this is obliquely confirmed by the low frequency of osteoarthritis

of the temporo-mandibular joint. But the fact that dental abrasion began early in life and was fairly extensive in deciduous teeth before the chewing muscles had developed great power suggests that the food was often abrasive. If so, this might have been due to grit shed into the flour from friable hand querns or perhaps adherent to cakes and roasts as a result of cooking techniques, or to champing of raw roots and vegetables which still retained particles of soil and sand around them. A very noticeable feature of the dental attrition pattern is its localization to certain groups of teeth, especially in the women.

* *I am indebted to M.P. Soulsby, Area Biologist to the Southern Area Water Authority, for the following information, conveyed by letter 13.9.78 : "Fluoride levels have been measured regularly in both the River Itchen and River Test and in Groundwater sources and have been consistently at a level of less than 0,22 ppm, approximately at the limits of detection of the analysis method. These levels are in general lower than in many other British rivers and in the unlikely event that the levels of fluoride have decreased significantly over the last 1000 years, it would appear they are unlikely to be the cause of the condition of your Anglo-Saxon teeth" SCH.*

Thus, Burials 42, 63 and 80 had heavy attrition of the anterior teeth, notably the maxillary incisors. This may sometimes be due to nibbling bones when all the molars have been shed but at Worthy Park, despite some molar loss, this is not an adequate explanation. Burial 77 (F) had good molar occlusion yet her anterior teeth were very saverely eroded. It is difficult not to think that these cases may have been due to using teeth as tools of some kind : perhaps to bite through threads when sewing, prepare leather thongs or to strip osiers for basketry. Among the men, Burial 57 shows a somewhat similar pattern of heavy anterior erosion. Burial 90 is another example.

Heavy deposits of tartar often indicate a soft, pappy diet with a high carbohydrate intake as from porridges, frumenty and bread puddings. The small amount of calculus at Worthy Park points to strong use of the jaws from an early age with a diet that was demanding enough to keep the teeth relatively free from these deposits. There is no dental evidence that toothpicks or other cleaning devices were used.

The overall impression from these teeth is that the Worthy Park people usually had an adequate amount of meat in their diet, which may have been roasted in embers rather than seethed in cauldrons ; that their carbohydrate consumption was not especially high, was unlikely to be predominantly of a porridge-like consistency nor, at the other extreme, was it baked into bannocks of an excessively hard "dog biscuit" type. It is also likely that children were weaned quite quickly, though not especially early, on to the same kind of diet that adults ate, rather than being kept on paps and gruels for a long transition between breast feeding and the adoption of a fully adult pattern of eating. Nevertheless, the high incidence of enamel hypoplasia, which indicates some adverse factors affecting these children in early childhood may be related to weaning troubles consequent on a too rapid transition to adult food. And the fact that the incidence of hypoplasia was 50 % higher in women than in men, and also tended to be more severe in women, strongly suggests that the boys were more favoured than the girls, especially perhaps when food supplies were short, and that the girls often grew up suffering from a slight degree of malnutrition which their brothers largely escaped.

The generally good occlusion of these jaws is further evidence that they were used strongly on a solid diet containing plenty of meat which had to be well chewed. The occasional cases of malocclusion and overcrowding of teeth serve, however, to hint that not all the people were well fed all the time. The poor functional development of a few jaws may reflect an inadequate standard of diet for at least a few persons in the group and it is probably not without significance that the most obtrusive examples of this occur in female burials.

3.13. Miscellaneous diseases.

There remain a few miscellaneous or problem lesions which have not been discussed above or have been only briefly mentioned.

Burial 11 (F) was an elderly woman who had exceptionally large and deep channels for her meningeal blood vessels in the L. side of her frontal bone. This is a condition which is typical of Paget's disease (osteitis deformans), where it is a response to the greatly increased blood flow through the arteries and veins. It may also be found in other conditions including certain forms of neoplasm. In the present instance it is difficult to decide whether these channels are pathological or merely a freak anatomical variant. Although she would have been an appropriate age no other feature of her skull or her surviving post-cranial bones supports a diagnosis of Paget's disease and no other relevant pathology is detectable. At present it seems that this problem must be left unsolved.

Burial 58 (F) has a smooth swelling, 30 x 12 mm, on the medial border of the R. femur, just proximal to mid-shaft. It rises c. 3 mm from the surface of the bone. This lesion much resembles the kind of osteoid osteoma described by Wells (1965 a) in an Anglo-Saxon femur from Caister-on-Sea. The diagnosis would depend on its radiographic appearance but, unfortunately the specimen does not yield good films and some doubt must remain. An alternative would be an ossified haematoma from a subperiosteal haemorrhage but nothing else about the lesion supports this. In contrast to this, Burial 92 (M) has an area of thickening on the medial surface of the distal third of the L. tibia. The bone is broken at this point and the full extent of the lesion cannot be determined. Its surviving part is c. 30 x 16 mm and rises 5 mm above the normal surface of the bone. This pro

bably is an ossified subperiosteal haematoma which was originally caused by a kick on the shin or some similar injury.

In Burial 45 (M) the L. humerus, ulna and radius are very much more slender than those of the R. arm. Mid-shaft maximum and minimum diameters are 24 x 18.3 mm on the R., compared with only 19,7 x 15,7 mm on the L. If this could be confidently accepted we should be justified in diagnosing a L. arm atrophy or paresis, perhaps as a result of poliomyelitis or a birth injury. Unfortunately these bones have been much worn by post-inhumation erosion and it is uncertain how much of their present disparity in size existed during life. With Burial 80 (F) we are on firmer ground. Here, again the L. humerus is unmistakably smaller than the R., and was so during life, but the difference in length is only 10 mm and this is within the limits of normal variability. While we cannot, therefore, wholly exclude the possibility that poliomyelitis may have been present in these people it would be reckless to assert that it was on this evidence alone. There is, however, another fragment of evidence : the coracoid process of the L. scapula is much lighter and less robust than that of the R. shoulder. The implication of this is that it took a lighter muscle pull than its fellow of the opposite side. The muscles which take origin from this structure are the pectoralis minor, the coracobrachialis and the short head of the biceps brachii - part of the biceps-brachialis complex. These two are extremely powerful flexors of the elbow join and supinators of the forearm and their presumed difference in size between the two arms, together with the slight difference in robustness of the humeri, adds substantially to the possibility that some pathological atrophy and paresis was present in the L. arm. In which case poliomyelitis would be a likely cause... which would make us wonder whether, as a psychological reaction to the deformity, this woman had a sour and waspish nature that encouraged her neighbours to think ill of her, deem her a witch and bury her alive - thus explaining the archaeological problem of her posture.

Burial 21 (1) (F) had only a few minor pathological changes but was distinguished by having been buried with the remains of a newborn baby or full term foetus. I have emphasized elsewhere (Wells, 1975 b) that this must not necessarily be assumed to imply an obstetric death of mother and child, though the possibility that it was so cannot be entirely excluded. Unfortunately, the precise relationship of the foetal bones to the woman's skeleton remains uncertain but it seems probable that they were in the region of the upper abdomen. If this were so it would be compatible with the woman having died near the end of her pregnancy but there is no shred of evidence to indicate whether her death was due to an obstetric cause or not.

A very different situation was found with Burial 26 (F) . This was a woman aged about 27 - 30 who was also buried with a newborn child. The remarkable feature here was that the baby appeared to have been only half born at the time of burial. Its head and trunk lay between the woman's thighs but its legs and feet were within her pelvic region as though they had not fully emerged from her vagina. This seemingly perplexing situation does, in fact, admit of several not very unusual obstetric solutions. The case has been fully discussed in another publication (Hawkes and Wells, 1975) and will not be elaborated here. It suffices to say that we think the most likely explanation is that the woman died as the result of a long and exhausting labour, which had already led to intrauterine death of the foetus, and that the full delivery of the child was impeded by a short umbilical cord or one which was wrapped several times around its neck - an exceedingly common obstetric hazard.

Burial 78 has already been mentioned as the probable teenage victim or rape. Reference was made then to a lesion at the distal end of her L. femur : a small cavity in the posterior surface of the bone, close to the lateral epicondylar ridge. It measures 21 x 10 mm and is 5 mm deep. There is a clean "healed" margin along its medial side but laterally it is slightly blurred by soil erosion. There is musch ambiguity about this lesion but the diagnosis would seem to be either a non-ossifying fibroma or direct, penetrating trauma to the bone associated with a low grade infection.

Another juvenile was Burial 31, a child of 5 or 6 years who has already been noted as suffering from severe cribra orbitalia. The skull has been broken into small pieces but several areas of vault survive to show hyperostosis spongiosa of the frontal and parietal regions. This is no doubt related to the orbital disease and is probably a response to iron deficiency anaemia due to malnutrition - specifically lack of meat, green vegetables and peas or beans.

Burial 41 (M) has a roughly circular lesion, C. 20 mm, in diameter, above the medial part of his L. supraorbital margin and about 5 mm from the orbit. This lesion is 8 mm deep but does not encroach on the frontal sinus. Around the supero-lateral quadrant of this cavity there is an extremely low ridge of bone, as though due to an expanding growth. There is no trace of healing and the appearance is strongly suggestive of a malignant tumour similar to those described by Well (1964 a and 1964 b). However, a good radiograph shows no evidence of any generalized myelomatous or carcinomatous secondaries elsewhere in the skull. The lesion might be due to deep penetration of a sebaceous cyst or to a rodent ulcer, with about equal probability.

In Burial 61 (F) a swelling is present on the L. side of the body of the mandible. It extends from the mental foramen back to the level of the 38 tooth, i.e. c. 37 mm in length and it is 18 mm in its vertical extent. It does not appear to be due to an exostosis or trauma.

Unfortunately, the internal structure of the bone has been somewhat obscured by post-inhumation changes and radiography of this swelling still leaves the diagnosis in doubt. It seems to show a cavity in the mandible, near the antero-inferior borber of which there are a number of small granular objects. The appearance does not resemble the common dental cyst and the diagnosis might be (a) a complex composite odontoma, (b) a compound composite odontoma, (c) an ameloblastoma or (d) some other neoplastic or cystic condition. If it is (b) the "granules" near the lower border may be denticles changed by post-inhumation factors. No unassailable diagnosis can be made

Burial 73 (M), one of the most pathological of the skeletons, has extensive remodelling of the head of the L. humerus, probably from a tear of the capsule of the joint antero-medial to the inter-tubercular sulcus. A similar but less severe condition is present on the R. humerus. These lesions might have been caused by violent occupational strains but it is not improbable that they could have been due to deliberate and excessive twisting of the arm by an aggressive thegn or overlord.

There remain a few vertebral lesions which have not yet been described.

This same Burial 73 (M) has an anomalous articulation between the spinous processes of the L3 and L4 vertebrae, which is additionally distinguished by an osteocarthritic reaction with eburnation of the contact surfaces. It is likely, but not certainly, to have been congenital in origin with secondary eburnation as a result of heavy use of the lumbar vertebrae. In Burial 63 (F) there is a large osteophyte which rises about 20 mm from the L. lateral side of the 1st sacral segment. This may be causally related to two areas of anterior epiphyseal dysplasia on the anterolateral contiguous borders of L4 and L5. The double vertebral lesion extends over a distance of c. 31 mm across the two bones and the osteophytotic flange on the sacrum rises at least as high as the inferior border of this anomaly on L5. It is virtually certain that trauma contributed substantially to this complex of lesions.

Finally there are four persons with synostosis of lumber vertebrae. Burial 2 (F), which has been noted above, was an elderly lady with fusion of L2 and L3. There is slight scoliosis (lateral spinal curvature) concave to the left and marked kyphosis (forward angulation). The fused vertebrae are severely deformed with collapse of their bodies. A radiograph shows gross narrowing of the intervertebral disc space and secondary sclerosis of the bones. It is probably not infective in origin, and therefore not tuberculosis, but is almost certainly due to a fracture of L2 which has collapsed into L3. Burial 20 (F) has fusion and scoliotic angulation of the L1 and L2 vertebrae. There are some very small fistulae into the body of L1 but the condition does not resemble a chronic tubercular or actinomycotic infection. A consideration of the gross specimen and its radiographic appearance shows that it must be diagnosed as a spondylosis, probably not of infective origin though it might possibly be due to an indeterminable organism. Burial 40 (M) has synostosis of the bodies and posterior joints of L4 and L5. It is a very poor specimen but the evidence here suggests that it is a spondylosis of infective origin, not due to tuberculosis. And lastly, in Burial 85 (F) two vertebrae are fused and show extreme narrowing of the disc space between them. The disc would not have been present at the time of death but the adjacent surfaces of the vertebral bodies are quite dense and clear in the radiographs. This is not chronic T.B. ; nor Scheuermann's disease because the vertebrae are not elongated. Again it is a spondylosis of unknown origin, probably not infective but just possibly due to an unidentifiable organism.

These four cases are interesting in that they do not support the suggestion that tuberculosis was present at Worthy Park.

In view of this it is particularly unfortunate that the thoracic vertebrae of Burial 39 (F) are not now with the rest of its skeleton in the Duckworth Laboratory. Mrs. Sonia Hawkes's **in situ** photographs of this burial show a marked kyphotic or humped-back condition of the spine in the thoracic region and in her field notebook she commented that this was caused by "fusion and deformation of several vertebrae". When the bones were first transferred to the Duckworth Laboratory, Mr Bernard Denston noted what he took to be tuberculosis of the first six thoracic vertebrae. It is a great pity that this case could not have been examined, along with other synostosed spines from this cemetery, by a trained palaeopathologist.

3.14. Absent diseases.

A brief mention may be made of a few diseases which might have been identified at Worthy Park but which, in fact, appeared to be absent.

That the diet of these people was not always adequate is suggested by the presence of **hyperostosis spongiosa** and **cribra orbitalia** both of which may be manifestations or iron deficiency. Other deficiency diseases were not identified. **Rickets**, which is due to lack of Vitamin D is always very rare in Anglo-Saxon contexts and no trace of it was found here. **Scurvy**, due to deficiency of Vitamin C (ascorbic acid) was likewise absent. Despite some very slight evidence that **leprosy** might have affected these people no definite case was found and unless more convincing material were forth coming we must assume that they were free from the disease. The same can be said of **tuberculosis** although a few of the synostosed vertebrae have a superficial resemblance to it. No hint of **syphilis** is present. **Poliomyelitis** is just possible for

Burials 45 (M) and 80 (F) but cannot be firmly diagnosed. **Malignant tumours** are absent unless the frontal lesion of 41 (M) was due to a rodent ulcer. **Kidney** and **bladder stones** were not identified. No **fractures** of the nose, mandible, clavicle, pelvis, femur, patella, fibula, carpus or tarsus were found. **Gout** was not present. Nothing suggestive of a **trephination** was detected and, apart from possible dental extractions, no other surgical operation was recognizable.

3.15. Cause of death.

Apart from weapon wounds that are obviously severe enough to have been rapidly fatal it is uncommon to be able to identify the cause of death, with complete certainty, in early burials. Evidence of malignant disease, widespread osteomyelitis or advanced leprosy may be strongly presumptive but some doubt is usually present even in such cases : a man may have extensive leprous lesions yet die, by chance, of an intercurrent pneumonia or dysentery.

At Worthy Park the archaeological findings hinted at violent, indeed punitive, deaths for Burials 43, 78 and 80 but the osteological evidence was reasonably convincing only for Burial 26 (1). This was the woman with the foetal bones in her pelvic region and between her thighs, who presumably died as a result of difficult childbirth.

Burial 31 is the child with hyperostosis spongiosa. It is probable, but unprovable, that its death was related to that condition - perhaps from general malnutrition or progressive anaemia. Whether the osteomyelitis of Burials 49 and 71 was severe enough to cause their death is doubtful : their only surviving lesions appear to have healed. Until antibiotics were available this was an extremely serious disease with a high mortality but in neither of these cases are the bone lesions extensive and the disease may not have spread much further than we can now identify it. Of the two, 71 is more likely to have succumbed to it than 49.

For no other person at Worthy Park can the cause of death be guessed with tolerable probability.

3.16. Parity.

As a result of the loosening of the pelvic articulations and the stretching of the muscles and ligaments which are attached around them, changes develop in the female pelvis during the course of pregnancy, labour and the puerperium (Angel, 1969 - Hougton, 1974 and 1975). These changes are concentrated round the pubic symphysis and the pre-auricular groove of the iliac bone ; their extent is partly a function of the number of pregnancies a woman has had. No precise estimation of parity can be made from these features but it seems possible to make an approximation to the number of babies born.

At Worthy Park 9 women have pelves well enough preserved to investigate their reproductive history. Table 10 shows the probable number of children they had borne (omitting miscarriages which are undiagnosable).

TABLE 10 - Number of children born to each woman

Burial	Probable range	Average
2	1 - 2	1 1/2
18 (2)	4 - 6	5 5
20	1 - 3	2
26	1 - 2	1 1/2
27	2 - 4	3
55	3 - 5	4
60	0	0
63	1 - 3	2
72	1 - 2	1 1/2

It will be seen that the averaged sum of births produced by these 9 women was 20,5 i.e. 2,3 per woman. If the likely minima from the probable ranges are averaged the total is 14 or 1.6 per woman ; if maxima are used the result is 27, or 3 per woman.

These figures may appear to be too low because it is commonly believed that before french letters were available, and latterly the contraceptive pill with its virtual 100 % efficiency, with a new conception following rapidly after the birth of the latest baby. There are very strong reasons for rejecting this view (Wells, 1975 b) and the probable average of about 2,3 babies born to the Worthy Park mothers is well in line with what can be inferred from many other early burial grounds. Even if we allow them the maximum number of infants based on the above Table, 3,0 per woman, it will be seen that, assuming a moderately high infant mortality (by our standards), we should not expect a rapid growth in population. Where it is possible to reconstruct, for ancient groups, the change in population over several centuries (Acsadi and Nemeskeri, 1957 - Hooton, 1930) it is usual to find only a slow increase in their numbers and, of course, occasional decreases. It is likely that this was due as much to low fertility as to high infant mortality.

At Worthy Park it is not possible to trace the graph of the rise or fall in their numbers on purely osteological grounds.

3.17. Muscle development.

One of the most important functions of the skeleton, whether endo - as in vertebrates, or exo - as in molluscs and other creatures, is to provide attachments for muscles. These attachments are usually marked by some roughness, ridge, pit, tuberosity or similar feature and because bone is an extremely plastic tissue the extent and salience of the areas give some indication of the strength and development of the muscles which are attached to them. It is common

knowledge that the rugosity of skeletons does not depend on their size : small persons often have huge attachments for muscles and tendons, large persons may have smooth bones with weakly developed markings. Because of this the study of the relative development of the different muscle markings in a skeleton may enable us to infer which muscles were most used... and therefore what movements were most employed. Unfortunately, the versatility of such joints as the shoulder, elbow and hip, combined with the multi-purpose ability of certain muscles or muscle groups, seldom allows us to be minutely precise in deciding what movements were carried out. Even a seemingly simple unit such as the temporo-mandibular joint and the Temporalis muscle of the human jaw is far more complicated anatomically and functionally than might be supposed. Moreover, it can hardly ever happen that a man - especially in an early community - had such a narrow range of activity that he developed one set of muscles to the almost total exclusion of all the rest. However, if the above caveat is borne in mind the careful study of a skeleton will often justify a range of possible conclusions.

No attempt will be made to analyse the musculature of every person at Worthy Park but a few representative and contrasting examples will be given. This approach has been virtually neglected by palaeopathologists although many years ago the distinguished surgeon and anatomist Sir W. Arbuthnot Lane (1887) gave a convincing example of what can be achieved by a minute study of joints and their surrounding muscles. He was given the problem of dissecting a cadavre to find out what occupation the man had followed. From his superb knowledge and understanding of anatomy Lane showed that the man had worked in a job that entailed bending forward, reaching out with his arms, straightening his back, half turning and throwing something over his left shoulder. In fact the man had been a coal trimmer who worked in ships' bunkers carrying out precisely the range of movements which Lane had been able to infer. Recently Desse (1975) has drawn attention to various skeletal changes, especially in the spinal column, characteristic of cyclists, skiers, wrestlers, footballers, tile layers, carpenters and sawyers. He thinks it is possible to infer the dominant movements performed by a person from the appearance of his bones.

The brief comments recorded here, simple though they are and limited only to male burials, may inspire other workers to more detailed investigations.

Burial 79 has an overall lack of muscularity, which is especially noticeable in his arms and forearms. It is unlikely that he spent much time on agricultural or other heavy labour and we can more plausibly see him, if not living in idle ease, as a craftsman who specialized in delicate tasks. At the other extreme is Burial 32 who had powerful muscle markings throughout his skeleton. It is difficult to select any one group of muscles here which was especially developed and he must be envisaged as a man who pursued a wide range of strenuous activities. His development would fit that of a general labourer ready to turn his hand (and trunk and legs !) to any heavy task which fell to him. Perhaps he was a small farmer who, round the seasons, was committed to the endless variety of heavy work which his livelihood entailed. Burial 83 was a man of generally sturdy build but with particularly strong thigh, leg and foot muscles and an especially powerful development of the Pronator quadratus and Pronator teres. These are the muscles which turn the hand on the forearm and must be forcefully used when heaving or turning an object from side to side against resistance. His Flexor digitorum profundus was also well developed. This combination of strong legs with powerful fore-arms and hand grip may suggest that he specialized as a plowman. His sholder arthritis would be admirably compatible with such a role and must add to the likelihood of the conjecture.

Burial 44 also had extremely powerful forearms and hands though his lower limbs were less strongly developed than those of 83. A possibility is that he was a blacksmith, wielding heavy hammers and pincers as he worked the refractory metal. Again, the associated pathology - osteo-arthritis of the wrist, a tear of the insertion of the deltoid muscle, and arthritic hips from jerking and swaying his trunk - are wholly compatible with the suggestion. Burial 94 has enormously developed deltoid tuberosities on his humeri and powerful Pectorales majores and Subscapularis muscles. The deltoid is a strong elevator of the arm and also contributes importantly to drawing the arm backwards and forwards and forwards and to rotary movements of the shoulder joint. The other two muscles rotate the humerus and draw the arm towards the thorax. If we had to infer the most likely lumberjack among the Worthy Park men Burial 94 would be the first choice. A life spent swinging an axe to fell trees and then dragging or lifting heavy sections of their boles would explain the exaggerated development of his shoulder girdle muscles : to which his arthritic shoulder joints may bear additional testimony.

Burial 57, although a smallish man, also had exceptionally well developed musculature of his Pectorales majores, Subscapularis, Supra and Infraspinati, Deltoids, Brachialis, Triceps brachii, Flexores carpi radialis and ulnaris, and the Flexores digitorum. This is indicative of vigorous use of shoulders, arms and hands. Perhaps he, too, was especially employed as a wood cutter. He undoubtedly led a physically traumatic life and one result of his occupation was widespread osteoarthritis which affected his shoulders, wrists, hips, feet and spinal column. Burial 73 was not robustly built but he was much overworked and came to develop certain groups of

muscles very strongly. First among these were the Pronators of his forearms and we might picture him as having spent much time at the plow, as was inferred for Burial 83. But when his extensive pathology, which includes arthritis, exostoses, synostosis and fracture, is viewed in conjunction with his specially developed muscles it may be more plausible to see him as the horse or ox breaker of the group : a groom exposed to violent jerks, wrenches and falls whilst always having to use his arms and forearms to their maximum power. Finally, Burial 95 was distinguished by no great development of arm or trunk muscles but by very sturdy attachment of his Soleus, Gastrocnemius, the Tibiales anterior and posterior, and other leg muscles. These are all muscles which are much used in quiet, steady walking over hill and plain and this may have been the man whose job kept him tramping around the country, perhaps as shepherd, drover, waggoner, wandering pedlar or tinker.

It would be too much to expect that each of these inferences is wholly correct. To achieve greater precision we should need skeletons which are more complete and less eroded than most of the Worthy Park ones. But if we are alert to the possible margin of error in these conclusions and are prepared to accept a range of likely occupations for each person, rather than a narrowly exclusive one, we can do much to lift them out of their misty anonymity. They become almost as real as the coalman, the bank clerk, the tractor driver or the professional footballer whom we meet at the local pub.

There is, however, need for caution in considering the above suggestions. Whereas burials 57 and 73 had no weapons in their graves and 32 had only a small seax or large knife, 79, 83 and 94 had spears, while 44 and 95 had shields as well as spears. It is believed that only freeman in early Anglo-Saxon society carried spears (Swanton, 1973) and iron-bossed shields must have been symbols at least of modest affluence. If the interpretation of their muscle development is correct, it follows that at least some men of free warrior status in the Kingsworthy community may have laboured in wood and field and carried out such specialist trades as blacksmith. Other weapon-bearing men in the cemetery were more normal in their musculature, however, suggesting that some could delegate the heavy tasks. The more prosperous freemen will have been slave owners, the employers presumably of such individuals as 57 and 73.

There remains the problem of how far the use of the weapons themselves affected the muscle development of their bearers. It would be unrealistic to suppose that they spent their whole adult lives fighting or training to use their weapons but we ought to consider the possibility that their sturdy muscle development was due solely or mainly to extensive use of their weapons, either in real combat or in practice for it. Could vigorous use of a spear, seax or shield produce the range of muscular development which they surely had ? This question is difficult to answer. The R. shoulder and arm of 94 would seem to be admirably adapted to hurling spears but the muscles on his L. side were almost equally well developed and it is unlikely that he was ambidexterous in the use of his weapons. Perhaps a two-handed use of a sword would explain what is found but the position of most sword wounds in Anglo-Saxon skeletons suggests that their normal fighting drill was based on simple dextrality and not on a two handed technique - to which their swords would, indeed, be ill adapted.

Burial 44 may also have acquired some of his muscle power from the extensive use of spear and sword. It is less certain that his osteo-arthritis would confirm this. The smooth, continuous flow of movement inherent in the projection of a spear or the sweep of a sword is far less conducive to the onset of arthritic changes than the severe and repeated jarring which is inseparable from hammering iron on anvil or crashing an axe into a standing oak... even if we were prepared to accept that an Anglo-Saxon warrior aplit as many skulls as a blacksmith made nails.

There can be no doubt that weapon training from an early age would develop strong muscles and that these would mould the bones to reveal their presence. (Though precision rather than power may have been the principal aim of training). Much depends on the amount of time spent in these activities and the exact anatomical location of their effects. It is also important to consider the external resistance encountered by each muscle. In fencing, the arms and trunk are vigorously used but not against strong resistance and the resulting development of skeletal muscle ridges is slight. In rowing or weight-lifting, the muscles meet great resistance and the bone response may be enormous. It is true, of course, that the use of weapons may produce not only ridges, etc... at their areas of attachment but also arthritic changes in the joints most stressed by their use. Specifically in the case of spears, it has been noted by Haney (1974) that in prehistoric Californian Indians "atlatl elbow", a form of osteoarthritis due to the use of a spear-thrower, became less frequent in later periods and she interpreted this as due to an increase in technological efficiency and the spread of agriculture at the expense of hunting. But it is important to note here that atlatl elbow was in fact due to hunting, as almost daily occupation, whereas Anglo-Saxon weapon training was probably sporadic and actual warfare undoubtedly so.

In parenthesis, it may be noted that compared with many early populations the Anglo-Saxons were a tall people whose overall linearity gave them long thin muscles rather than short thick ones. To make the most effective use of a spear a long arm and forearm, adapted for speed leverage, are needed. In general this is what the Anglo-Saxons had and what they sho-

wed in common with other typical spear users such as the linear Nilotics, Masai and Australian aborigines. By contrast, to use a bow to best effect demands a stocky physique, adapted for maximum power leverage, arising from a short strong arm and forearm, a broad chest and a thick shoulder girdle. It is not without significance that the most efficient bowmen were found in the mongoloid races, among peoples of thickset, non-linear build : the mounted archers of the Steppes became the scourge of Europe and the East, whilst the short Turkish bow, adapted to the anatomy of its users, attains a greater maximum performance than longer and heavier weapons. It is further noteworthy that the compelling facts the bow as unsuited to them despite their knowledge of it. This may have applied also to the Anglo-Saxons. Conversely, when thickset people adopt the spear or lance, as the Eskimo eventually did, they often use it in conjunction with the atlatl or spear-thrower, thereby attaining an artificial linearity denied them by nature.

In these circumstances the principle of selection in body build obtains : a certain shape inclines its possessors to a certain range of activities and practising that range further develops the shape. What has been said about occupational possibilities for some of the Worthy Park individuals must be seen in the context of these principles, against a background of the modal Anglo-Saxon physique and the functional behaviour appropriate to it.

3.18. Gnawing of bones.

In some early cemeteries bones gnawed by dogs, rodents or other animals are common and are occasionally mistaken for pathological changes (Wells, 1967). Many were found in a Romano-British burial ground at Cirencester (Wells, 1982). Except in relatively rare instances of extensive removal of soil by floods or other natural agencies this presumably indicates that the burials were originally shallow and that the graves were soon neglected. That molestation by animals was a well known and dreaded hazard after battles, where perfunctory interment was often inevitable, is clearly stated in the **Chanson de Roland** (Laisse CXXXII)

At Roncevaux, when Olivier and Roland were arguing whether to blow the olifant and summon help from Charlemagne, Archbishop Turpin persuaded Roland to sound it, by saying :

"Nostre Franceis i descendrunt a pied,
Truverunt nos e morz e detrenchez,
Leverunt nos en bieres sur sumers,
Si nus plurrunt de doel et de pitet,
Enfuerunt nos en aitres de musters,
N'en mangerunt ne lu ne porc ne chen".

To which good advice Roland replied :

"Sire, mult dites bien" and blew.

No skeleton at Worthy Park showed any trace of animal gnawing and this probably implies that the graves were dug deeply and were there after well tended, at least until the bones had lost any savour that might have attracted a sniffing and predatory snout.

3.19. Demography.

In any population the number of adults and children, of men and women, and their age at death are always closely related to the health they enjoyed and the diseases from which they suffered. Therefore a few brief comments about the demography of these Worthy Park people will not be irrelevant. It must be emphasized, however, that what is said here may not give a true picture of the Kingsworthy situation. Only part of the burial ground was excavated and experience from other sites has shown that it is unwise to assume that a sample of a cemetery necessarily gives a reliable picture of the whole. Occasionally early burial grounds had some areas reserved exclusively or predominantly for men, other areas for women ; sometimes children were concentrated in enclaves or infants, apparently, even excluded from the graveyard ; different families and social classes may have had separate plots ; etc... Until the entire site has been cleared uncertainty must remains - as here.

Omitting Burial 64 (2) which through the vicissitudes of travel had become unsuitable for consideration and 26 (2) which was not thought to have attained an independent postnatal life, the skeletons of 96 persons were examined. Of these, 25 (26,0 %) were juveniles less than 18 years of age. Two adults were unsexable but 3 juveniles were sexed, giving a total of 72 persons whose sex was determined with various degrees of assurance and of these 40 (55,6 %) were female, 32 (44,4 %) were male - approximately the reverse of what was found at Jarrow.

These figures do not accord with a demographically "normal" population but in view of the smallness of the sample the divergence is not great. The preponderance of women could be explained in several ways. Perhaps the most probable reason is the socio-cultural one that men were more likely to travel far from the community and be buried elsewhere. But purely biological reasons are not impossible : the juvenile death rate might have been higher among the boys than the girls, although this seems extremely unlikely.

The defective nature of this material makes it imperative to be especially cautious in estimating the age at death. Except for a few of the younger persons it is seldom possible to be precise. Most adult ages were assessed within a range of not less than 10 years, sometimes double that. In a sixth of all skeletons

the evidence was too scanty to justify even an approximate estimate of their age and they were recorded merely as "Adult". For the purpose of obtaining the average age at death of these people the mean of each age range was taken. Thus, although Burial 34 (F) and 41 (M) were thought to have died between 28-40 and 45-60 years respectively these figures were, for convenience, averaged to 34,0 and 52,5 when calculating the group mean. This gave an average age at death of 36,2 years for 26 males and 37,0 years for28 females. In most early populations the men outlived the women by several years although Table 11 shows that this was not invariably so.

TABLE 11 – Mean age at death

SITE	Age at death M	F
Worthy Park	36,2	37,0
Jarrow	41,3	42,2
Monkwearmouth	40,8	37,6
North Elmham	38,2	35,8
Thetford	38,1	30,4
Caister-on-Sea	36,8	31,7
Caerwent	31,6	31,7

We should expect the male daths to average 3-5 years older than the female. Although the difference is slight at Worthy Park, the fact that the men appear to have died a little younger may be related to the unbalanced sex ratio noted above. Complete excavation of the cemetery might give a different picture.

If the above figures are a true representation of the ages at which these people died, they suggest that there was little real difference between the general level of health of men and women. This somewhat conflicts with what was inferred on the basis of the dental evidence given by enamel hypoplasia. The difficulty is, perhaps, more apparent than real. Although it seems likely that in early childhood these girls were slightly undernourished compared with the boys it is probable that as soon as they began to have kitchen duties, and no doubt to learn how to cook, their access to ladle and larder gradually made up for any earlier deficiency, so that by the time they had reached their teens their nutritional status had caught up with that of their brothers.

We have seen that although these people show a wide range of pathology the total amount of disease from which they suffered was not especially high by early - and specifically Anglo-Saxon - standards ; that despite the demands of vigorous living they were mostly fairly healthy persons, as good or better than the Anglo-Saxon average, as far as we can estimate what that may have been. The overall evidence of their demographic statistics, meagre though it is, confirms what can be inferred from their pathology. They seen to have been a population whose elan vital was reflected in a moderately high longevity no less than in the distribution of their by no means excessive arthritis.

The 28,3 % of juvenile deaths is given some perspective in Table 12 which compares this with the rate at a few other sites.

TABLE 12 – Percentage of juvenile deaths

SITE	Burials	Juveniles	%
Worthy Park	99	28	28,3
Jarrow	261	109	41,8
Monkwearmouth	206	79	38,3
North Elmham	206	39	18,9
Thetford	85	24	28,2
Caerwent	121	27	22,3
Owslebury	50	29	58,0

It will be seen that there are interesting differences between the sites, with Iron Age Owslebury having more than three times the death rate of Middle-Late

TABLE 13 – Distribution of juvenile deaths by age

AGE	SITE W.P. n	%	JARROW n	%	M.K. n	%	THET n	%	N.E.P. n	%	Owslebury n	%
< 2	6	21,4	21	19,3	37	46,8	14	58,3	3	7,7	25	86,2
2 – < 4	5	17,9	26	23,9	14	17,7	4	16,7	10	25,6	1	3,4
4 – < 6	2	7,1	8	7,3	2	2,6	3	12,5	6	15,4	0	0,0
6 – < 8	6	21,4	14	12,8	8	10,1	2	8,3	7	17,9	0	0,0
8 – < 10	1	3,6	8	7,3	5	6,3	0	0,0	1	2,6	0	0,0
10 – < 12	4	14,2	11	10,1	3	3,8	1	4,2	1	2,6	0	0,0
12 – < 14	1	3,6	9	8,3	6	7,6	0	0,0	6	15,4	0	0,0
14 – < 16	1	3,6	4	3,7	3	3,8	0	0,0	1	2,6	2	6,9
16 – < 18	1	3,6	8	7,3	1	1,3	0	0,0	3	7,7	1	3,4
?	1	3,6	0	0,0	0	0,0	0	0,0	1	2,6	0	0,0
% Juveniles	28,3		41,8		38,3		28,2		18,9		58,0	

Saxon North Elmham, and Early Saxon Worthy Park having one of the lower rates. But it is more informative to show the distribution of these juvenile deaths. Table 13 does this.

This shows that the Worthy Park death rate, under 2 years, was lower than any except North Elmham and was less than a fifth of that at Owslebury where 68,0 % of deaths in this age group were of newborn infants. At Worthy Park only 3 newborns were found, apart from the half delivered foetus of Burial 26. Why Worthy Park should have a neonatal death rate so much lower than that of Owslebury, Monkwearmouth or Thetford is uncertain. At Owslebury there was some slight osteological evidence of infanticide although the archaeological evidence did not confirm this. That obstetric standards differed much among these groups is unlikely : for any but the most trivial of obstetric difficulties they were probably all equally inept. It is possible that general levels of hygiene varied considerably from site to site and that that level of infant care was much better at some than others. A great deal depends on social and especially parental attitudes. If families want their babies to survive they will show astonishing ingenuity to achieve this. That Burial 38, a monstrous deformity from birth, was reared to manhood by his parents is a clear indication of a social attitude among this group. Elsewhere the solicitous and ingenious rearing of babies with cleft palates shows that some Anglo-Saxons took much trouble to cherish even deformed children who would be unlikely to survive owing to their inability to suckle effectively. It is difficult to resist the impression that the Worthy Park women were devotedly solicitous mothers and perhaps more efficient lactators than the women in some of the other communities, since failure of breast milk with its almost inevitable consequence, resort to cows' milk contaminated by the organisms of enteritis and dysentery, was one of the commonest causes of infant death until the recent era of pasteurized and dried milk. Perhaps a mutual service of wet-nussing or foster-mothering was more develope at Worthy Park than among most early groups. Perhaps our figures are illusory : young babies may often have been given only shallow and perfunctory burial so that the pigs soon rutted them out to devour them without trace. There is no way of knowing what exactly happened.

In contrast to most of the other populations in Table 13 a high proportion (28,3 %) of juvenile deaths at this site fell in the period of middle childhood between the ages of 6 and 12. Again, if this is a true account of the facts, it demands explanation... which again is elusive. Perhaps it was a time in their lives when childhood was felt to be ending ; when increased pressures and demands were made on the young persons. Perhaps a "toughening up" process was applied to them which only the tough withstood and to which many of the weaker or less resilient succumbed. These are problems which can only be solved, if at all, by the combined resources of pathology, archaeology, history and other disciplines. What remains indubitable is that these ancient communities were not, as we now see them, skeletons from a cemetery but living persons with likes and dislikes ; with customs, prejudices, fears and taboos , with a social and a personal way of life. It is for us to reveal this web of their behaviour patterns as fully and as sympathetically as we can.

4 – SUPPLEMENTARY REMARKS ON SKELETAL SERIES

by Sonia Chadwick Hawkes

4.1. Introduction.

It has been noted above that by the time Dr. Calvin Wells came to examine the Kingsworthy material in the Duckworth Laboratory at Cambridge parts of some skeletons had been removed to London and could not be recovered. We smay never know exactly what he missed seeing through no fault of his own. In view of this, great importance attaches to the original data sheets filled out by Mr. Bernard Denston when the sekletons were first unpacked in Cambridge in 1961 and 1962. The writer is extremely grateful to him for allowing her to copy and make use of them. They, and to a lesser extent her own site notebooks, make it clear that Dr. Wells was denied sight of several important pathological specimens.

Notes about these have been incorporated in Dr. Wells's text and they need not be described again here. It is more difficult to assess the less obvious losses and damage which might have hampered Dr. Wells in this estimation of such things as sex and age.

4.2. Sex and Age.

In sexing the Kingsworthy skeletons Dr. Wells worked throughout in close consultation with the excavator and presented her with few serious problems : we have no obvious anomalies such as Amazonian "ladies" with spears or effeminate "gentlemen" with strings of beads to mar the picture of this Anglo-Saxon community. There were a few doubtful cases, however, of android females or gynaecoid males, who caused much checking and double checking of both biological and archaeological evidence before even the most tentative decision could be made. Among the most difficult cases, Burials 3, 12 and 58 finally, and probably correctly, joined the ladies, while 40, much more doubtfully, was taken (by Mr. Denston as well as Dr. Wells) for a man. Finally, when opening the box containing the remains of Burial 64 (2), Dr. Wells refuse to believe that the masculine-looking skull and feminine postcranial bones belonged to the same skeleton. That they really did can be seen, but the writer respects his decision to leave this individual un-

sexed. Otherwise the only adult not sexed is the fragmentary Burial 75. Our picture of the distribution of the sexes in the excavated area of the Kingsworthy cemetery is thus remarkably complete (Table 14, p.).

When it came to ageing the skeletons, Dr. Wells produced results for 27 out of 28 juveniles with surviving bones or teeth, but for only 25 out of 31 adult males and 28 out 38 adult females. The fact that Mr. Denston was able to give age estimates for several skeletons which Dr. Wells could only call "adult" suggests that some diagnostic bits and pieces may have gone astray between their two examinations. Where both produced estimates for the same skeleton their results were usually so similar as to suggest that they were using the same criteria. In view of this it is tempting to supplement Dr. Wells's figures with Mr. Denston's and thus increase the number of adults approximately aged to 29 males and 30 females. If we follow Dr. Wells in averaging these together with the sexable adolescents, we arrive at a mean life expectancy of 36,4 years for 30 makes and 38,0 years for 32 females, figures slightly higher than those calculated by Dr. Wells on his lesser numbers of aged individuals (p.). But not everyone would include the small number of sexable adolescents in such calculations of adult life expectancy. If we exclude them, and consider only the individuals over sighteen, using Dr. Wells's figures alone we arrive at an average life expectancy of 37,0 years for 25 males and 38,8 for 26 females, and using the combined figures of Dr. Wells and Mr. Denston, the average age death works out at 37,0 for 29 males and 39,6 for 30 females. Finally, taking the community as a whole and averaging juveniles with adults, irrespective of sex, in the area of the cemetery excavated the mean age at death was approximately 28 years.

In his Table 13 Dr. Wells gives the age distribution of 28 juvenile deaths. Table 14 gives the age and sex composition of the cemetery based on all 99 individuals with surviving skeletal remains. The relatively low 28,3 % of juvenile deaths has been discussed by Dr. Wells. To the archaeologist, noting that the vanished occupants of the child-sized graves 6, 66, 67 and 86 have not been reckoned in, the figure for

TABLE 14 – Age and Sex composition at Worthy Park, Kingsworthy

Ages	Males	N°	%	Females	N°	%	Unsexed	N°	%	Total	N°	%
0 - 2							15, 17A, 18(2) 21(2), 26(2) 65	6	6,1		6	6,1
2 - 4							4, 23, 48, 51 54	5	5,1		5	5,1
4 - 6							31, 52	2	2,0		2	2,0
6 - 8							7, 17B, (2), 28 37, 64(1), 91	6	6,1		6	6,1
8 - 10							25(1)	1	1,0		1	1,0
10 - 12							5, 19, 35, 59	4	4,0		4	4,0
12 - 14				74	1	1,0					1	1,0
14 - 16	71	1	1,0								1	1,0
Child							42(2)	1	1,0		1	1,0
18 - 29	22, 38, 45 46, 69, 81, 84 95	8	8,1	18(1), 21(1) 26(1), 53 60, 66, 88	7	7,1					15	15,2
30 - 39	13, 33, 36, 73 79, 94	6	6,1	9, 34, 61, 85 93	5	5,0					11	11,1
40 - 49	17B(1), 24 40, 44, 49, 50 83, 87, 90, 92	10	10,1	2, 16, 18(3) 27, 39, 42(1) 43, 55, 58 63, 77, 82	12	12,1					22	22,2
50 +	14, 32, 41, 57 70	5	5,0	3, 12, 20, 62 72,80	6	6,1					11	11,1
Adult	1, 25(2)	2	2,0	8, 10, 11, 29 30, 47, 45, 76	8	8,1	64(2), 75	2	2,0		12	12,1
TOTAL	Males	32	32,3	Females	40	40,4	Unsexed	27	27,3	Total	99	100 %

child mortality appears to be underestimated. If we include these 4 children, therefore, as also the vanished occupant of the adult-sized grave 89, thus bringing to 104 the total of individuals originally buried in the excavated part of the cemetery, the percentage of juvenile deaths rises slightly to 30,8 %. This comparatively low figure reassures and confirms that child mortality was not excessively high in the Kingsworthy community.

Returning to the 99 individuals in Table 14 and looking now at the adults we find that, whereas 26,3 % of the whole groupe died between the ages of 18 and 39, a relatively high 33,3 % survived into their forties and beyond. If we exclude the children and the 12 (12,1 %) adults who could not be aged even approximately and consider by themselves the 59 adults who could be both aged and sexed, we arrive at the results given in Table 15. If it is representative of the whole community, it suggests that, once they had reached maturity, the people at Kingsworthy stood a more than 50 % chance of attaining middle age.

TABLE 15 — Percentual distribution of 59 Adult Deaths by Age and Sex at Kingsworthy

Ages	Males %	Females %	Total %
18 - 29	14	12	26
30 - 39	10	8	18
40 - 49	17	21	38

Dr. Wells has commented on the generally higher life expectancy among the women at Kingsworthy and some interesting confirmatory information appears when we analyse the figures for average age at death according to social status. At this early period, in the pagan fifth, sixth and earlier seventh century, the presence or absence and quality of personal possessions adn grave-goods buried with the dead are precious indicators of social status. At Kingsworthy there were no outstandingly wealthy individuals but even so there was sufficient variety in the burial rite to enable us to divide the community into three categories of haves and havenots. Class A is made up of males with spears and other major weapons and of females with jewellery or other significant possessions, some of whose burials were coffined. Class B consists of individuals with knives, including Burial 32 with his small seax, and other minor items of domestic or personal use ; and Class C of people buried, often in small cramped graves, with no possessions at all. From what we know of early Anglo-Saxon society through its law-codes, we can be reasonably certain that Class A represents the community's freemen, the warrior class, of whom some at least will have been landholders, at best half-free at worst wholly servile. It is noticeable that all five individuals whom Dr. Wells identified on purely pathological grounds as the "over-worked drudges of the community", 20, 40, 57, 70 and 73, belong in Class C, as does the deformed Burial 38.

Table 15 shows the social breakdown of the burials in the Kingsworthy cemetery and the average age at death of the Members of the various classes. If we look first at the 17 ladies of Class A we find, as we might expect from the presumably best fed and least hard-worked group, that their average life expectancy of 41,1 years exceeds the general mean for the females in the community. But it is disconcerting to find that the 7 females of Class C fared even better, with an average age at death of 42,5 years, while the possibly less menial females of Class B averaged only 31,8 years. It is tempting to suggest that the weaker female slaves might have died in childhood or adolescence, leaving the survivors to become very tough and fit old birds indeed, but for this argument to be valid, the same should surely be true of the men, and it appears not to be. Probably the Class B and C groups by selves are too small to produce results which are statistically valid and, since the social differences between them are anyway none too distinct, it is safer to take them together and produce a combined average. At 37,5 their combined average expectancy of life

TABLE 16 — Life Expectancy of Adults according to Social Status at Kingsworthy

CLASS	MALES	AVERAGE AGE	FEMALES	AVERAGE AGE
A	22, 24, 33; 36, 41 44, 45, 46, 49, 50 79, 81, 83, 84, 87 94, 95 **Total 17** (Including 71 =18)	34,5 (33,5)	2, 3, 9, 12, 18(1) 34, 39, 53, 58, 61 62, 63, 68, 72, 77 80, 93 **Total 17**	41,1
B	13, 14, 17B(1), 32 **Total 4**	44,4	16, 21(1), 26(1), 55 85, 88 **Total 6**	31,8
C	38, 40, 57, 69, 70 73, 90, 92 **Total 8**	38,8	18(3), 20, 27, 42(1) 43, 60, 82 **Total 7**	42,5
B + C	**Total 12**	**40,6**	**Total 13**	**37,5**
Total	**Males 29**	**37,0**	**Females 30**	**39,6**

is 3,6 years less than that of their more prosperous sisters in Class A. This, presumably, is what one should expect.

The situation amongst the men is strikingly different. If we include Burial 41, robbed apparently for the sake of a coveted sword or spear, we have 17 adult Class A males whose average age at death was only 34,5 years, that is 6,6 years less than that of their 17 womenfolk. If we add the 17-year old spearman in Burial 71, he brings the average as low as 33,5. Yet the men in both the B and C groups had a higher life expectancy, which, averaged together for all 12 of them, works out at 40,6 years. This, exceeding the equivalent B-C female mean by nearly 3 years, would be regarded by Dr. Wells as demographically normal (p.). If these figures are genuinely representative, then clearly some factor was at work amongst the Class A males to curtail their expected longevity. It is not far to seek. Most of the other Anglo-Saxon cemeteries examined by Dr. Wells, where male life expectancy exceeded the female, belonged to later communities and more settled times, when men were perhaps not often called to be combatants. The archeological evidence suggests that the Kingsworthy community had a chequered and possibly bloody history. The battered state of the shields in Burials 22, 24, 33, 36, 44, 49, 81 and 95, shows that the weapons of the Class A males were not merely symbols of status but had actually seen use, some on more than one occasion (pp.). In at least one case, 33, there is evidence that the shield was in the course of repair when it was required for its owner's funeral. Burial 33, then, had probably died of his wounds: he was about 30. His skeleton, however, was too fragmentary to show the nature of any injury. Possibly there were other cases of deaths from wounds which did not leave their mark on the skeletons. At all events, it seems likely that the abnormally low average age at death of the Class A males at Kingsworthy was the result of a lifestyle that involved the active use of the weapons with which they were buried.

4.3. Stature.

Analysis of the metrical data was not part of Dr. Well's brief so there is no section in his report on the stature of the Kingsworthy population. It is too important to omit, however, so with the permission of Mr. Denston, the writer has worked through the long-bone measurements on the original data sheets at Cambridge, applying the normally accepted regression equations (Trotter and Gleser, 1952, 1958). Many of the skeletons were very fragmentary, with the result that stature estimates could be made for only 23 out of 31 adult males and 27 out of 38 adult females. Male height varied very considerably, ranging from the 1580 mm. (5 ft. 2 1/4 in.) of Burial 40 to the 1890 mm (6 ft. 2 1/2 in.) of Burial 50, and averaged 1736 mm (5 ft. 8 1/22 in.). Female height varied from the 1524 mm (5 ft) of Burial 63 to the 1715 mm (5 ft 7 1/2 in.) of Burial 62 and averaged 1613 mm (5 ft 3 1/2 in.) With such small groups as these it will be apparent how important it is to get the sexing right because even one individual wrongly attributed may effect the mean quite significantly. In this case, if Burial 40 was not a man, and it is open to question, the male average would rise to 1743 mm (5 ft. 8 3/4 in.).

As with the age statistics, it is rewarding to see how the stature of the Kingsworthy population varied according to social class. This can be seen in Table 17. The differences are most apparent among the men, of course, with their greater range of stature. Height estimates were obtained for 11 weapon-bearing males, whose stature ranged from 1695 - 1890 mm 5 ft 6 1/2 in - 6 ft. 2 1/2 in.) and their average of 1768 mm (5 ft 9 3/4 in.) exceeded that of the 12 B and C Class males by 61 mm (2 1/2 in.). As to the women, 15 Class A ladies, ranging from 1524 - 1715 mm (5 ft 5 ft 7 1/2 in) averaged 1624 mm (5 ft. 4 in.) and

TABLE 17 – Stature of Adults according to Social Status at Kingsworthy

CLASS	MALES	AVERAGE STATURE	FEMALES	AVERAGE STATURE
A	22, 24, 41, 44, 46 49, 50, 79, 81, 83 95 **Total 11**	1768 mm 5 ft 9 3/4 in	2, 3, 9, 12, 18(1) 30, 39, 58, 62, 63 68, 72, 77, 80, 93 **Total 15**	1624 mm 5 ft 4 in
B	13, 14, 17B(1) 32 **Total 4**	1737 mm 5 ft 8 1/2 in	16, 21(1), 26(1) 55, 56 **Total 5**	1594 mm 5 ft 1 3/4 in
C	1, 38, 40, 57, 69 70, 73, 90 **Total 8**	1692 mm 5 ft 6 1/2 in	18(3), 20, 27, 29 42(1), 43, 60 **Total 7**	1601 mm 5 ft 3 in
B + C	**Total 12**	1707 mm 5 ft 7 1/4 in	**Total 12**	1596 mm 5 ft 3 in
Total	**Males 23**	**1736 mm 5 ft 8 1/2 in**	**Females 27**	**1613 mm 5 ft 3 1/2 in**

exceeded the total mean stature of the 12 Class B and C women by 28 mm (1 in.). Fuller details are set out in Table 17 (p.).

These figures suggest that, in both sexes, stature was affected by social status, and that the better-off members of the community were generally taller than their social inferiors. Doubtless the simple distary explanation, that better feeding in childhood promotes greater growth, is the dominant reason for the differences observed, but other factors may have been involved. Dr. Wells has suggested, for example, that some of his "overworked drudges" may have been of different, British stock.

Others of Classes B and C were certainly Germanic, however, and some of the variety one perceives amongst these lower social groups may be explained by people having lost status and freedom when already adult. Some such explanation might be appropriate to some of the long-lived and taller than average women of Class C in the Kingsworthy cemetery, and would seem particularly compelling in the case of the tall, long-lived, but crippled and weaponless male Burial 14.

The skeletal material from the Kingsworthy cemetery has proved a vital source of information about the lives and deaths of the people in the community it served. Dr. Wells's detailed and throughtful exposition of the pathological evidence is undeniably a major contribution to our understanding of Anglo-Saxon society. It is hoped that the additional analysis of information about age and statures subjects normally dismissed in bare, unsophisticated statistics, will have added a jot more to our appreciation of the importance of the skeletal evidence. Multiplied many times over, studies as detailed as this one on the Kingsworthy skeletons, should add a new dimension to early Anglo-Saxon history.

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